NAFI
National Association of Forest Industries Ltd

SUBMISSION

# Submission to the Senate
# Rural and Regional Affairs and Transport Committee
# **Inquiry into Rural Water Resource Usage**

## SYNOPSIS

*To restore some form of environmental equilibrium to our catchments, it is essential to manage the landscape in a strategic manner.*

*The growing concern over Australia's water resource usage and the competing demands for those resources are placing pressure on Governments to deliver an effective water property rights and allocation regime*

*Any such regime should consider all of the competing water needs and put in place a system that delivers allocations on the basis of the economic, social and environmental outcomes.*

*Water resources should be directed towards those landuse activities that provide the greatest overall benefits, while encouraging the most sustainable and efficient use of the limited water available.*

*Targeted land areas could be reafforested (or afforested) to provide commercial resources for industry while simultaneously addressing biodiversity, salinity and greenhouse issues. Such tree crops would represent a very reasonable use of water:*

> *"with careful planning, it is possible to minimise the hydrologic impacts of afforestation.*
>
> *"catchments with less than 20% area planted exhibit little water yield effect." - (Vertessy et al, 2002)*

*There is little point adding to the current rights system with additional regulatory controls that do not address the long-term needs of water users or the environment.*

*If anything, such a piecemeal  approach will deliver uncertainty over possible future changes in rights and allocations, adding needless risk to many investment decisions.*

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## INTRODUCTION

To deliver a sustainable future for Australia's rural industries, communities and the environment, it is essential that all levels of Government provide a regulatory framework that supports the most effective use of our water resources. There have been some discussions on simply maintaining the existing water rights regime and adding to it a set of specific controls governing landuse change. However, for a water allocation and water property rights regime to be truly effective, it will be of fundamental importance to consider all landuses and the need for environmental flows.

The past clearing of forests and woodlands to support cropping and grazing has been an important part of Australia's growth and our heritage. As a consequence of those activities, the removal of woody vegetation has raised water tables and increased the amount of water that can be diverted for storage and/or primary production purposes. Unfortunately, the rising water tables have had a major impact on our land systems. While most interest in the water debate has centred on the need to balance rural water use across all landuses, it is of particular concern that there has been a lack of interest in providing some balance between the environmental flows that existed prior to European settlement and the demands on our water resources today.

## Recommendations

1. **A national approach to water rights and allocations should take into account water use by all irrigated and dryland rural industries in a non-discriminatory manner. There is no scientific basis to suggest that plantation forestry should be regulated in a different manner to any other dryland landuse.**
2. **A nationally consistent water property rights framework should be based on a Strategic Environmental Assessment process, which can be applied on a regional catchment basis, to evaluate the water used by all industries and the overall economic, social and environmental benefits associated with their use of that water. This process would be the basis for determining the allocations of water to various land uses.**
3. **Although more than one quarter of Australia's surface water management areas are over-used or over-allocated, there should be some recognition of the importance of using all water resources more efficiently, particularly those that are divertible. Nationally, only 18,147 GL, of the total possible divertible water resources (98,100 GL) are diverted.**
4. **In addition to providing an appropriate and effective framework to assist catchment management agencies to allocate water rights, the Strategic Environmental Assessment process would identify the needs for compensation and structural adjustment payments to those landholders adversely affected by the new water allocations.**
5. **Regulators developing a national water rights and allocation regime should be wary of the outcomes of the Regional Forest Agreements, where State Governments were able to move away from the spirit of the Agreements (in the mainland States), even though they were signed by Premiers and the Prime Minister. The Commonwealth needs to build into a national water rights approach, adequate protection mechanisms for dry land water users to ensure that their future rights are not eroded by short-term State or Federal political agendas.**

6. **Suitable pressure should be applied to State Governments to ensure that vegetative resources in primary catchments are adequately managed to prevent major bushfires which have resulted in the preventable loss of future water supplies through forest regeneration processes on the scale that will result from the 2003 bushfires in southeast Australia.**

7. **The value of water lost to rural industries during the forest regeneration process following bushfires and the costs of purifying water affected by sedimentation and ash, should be weighed up against the costs of actively managing national parks that double as rural industry (and urban water supply) catchments. This information could be used to determine the most effective approaches to fire prevention, fire suppression and fuel load reduction.**

8. **Without proactive management of national parks affected by the 2003 bushfires, water yields in the catchments of southeast Australia may fall by 1,500 GL per annum, impacting on environmental flows and water availability for rural water users. Water management planning must retain a dynamic component to deal with major disasters through the related links to regional vegetation management.**

## RURAL WATER RESOURCE USAGE

### Using Plantations To Repair The Environment

To restore some form of environmental equilibrium to our catchments, it will be necessary to introduce trees back into the landscape in a strategic manner. That is, tree crops could be planted to provide the commercial resources for industry while simultaneously repairing the environment. This environmental repair can include salinity amelioration, greenhouse gas sequestration, protection against wind and water erosion, addressing soil acidification and the control of weeds (including serrated tussock).

