SUMMARY OF KNOWLEDGE ON FORESTS AND WATER June 2006

1. Catchment water yield

☞ *Forests generally use more water than grass.*

A global review of catchment water yield measurements classified into forested and non-forested catchments has shown that forested catchments have lower streamflow than non-forested catchments. That is, for catchments with equal rainfall and equal potential evapotranspiration, the forested catchments yield less streamflow and this difference increases as catchment rainfall increases above 500 mm per year. Forests use more water than grass or annual crops because of their deeper roots, longer-growing seasons, ability to absorb more radiation, and greater height and roughness of canopy that tends to increase evaporation. It is these characteristics that make plantations an often effective strategy for overcoming the leakage of water through soils that has caused widespread salinity in Australia. There are additional environmental benefits of plantations such as wood production, biodiversity and carbon sequestration that need to be taken into account when evaluating the consequences of plantations.

The global review of water yield is supported by similar analysis of streamflow data from forested and cleared catchments in Australia. Monitoring of streamflows after significant forest death from bushfires shows an initial increase in streamflow followed by lower streamflow during vigorous forest regrowth. Furthermore, direct measurements of plant water use have confirmed that, in general, trees use more water than grass. A separate body of research has shown that the same principles and general results apply to changes in groundwater resources as to changes in streamflow.

2. Impacts of plantations on streamflow

☞ *Generalised relationships can be used to estimate the impacts of plantations on streamflow.*

☞ *Better capability is needed to assess the impacts of individual plantation proposals on streamflow because of the importance of site-specific conditions.*

☞ *All forms of woody vegetation may use more water than grass, not just plantations.*

Although there is a general pattern of lower streamflow from forested catchments than non-forested catchments, there is much variation between catchments. Thus, there are circumstances where forested water catchments have much higher water yields than predicted from the generalised curves, and circumstances where water yields from non-forested catchments are lower than expected. This is because of variation in factors such as the type and species of forest that affect its vigour, distribution and location in the landscape, soil type, and seasonal rainfall patterns.

Spatial distribution is important. For example, 1000 ha of forest established in a contiguous block will have a very different impact on water resources than 1000 ha spread across the landscape and planted on hill tops. Although the focus to date has been specifically on plantations, we note that other forms of revegetation, such as conservation plantings, also use water and impact upon streamflow, sometimes to the same extent as commercial plantations for any unit of land area occupied.

The specific conditions at those plantations and the forest management practices need to be taken into account. The generalised relationships described above are useful to broadly assess the impacts of plantations on streamflow, but they are insufficient for the purpose of assessing the net impacts of individual plantation developments, especially on the availability of water for allocation. Furthermore, the net impacts of plantations on social, economic and environmental values need to be balanced against the uncertainty of water yield predictions. Until recently this has not been a crucial issue for forest or water management but it needs urgent resolution now that forest water use could be formally incorporated into water planning and allocations. Research is beginning into this topic from a range of approaches.

3. Impacts of plantations on water allocations

☞ *It is important to differentiate between the impacts of plantations on streamflow and impacts on availability of water for allocation.*

Much of the research to date on forest water use has been expressed in terms of consequences to mean annual stream flow, in units such as megalitres per year. This has been useful to compare plantations to other land use changes, climate change and bushfires. It is wrong though to equate these changes in streamflow to megalitres per year that are allocated to irrigators, town water users or environmental assets (such as The Living Murray icon sites). In general, the impact on these formal water allocations will be lower. There are several reasons for this:

i). In many river basins the catchments of the water supply reservoirs have always been forested and will remain that way. Plantations are being placed outside those water supply catchments in sub-catchments that have a lower impact on water users.

ii). Seasonal flow patterns and flow allocation rules within rivers need to be taken into account and these generally ameliorate the apparent impact.

iii). Plantations often only make up a small proportion of catchment area and thus make only a small difference to water allocations.

To properly assess the consequences of plantations to water allocations these factors need to be taken into account. Research is just beginning in this topic and would benefit from increased involvement of the water and forestry industries.

4. Forests in water supply catchments

☞ *The role of existing native forests in controlling water yield and availability is as important at the national level as the impact of afforestation.*

☞ *The impacts of climate variability and change on forests and water yield could be profound so more information is urgently needed.*

☞ *Management tools are available to manage water yield from forests and to mitigate the potential impacts of climate change.*

As noted above, many of Australia's water supply catchments are forested. Forest management and bushfires can change the water yield patterns of these catchments, temporarily augmenting or reducing the water supply, as the cover and vigour of the forests changes and thus the evaporation of water changes. This is becoming an increasingly important issue as pressure to maintain supply increases with increasing demand for water. The recent droughts have also demonstrated an interaction between climate and water yield through forest vigour. Drought stress has increased disease and insect attack for example reducing evapotranspiration from forests and increasing streamflow above that which would

otherwise be expected. The impacts of climate variability and change on water security in forested, high-yielding water catchments, is an area of research requiring urgent attention.

There is an opportunity to use forest management as a tool to control the changes in water yield with time and ameliorate some of the worst impacts. The Western Australian Government is actively pursuing this possibility to augment Perth's water supply through research projects that include hydrologists, foresters and ecologists.

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