Although it has been repeatedly recognised that trees can be one of many effective solutions for repairing the environment when they are planted in the most appropriate locations, afforestation can also be a costly to implement. Adding to the cost is the scale of the activities to be undertaken. It was estimated that of the $65 billion required to repair the environment over the next decade, more than $25 billion would need to be spent on woody revegetation.

Off-farm investors can expect a reasonable and consistent rate of return on their investments in plantation forestry but, with the high costs of establishment and the lengthy period between planting and harvesting, the projects must retain a strong commercial focus. At the present time, the only tangible product with any real value to be generated from multiple-purpose plantation investments is timber. Accordingly, timber markets and the future needs for timber become the major drivers behind investments in forestry projects.

### Water Use An Important Consideration

In addition to the financial costs of plantation forestry, the timber industry is aware that trees, like any other agricultural crop, use water. A minimal amount of research has been completed so far on water use by plantations. In most cases, the studies are restricted to a comparison of water use by complete afforestation versus the water use under cropping and grazing, without any consideration of the economic or social benefits to the catchments from the further regional utilisation of those farm outputs.

This limited information has been over-extrapolated and over-interpreted to the point of suggesting that special regulatory controls should be applied to the future expansion of Australia's plantation forests. For example, plantations would be the only landuse activity specifically regulated in the southeast of South Australia under that State Government's proposed 26-point plan. There has been no effort to regulate the water use associated with any other changes in landuse, which could have a significant impact on the region's water use.

What is of particular concern to the forest and timber industry is that policy options are being developed from incomplete hydrological modelling. In many cases, the models do not reflect the current state of the industry or the nature of its operations. For example, the CRC Catchment Hydrology work (Vertessy et al, 2002) covers a limited subset of industry activities and has limited applications beyond the specific parameters assessed in each model.

Numerous examples can be provided of how the researchers have not properly considered the rainfall where plantations are located, the proportion of catchments that have been planted, the positions in catchments where trees are planted, the underlying geology, or the benefits from having plantations of different ages with catchments. All of these factors are crucial in determining the amount of water that is used by commercial tree crops.

In fact, there is almost no research that looks at the employment, income, regional development or infrastructure outcomes from plantation forestry or various other water uses in rural areas. Any present effort compares water use for a small number of landuses in isolation of any other information and attempts to specify, from that perspective, how much water should be allocated to various activities.

## Strategic Environmental Assessment - The Water Budget Accounting Approach

It is essential that *all* landuses are treated equally during the development of an effective property rights regime for distributing Australia's water resources between various primary production activities and the environment.

The approach taken by South Africa has been to support an allocation of water resources on the basis of the economic, social and environmental benefits associated with its use. This process is known as a Strategic Environmental Assessment and is equivalent to the water budget accounting process outlined by the Wentworth Group in a '*Blueprint for a National Water Plan'* (2003). Where any two of the social, economic and environmental assessments are positive for a particular landuse, it has been possible for those landuses to gain a greater share of the available water resources.

If Australia were to use this type of process as the basis for allocating the rights to water, there would need to be a far broader consideration of the positive and negative impacts associated with the amount of water used by all industries. Within each catchment, there could be a greater dependence on weighing up the environmental, employment, farm income, regional development and infrastructure outcomes associated with allocating water to various uses. As a direct result of this assessment approach, water could be allocated to the most effective and efficient uses for each catchment.

The key requirement is to have a consistent, transparent and transferable framework to support the water allocation process undertaken by Catchment Management Agencies.

This approach is not unique. Within Australia, the Southeast Regional Marine Plan and the Regional

Forest Agreements were developed on the basis of balancing the environmental, economic and social outcomes associated with the use of those respective resources. The aim of the assessment process was to determine the amount of resources to be protected and the proportion that would remain available to industry.

The Southeast Regional Marine plan applies to the fishing area, which runs along the south coast of NSW and the southeast coast of Victoria. The aim of the assessment process that sits behind the plan, was to ensure that the stock of fish remained at sustainable levels and to provide an allocation of fishing rights to support the coastal communities that depend heavily on the fishing industry.

With the Regional Forest Agreements, the strategic assessment process determined that area of forests to be protected in order to provide a comprehensive, adequate and representative reserve system and the area left available for the timber industry. Although the respective Premiers and the Prime Minister signed the Agreements, nearly all of the Agreements have been unilaterally altered by the mainland State Governments. These changes have clearly contradicted the spirit of the Agreements, but the changes have been easy to implement because the State Governments failed to reflect the contents of the Agreements in State legislation.

If a similar process were followed to establish a national approach to water rights and allocations, it is essential that the framework be supported by the introduction of strong complimentary legislation by the Commonwealth and State Governments. This legislative backing will minimise the potential risks to the private sector that the water rights and allocations could be undermined by government responses to green or special interest groups.

In addition to defining the allocations of water to various landuses within the respective catchments, the Strategic Environmental Assessment approach would identify the compensatory and structural adjustment needs of rural landholders resulting from any change in water allocations.

## Landuse Changes To Be Given Equal Consideration

At the present time, the stress on water rights and allocations has caused some rural landholders to become quite concerned over the impacts of landuse change. With the future of the timber industry's growth to be driven by the need for multiple-purpose plantation forestry, these concerns need to be effectively addressed.

The forest and timber industry believes that a consistent treatment of forestry and agriculture will provide the best all-round outcomes for sustaining farming communities, farm productivity and the environment. From the limited research that has been completed, the hydrological modelling indicates that up to 20% of catchments can be planted to tree crops without having a detectable impact on total water yields (Vertessy et al, 2002). That is, trees can be strategically located within catchments to provide benefits to the environment, timber for industry and a limited impact on water yields or run-off.

In one of Australia's major plantation regions, the Greater Green Triangle Region of southwest Victoria and southeast South Australia, plantations cover less than 5% of the total area. For the South Australian portion of the Green Triangle at least, there is a considerable amount of vertical recharge to the unconfined aquifer underneath those plantations. The South Australian agency controlling water resources provides an average recharge allowance of 23% for Blue gums and 17% for radiata pine. In effect, Blue gums are therefore using around three-quarters and pine approximately five-sixths, on average, of the rain falling across the plantation estate.

Other primary producers, particularly irrigators and regional processing industries as well as the natural environment, use the recharge provided to the aquifer. In this region, the land to the north and west of Mount Gambier is cris-crossed by large open drains that take a considerable amount of fresh water out to sea. The drains normally flow in the winter months and are designed to protect farmland from inundation during the wetter periods, when water cannot permeate into the unconfined aquifer quickly enough.

## Water Use Impacts of Plantations and Bushfires

While there is no doubt that trees use water, like any other agricultural crop, there is a considerable degree of conjecture over how much water they actually use and how beneficial that water use is.

Forests and woodlands cover over 164 million hectares of Australia, with plantation forests representing just 1% of the forested area and 0.7% of the agricultural land area (Stanton, 2000). This is likely to increase with further investment under the Government-industry strategy, *Plantations for Australia: the 2020 Vision*, and the inclusion of commercial tree crops in the mix of solutions for repairing the environment. The issues surrounding plantation water use are addressed in response to the Inquiry's first term of reference.

At the same time, the impacts of environmental disaster will affect the amount of water available for primary production activities and the environment. The devastating bushfires of January-February 2003 will reduce water quality in the immediate future and significantly reduce water yields for a period between 5 and at least the 50 years from now.

By burning over 3 million hectares of south-eastern Australia, the loss of vegetation cover has led to a considerable increase in water yields throughout the affected catchments over the next 5 years. While water yields will increase, the additional run-off will bring with it high sediment loads and ash contamination of the water supplies.

Even with moderate rainfall levels over the past six months, the streams of these vast areas are starting to fill up with sediment and Canberra now has a major problem obtaining fresh drinking water. The ash and topsoil contaminating the city's Bendora and Cotter catchments means that up to $50m may need to be spent in the immediate future to purify the water for Canberra and the surrounding communities. This reduction in water quality will also affect rural water uses further down the Murrumbidgee and Murray River systems.

Between 5 and at least 50 years from now, the expected natural regeneration of large areas of forests will use up a significant volume of the water resources that other sectors of the community were hoping to use for primary production purposes or the environment. As a direct result of the 2003 bushfires, water yields from the top of the Snowy, Murrumbidgee, Hume and Murray River systems will be reduced by 1,500 gigaliters per annum throughout this period. This is equivalent to one-eighth of the total water used in the Murray-Darling Basin for all primary production activities.

In addition to affecting the future amount of water available for farming and the environment, the bushfire-induced reductions in water yield will impact on hydroelectric production. These outcomes will be severely exacerbated in drought years and. Over a period of at least 50 years, it is reasonable to expect that there will be at least 5 major droughts affecting those catchment areas.

If there is to be an effective and efficient property rights system developed for Australia's water resources, then the impacts of major disasters must be considered alongside the needs of industries and the environment. If anything, the bushfires of 2003 should indicate to State Governments the importance for a sound water policy of actively managing our National Parks.

## Forestry Stewardship Is An Option

Hazard reduction burning and forest stewardship projects should be supported to assist with future management of the national parks to ensure that fuel loads, fire trails and committed efforts to suppress fires as soon as they start, are all kept up to a reasonable standard. In nearly all cases over the past decade, State national park agencies have not had the money, resources, personnel or suitable weather to complete these activities. Given that we know these targets can't be met by hazard reduction burning, the forest stewardship approach provides an alternative means for delivering cost-effective fuel reduction and the protection of economic, social and environmental assets.

The forest stewardship projects could be managed under a consolidated planning approach for minimising national park fuel loads. Not-for-profit organisations, community groups and small businesses could be responsible for reducing fuel loads and maintaining the fire trail networks as well as building their knowledge of the landscapes they operate in. To pay for their efforts, these groups could sell the materials they harvest.

For example, large areas of alpine ash forests were burnt during the 2003 bushfires. When these forests eventually regenerate, they will use a significant amount of water. To minimise the impacts of regeneration on water yields from ash or mixed eucalypt forests, stewardship projects could be set up to allow the thinning of those forests. It is known that if the alpine ash forests are thinned at 15 years of age, the water yields can increase by up to 4-fold. Such an approach would assist all sectors of the community by providing fuel reduction, maintaining access (fire) trails, minimising the intensity of future fires, increasing water yields and generating timber resources to be used for renewable energy, firewood or other industrial purposes.

## Forests, Plantations and Other Water Users

Is it possible to have healthy forests, new plantations and water for other rural users?

It may appear that there are some inconsistencies in the forest industry's concerns over the impacts on Australia's water resources from bushfires and the future growth in the plantation estate. In both cases, large areas of trees are involved and a reasonable volume of water will be used to support the growth of those trees. However, it is essential that there is some understanding of the fundamental differences in the forest regeneration and plantation development scenarios.

Following the bushfires, regeneration will cover whole landscapes at the top of major catchments. With the 2003 fires being so intense, as a result of the excessive fuel loads on the ground, the moist gullies were burnt in addition to the exposed hilly areas. These gullies are the major drainage lines within the catchments and it is well known to foresters that they represent the most productive areas in the landscape and, therefore, the areas of greatest water use.

As the forests and bush regenerates, the regrowth in the gullies will use a high proportion of the water that would otherwise become run-off. Whole landscape regeneration, with trees of a single at age, will lead to a significant use of water for a considerable period of time.

However the outcomes from plantation forestry investments covering a similar total area will have a quite different impact on water yields, water run-off and the amount of water available for other industries. Due to a combination of the multiple benefits (and possible products) from timber plantations and the high costs or limited availability of land, commercial tree crops could be used to simultaneously control vertical recharge, the height of water tables and the spread of salinity.

These processes are likely lead to the strategic placement of trees in the landscape with an increasing integration of agriculture and forestry. This mosaic approach to plantation forestry in the 550-850mm rainfall zones, where plantation forestry can compete in commercial terms with other landuses, is the most likely and sustainable approach for future tree investments. The industry is also aware of the importance of keeping trees away from drainage lines, even though these are the most productive areas to plant. In most cases (such as New South Wales) this is addressed in the State's Codes of Forest Practice.

By having commercial tree crops spread strategically across the landscape in a mosaic pattern, with those trees planted on an appropriate scale to support timber-processing industries, the impacts of plantations on future water yields should be minimised. Add to this the key fact that the forestry investments will be spread over a lengthy investment horizon (of 10 to 30 years), then there will be a significant difference in the volume of water used by trees regenerating from bushfires and trees growing in plantations.

## An Effective Water Property Rights Approach

The question that needs to be continuously asked is whether the outcomes from one given water use are better or worse than the overall outcomes from alternative uses for that water. This is a far more important question than simply determining which landuse activity uses the most water. By only addressing the latter question, there will be lost opportunities for regional communities to simultaneously deliver sustainable regional development, environmental improvement and the allocation of water to its highest value uses.

To deliver the most effective use of Australia's water resources, it is absolutely necessary to consider all landuses and to have water allocated to the most beneficial uses. Catchment management groups will therefore need a consistent framework for assessing the economic, social and environmental benefits associated with allocating various amounts of water to a range of landuse activities.

With the backing of an integrated and comprehensive assessment framework, a specified volume of water could be allocated to dryland and irrigated landuses within each catchment. Based on a volume approach, the various industries within each catchment would have the capacity to change their management options and use the allocated water to their greatest advantage, with the added potential of maximising the returns to the community.

This process would inevitably lead to a re-allocation of water rights that would need to be underpinned by suitable compensation and structural adjustment measures. The new water allocations could then be traded between landuses within each catchment. In addition, catchment management agencies should have the capacity to bid for unused water allocations in neighbouring catchments or to temporarily sell their excess water to those catchments.

Effective water rights and water trading regimes should be underpinned by the need to maximise the social, economic and environmental returns associated with using Australia's valuable water resources. Through this process, all landuse activities would need to be given due consideration for the direct and indirect benefits from their respective water allocations.

## TERMS OF REFERENCE 1: CURRENT RURAL BASED WATER RESOURCE USAGE

At the present time, little is known about the diversion and use of water by individual rural industries, including the forest and plantation activities. Most data that is available is provided through indicative studies or through national aggregation exercises such as the National Land and Water Resources Audit (NLWRA). While the indicative studies may specify the amount of water used by particular industries in one area, this information is not readily transferable to other areas, due to a number of factors that impact on water use. These factors include rainfall, temperature, geology, slope, hydrology, landuse options, land management, water management, tree cover and evapotranspiration patterns.

According to the NLWRA, the mean annual run-off for Australia is 387,184 GL per annum. The vast majority of this water falls in the drainage areas of northern Australia, where there is a limited capacity to divert and store the water resources for productive purposes. Total water use across all personal and industrial uses in Australia is approximately 24,000 GL per annum, of which 18,000 GL is consumed for irrigation purposes.

However, a considerable, but as yet undetermined, amount of water is used to maintain our grass, forest and woodland coverage. For example, in the southeast coastal area of the mainland, there is an average 42,390 GL of run-off each year of which only 1,852 GL is diverted for consumptive purposes. In the Murray Darling Basin, run-off averages 23,850 GL per annum, of which 12,300 GL can be diverted and 12,051 GL is actually diverted.

In many cases, the use of available fresh water resources is highly concentrated. Across the country, there are some 325 surface water management areas of which 26% are either fully used or over-used. These 85 water management areas use over half of Australia's accessible water resources (13,200 GL per annum). For groundwater, there are 535 management units of which 30% are close to fully allocated or over-used.

Water storage capacity in Australia is also an important aspect of effective water use. Australia has a large dam capacity of 79,000 GL and less than 10% of our stored water is held by private dams on farms.

At the national scale, there could be substantive benefits in determining how to use just a small proportion of the rainfall that is not currently diverted for personal consumption or industrial uses. This is particularly important given that the divertible water potential is 98,100 GL per annum, but only 18,147 GL (or 18.5%) of this water is diverted for industrial or consumption purposes each year.

For individual industries, it is very difficult to obtain comparative information on the water used for productive purposes. A detailed list of allocated water volumes for various irrigation activities in the Tintinara Coonalpyn Prescribed Wells Area of southeast South Australia is provided at Attachment A. The base allocation for various irrigated crops is contained in column C of the table. Annual rainfall should be added to this amount to determine the total water used by each crop. For this region, the rainfall would be in the vicinity of 5-7 ML per annum. In this same area, plantations use less than the water than the total rainfall, yet there are attempts to regulate plantation forestry developments due to concerns over their water use.

## A Comprehensive Approach To Assessing Water Use By Plantation Forests

A limited amount of research information has been provided to clearly understand the total water usage patterns by Australia's plantation forests. With approximately 70-80% of the plantation resources located in areas with less than 1,000mm rainfall and most future planting destined for the 550-850mm zone, additional research will be required to determine the positive and negative impacts of having plantations integrated with agriculture.

However, as a general phenomenon, the impact of plantation on run-off decreases as the average annual rainfall declines. In those areas that receive less than 800 mm of rainfall per annum, plantation forestry has only a small effect on run-off and water yields.

Of the analyses that have been completed, much of the modelling work has been based on the relationship between rainfall and evapotranspiration, such as the Holmes and Sinclair Curves or the curves produced by Zhang et al for the CRC Catchment Hydrology. While the CRC modelling is shown to be a good predictor of water use, it really only applies to those regions where the models are used.

A number of people in the scientific community and the media have attempted to extrapolate and interpret the results of this modelling work, with the inference that the water use patterns apply to all plantation forests. For example, the article published in the *Australian Financial Review* (Macken, 2002) caused an unnecessary degree of concern over the volume and value of water used by Australia's plantation estate. More recently, these same issues have been raised in the *Weekly Times* (23 July 03)

Any thorough analysis of plantation water use should take into account the large number of variables that impact on water use. This work should recognise that water use by trees is a function of:

- Rainfall
- Species
- Thinning/spacing/pruning management regime
- Variations in age class
- Site productivity, fertiliser application
- Soil type and underlying geology
- Slope
- Period to canopy closure
- Location in the catchment (upland versus lowlands)
- Humidity and evapotranspiration patterns
- Groundwater recharge/discharge locations
- Proportion of catchment planted, and
- Treatment of riparian zones and drainage lines.

It is the large degree of regional variation, based around these variables, that has lead the CRC Catchment Hydrology to conclude that, if trees are planted in a mosaic across farming landscape, 'Catchments with less than 20% area planted exhibit little effect on water yield' (Vertessy et al, 2002).

It is therefore absolutely necessary to have all of the variables contained in the modelling work that is undertaken to assess the amount of water used by commercial tree crops. This is especially important where the results of scientific modelling are being used to underpin water allocations for individual landuse activities such as plantation forestry.

## Indicative Research Results

In some cases, the positive or complementary impacts of plantation forestry need to be better understood. For example, in the Deniliquin region of New South Wales, the recharge from 70,000 hectares of irrigated crops may be sufficient to support 14,000 hectares of plantations, if the trees are planted along prior streams. By planting the trees over prior streams, the plantations can efficiently use the excess irrigation water without tapping into the underlying water table (Polglase et al, 2002).

Understanding the seasonal influences over water use is also important. Recent work completed by the CRC Catchment Hydrology indicates that evapotranspiration by trees may be lower in those areas that receive the major portion of annual rainfall in the summer months (Potter, 2003).

Understanding the recharge process will help to indicate the overall impacts of plantations. In southeast South Australia, it has been determined that 23% of the rain falling on Blue gum plantations (and 17% of the rain falling on pine plantations) will end up as recharge. This is due to a combination of events, including the capacity for recharge under very young plantations to be equivalent to the recharge from pasture up until the time of canopy closure.

Within any one plantation, only 70-80% of the land area is suited to growing trees, leaving a reasonable area of land from which recharge will occur. Site quality is another important determinant as plantations on productive sites may use all of the rainfall, whereas on the lower site qualities, there may be recharge of 1 ML per hectare per annum. However, these outcomes can vary across individual plantations and across plantation regions.

Site selection is a crucial factor for water use. The CRC Catchment Hydrology modelling results indicate that there are significant differences in water use between those plantations established in the upper or in the lower reaches of catchments (Vertessy et al, 2002). If tree planting were to occupy the top 30% of the modelled catchment, run-off would be reduced from 0.7 to 0.6 ML/hectare/annum. However, planting the lower 30 of the catchment would reduce run-off from 0.7 to 0.2 ML/hectare/annum. These variations in run-off would be quite considerable when measured across whole catchments.

## Launceston Case Studies

Additional studies on the water catchments surrounding Launceston highlight some of the key issues to be considered when examining the empirical and modelled data on plantation water use. Given the 80-year history of forestry in the North Esk and St Patricks catchments, it is important to note that the industry has had no detectable impact on water flows or water yields (Bren and O'Shaugnessy, 2001). At the present time, approximately one-eighth of the catchments area used for forestry and, even if all the suitable cleared land was planted to trees, they would cover around one quarter of the catchments and possibly reduce water yields by 8-10% per annum.

The Launceston catchments are susceptible to periods of low flow in February and March of years where there is lower than average rainfall. Low flows are classified as being periods where there is inadequate water flowing in the North Esk and St Patricks Rivers to completely supply Launceston. At the present time, low flows occur every one in seven years. If the maximum area of plantation development occurred in these catchments, the frequency of low flows would change from one in seven to a worst-case scenario of one in five years. This effect may be considerably ameliorated by spatially distributing plantations across the catchments and ensuring that the trees are not planted in close proximity to the streams.

In a second study completed for the North Esk River, it is difficult to determine the overall effects of plantation forestry on water flows, as the researchers based their report on some plantation management options that are not used by industry (Peel et al, 2002). In this study it was however noted that the "range of possible flows is strongly related to climate variability and only weakly related to vegetation changes associated with logging scenarios."

When run-off was considered over the driest three months of the year, it was interesting to note in the Peel et al study that 11.8% of the catchment was grassland and 10.3% of the precipitation fell on this area. However, in the drier periods, the grasslands/grazing areas only supplied 4% of the run-off while the forested areas in the upper reaches of the catchments continued to provide over 60% of the run-off. This indicates that if some of the grazing areas were planted to trees in the North Esk catchment, they would have a minimal impact on water flow even during the driest months, as these parts of the catchment make a very limited contribution to run-off during the low flow periods.

## A Detailed View Of Plantation Water Use In Southeast South Australia

With limited knowledge on the comparative use of water by various landuse activities in each catchment, it is difficult to determine how water resources should be allocated between the various dryland and irrigation uses, and the environment. The Greater Green Triangle Region of southeast South Australia and southwest Victoria is one region that is building its regional knowledge of plantation water use – but that knowledge is quite region-specific.

Three of the catchments in the region are Glenelg, Hopkins and Portland catchments. The annual flow of surface water from these catchments averages 1,370 GL per annum of which 28% is divertible and 7% is use for productive purposes. A considerable amount of water may therefore be available for productive purposes without putting undue stress on the catchments.

In the South Australian part of the region, farmland sits above karst limestone formations. There are no rivers or streams in this area, so primary producers are heavily dependent on groundwater. In this region, the depth to water in the unconfined aquifer is measured at a number of observation wells (Department for Water Resources, 2001).

The historical records show that close to the plantations, the groundwater prior to 1983 was around 6 metres below the soil surface. After the major fires of 1983, the groundwater rose to within 3.5 metres of the surface. At that same well, the groundwater height began to fall in 1994 and returned to historical levels by 2000.

At another observation well, the depth to groundwater changed by only a small amount over the period 1974-1994, remaining at 3-4.5 metres below the soil surface. However, the water height started to drop in this second well from 1994 onwards. It is therefore hard to determine if these changes were the result of the re-establishment of plantation forests in the mid to late 1980's, increased centre pivot irrigation and irrigated pasture activities in the mid-1990's or both.

Across this region, irrigated cropping went through a significant growth phase in the 1990s and the dairy industry recently released its vision to double regional output by the end of the decade. This will have to be supported by a significant increase in the area of irrigated pasture and cropping. As a result of all these landuse changes, it is hard to understand how the State Government can attempt to introduce specific planning controls for plantation forestry without fully understanding the total water use patterns and demands within the region.

The current water allocation process in southeast South Australia is based on a single rate of water use for each primary production activity. For example, it has been estimated that an equivalent amount of water would be used by 35,000 hectares of plantation forest, 24,000 hectares of irrigated vines or 7,000 hectares of perennial pasture irrigation. These figures do not take into account any intra-regional differences in water use for each activity.

Even if these figures are true indications of water use, they should not be the stand alone basis for determining the amount of water allocated to each activity, as currently occurs with the system of water rights and the determination of the Permissible Annual Volume for extraction by irrigators. Instead, there should be a framework provided to determine the economic, social and environmental outcomes associated with the allocation of water resources to these three landuses, as well as the other dryland activities.

Understanding the hydrological principles that apply to the various parts of the Greater Green Triangle Region will help the catchment management agency to decide whether trees in certain locations should gain a greater share of the available water.

Plantations growing in areas where the water tables are greater than 6 metres below the soil surface do not utilise groundwater. However, in those areas where the water tables are less than 5 metres below the surface, plantation trees are likely to access the groundwater resources. This would be a beneficial outcome in those areas as they area prone to inundation and are currently cris-crossed by large drainage channels that take a significant volume of fresh water out to sea each year.

## Further Research On Plantation Water Use

Further research is required to accurately measure and model plantation water use.

It is essential that any future modelling of water use and water allocations is undertaken with the intention of being part of a broader framework to investigate water use in areas where farming and forestry are highly integrated. To date, the modelling work is of limited value as it only applies to the defined situations adopted by the researchers. In most cases, those scenarios do not represent what is actually happening in the forestry sector.

The modelling work needs to take account of the planting patterns and planting rates adopted by industry, especially when the industry is required to conform with State legislation and Codes of Practice. In each State, there is a limitation on plantation establishment in drainage lines or riparian zones. Excluding tree crops from these areas can have a significant impact on overall water use.

By integrating landuses and the water used by those landuses, it may be possible for hydrologists to gain a more realistic understanding of water use patterns. In addition to the water use, the models could be extended to account for the social, economic and environmental outcomes associated with water use. As a major consideration of any water use, there should be some capacity to suggest how water could be allocated to various uses because of those industries' abilities to promote regional development.

From a purely forestry perspective, the hydrologists must start to take account of the various ages of the resource planted in any one catchment, the probability of the industry planting large proportions of high quality farming country and the various forest management regimes. The forest management regimes include species selection, management options, fallow periods, tree spacing, the locations within catchments (recharge sites and/or upper reaches) and the treatment of areas that are left unplanted.

With a proper integration of this information, the hydrological modellers may inform forest managers of the options for improving the efficiency of water use by trees. However, stating trees use water in isolation of any other information, provides no basis for researchers to suggest that plantation forestry developments should be regulated under specific pieces of national or State legislation.

## Protecting Water Supplies Through Active Catchment Management

Water collection and the active management of Australia's forests should not be regarded as mutually exclusive activities. If anything, research results indicate that forest management and water collection in major catchments can be mutually beneficial.

A number of studies have indicated the importance of protecting forests from the threat of bushfires. The "Kuczera effect" describes the considerable consumption of water associated with the regeneration of forests burnt by wildfires, although there are two phases to the changes in water yields (Opie, 1997).

In the years immediately after bushfires, particularly those of the magnitude that devastated 3 million hectares of southeast Australia in 2003, there is an increase in water yield. This additional water carries with it high sediment loads and is likely to be contaminated with ash.

From 4-6 years after the bushfire attacks on ash and mixed eucalypt forests, the regenerating trees will start to consume a considerable volume of water and thereby reduce catchment yields. From the research undertaken, water yields in these regrowth forests will remain below the volume of run-off that existed prior to the fire, for a period of up to 150 years. Large wildfires can therefore lead to a considerable loss of water for both rural use and the urban communities.

As determined by the Kuczera Curve, the impact of fires in the high-yielding ash forests, has the following effects:

- Mean annual run-off prior to the bushfire is approximately 12 ML per hectare per year,
- This declines to a minimum of 5.8 ML per hectare per year by the 27$^{th}$ year after the fires,
- Then water yields slowly return to the pre-disturbance levels over a period of 100-150 years.

However, the Kuczera curve fails to recognise the increase in run-off for the 4-6 years after the fire and the curve has quite wide error bands, which mask the regional differences in ash forest characteristics.

The most effective options for managing the high water-yielding ash forests is to remove the burnt trees, replant the area then thin the standing trees quite heavily at 15 years of age. This management approach would have a benefit/cost ratio, in terms of water yield alone, of four to one (Opie, 1997). These salvage, replanting and thinning operations could be part of the forest stewardship approach that NAFI is promoting to reduce fuel loads in national parks, particularly those national parks that serve as water catchments for rural and urban consumers.

It is intended that small businesses, community and not-for-profit organisations would undertake the forestry stewardship projects. The key element of the projects would be fuel load reduction with the aim of minimising the intensity and damage caused by bushfires, with the added benefits of maintaining an effective road network in the forested catchments and the maintenance of water resources for future use.

In the Central Highlands of Victoria, water is collected in the Goulburn, Yarra, Bunyip, Latrobe and Thomson River catchments for use by primary producers, country communities and the city of Melbourne. The probability of a major bushfire occurring in the Central Highlands over the next 100 years is 97.6% and over the next 200 years, it is 99.9% (Opie, 1997). It is therefore almost inevitable that a major fire will occur during this time, leading to significant reduction in water availability for a range of rural landuses, unless there is some active management of the forests in those catchments.

The Thomson Catchment covers an area of 48,700 hectares, with the forest industry harvesting ash timber from an area of less than 150 hectares per annum. At the present time, approximately 90 hectares or 0.18% of the catchment is harvested each year, producing 27,000 cubic metres of high value timber each year from the catchment. Over an 80-year rotation period, less than 20% of the catchment would be utilised for timber production. As is the case with plantations, the CRC Catchment Hydrology notes that "water yield changes are difficult to detect if less than 20% of the catchment is treated" by the harvesting of timber (CRC Catchment Hydrology, 1998).

Forestry and active forest management approaches could be used to minimise the intensity of bushfires and their impact on water yield and water quality. In the case of the ash forests, such as those in the Central Highlands of Victoria, the mosaic of harvested areas and forest compartments at different stages of growth will provide differing canopy heights and differing levels of humidity across the forests. These variations in forest structure make it far more difficult for wildfires to burn out a large proportion of the catchment.

## Impact On Water Yields And Run-Off Than Native Forests

Do plantations have a greater impact on water yields and run-off than native forests?

The major portion of the water debate, so far, has focused on the distribution of water rights and water allocations between various landuses. Little attention has been paid to the timing and extent of environmental flows that would have originally occurred when the grazing and cropping lands were covered with trees. A closer examination of this matter should allow some consideration of the timing and extent of environmental water flows. The key question may therefore be 'whether the replanting of trees in the farming landscape would help to restore the original environmental water flows?'

Recent results from a comparison of pine plantations and native forests in paired catchments of northeast Victoria, indicated that the plantations use less water than the native forests (Bren and Hopmans, 2001). The initial conversion of native forest to plantation gave an increase in water yield and stream flow, particularly during the early winter storms.

Immediately after the plantation was established, there was an increase in run-off of 3 ML per hectare per year, which slowly returned back to the native forest yields as the plantation canopy closed. After the plantation was thinned, water yields increased by 2.21 and 1.87 ML per ha in the first and second years, respectively. Even with the plantations being over 20 years old, there was no change in the low-flow frequency between the plantations and native forests.

Given the similarity in water use from native forests and plantations, it may be possible for strategically-located plantations to help restore the patterns of water yield and run-off that existed when areas of farmland were previously covered with trees.

## TERM OF REFERENCE 2: OPTIONS FOR OPTIMISING WATER RESOURCE USAGE AND SUSTAINABLE AGRICULTURE

In the past, the State systems of distributing water rights have lead to an over-allocation of resources in more than one quarter of Australia's surface water management areas. Although this allocation may not have been fully used in any year, the potential stress on the catchments has lead to some concerns over the introduction of landuse changes, the potential water use of those new landuses and the impacts on existing water rights.

To avoid any difficulties associated with the possible treatment of landuse change activities, particularly where new regulations may be attached to existing water resources legislation, a whole new approach should be applied. In the first instance, the 'value' of water consumption should be assessed for each landuse. That is, catchment management agencies needs a framework for assessing the economic, social and environmental outcomes associated with the water use for each landuse activity. Based on a consistent assessment approach, the catchment management agencies could then re-allocate water resources to the various landuses, based on the most effective and efficient balance of outcomes for the communities, industries and the environment.

For example, there have been concerns raised over the volume water that is used by plantations each year in the Greater Green Triangle Region and the impact this has on other water users. A closer examination of the region demonstrates that it covers 5.5 million hectares of which plantations cover less than 5%. The industry has a turnover exceeding $1bn per annum and from less than 5% of the land area, it produces 29% of regional output and supports 25% of employment. To determine whether this is a suitable use of water, the benefits from the other landuse activities would need to be compared on a similar basis.

If the catchments have a suitable and consistent framework for assessing the impacts of water use that is the basis for determining allocations, two other components could be provided to deliver an improved system of water property rights and allocations. In the first instance, the assessment process, known as a strategic environmental assessment, would identify the level of compensation and structural adjustment required for those landholders that lose some entitlement to their existing water rights.

Secondly, there could be some temporary trading of the excess supply or excess demand for water allocations between the catchment management agencies, on behalf of their landholders. This may be the most effective means for operating a market, particularly where there is an interest in trading any unused water rights or the unallocated water from one catchment to another, if that water cannot be utilised by other landholders in the catchments where they are generated.

## TERMS OF REFERENCE 3 AND 4

Terms of Reference 3 and 4 have been dealt with throughout this submission.

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