



Hydrological impacts of timber harvesting

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Background

As understanding of the impact of timber harvesting and associated silviculture on catchment hydrology in the jarrah and karri forests improved, additional measures were implemented to provide protection to stream water quality. These include the retention of:

- a stream reserve that is protected from timber harvest and which acts to minimise the transfer of sediment to streams from upslope harvested areas.
- a minimum density of vegetation in space and time following harvest in the lower rainfall zones (<1100 mm long-term average annual rainfall) where groundwater is saline. This acts to limit the transient rise of saline groundwater levels that may follow the harvest and hence reduces the risk of an increased discharge of saline groundwater into the stream.



To examine whether the constraints on timber harvest and associated silviculture are effective in protecting stream water quality and water quantity, two catchments were treated in a paired-catchment study that included an untreated control. One catchment received a standard timber harvest and associated silviculture that reduced overstorey density by an initial 30 per cent and a second catchment received a more intensive treatment that reduced overstorey density by an initial 55 per cent. Overstorey density subsequently recovered over time.

Findings

- Climate had a more dominant effect on groundwater levels than either the standard or the intensive treatments. Groundwater levels were declining in response to a long-term decline in average annual rainfall before the treatments were applied. The treatments slowed the rate of decline in groundwater by an amount that was directly related to the magnitude of the reduction in vegetation density (Fig.1). However, the reduction in vegetation was insufficient to reverse the decline in groundwater level.

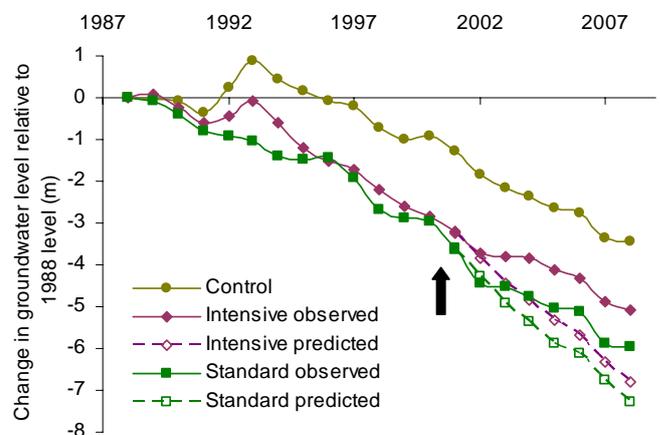


Fig. 1. Change in groundwater levels in treated and control catchments relative to 1988 level (solid symbols) and predicted change in groundwater levels in treated catchments relative to control if there was no treatment (open symbols). Arrow shows time of treatment.

- The extent to which groundwater levels slowed in their decline relative to the control is a measure of the relative rise in groundwater levels in response to the treatments. For valley situations the relative rise in groundwater level was 0.6 m after eight years following the standard treatment and 1.5 m after eight years following the intensive treatment (Fig. 2). These are much smaller responses than the rises that occurred in a study of the effect of timber harvesting practices in the 1970s and 1980s in which valley groundwater levels rose by 3.5 m after nine years following an initial 90 per cent reduction in vegetation density, and 4.5 m after six years following an initial 100 per cent reduction in vegetation density (Fig. 3).
- Annual streamflow volume did not increase following either the standard or the more intensive treatment.
- Annual flow-weighted stream salinity did not increase following either the standard or the more intensive treatment because saline deep groundwater levels did not rise.
- Annual flow-weighted stream turbidity ranged between 1 and 3 nephelometric turbidity units (NTU) following the intensive treatment, and between 5 and 6 NTU following the standard treatment, except for 2005 when turbidity was about 12 NTU (Fig. 4).
- The higher turbidity in the catchment receiving the standard treatment appeared to be due to an actively eroding unsealed road that delivered sediment by overland flow into the stream at a crossing 200 m upstream from the turbidity sensor.

Management Implications

- Within the settings of the current drying climate and declining groundwater levels neither the standard nor the more intensive timber harvest and silviculture poses a risk of increased stream salinity.
- Stream reserves are effective in protecting streams from an increase in turbidity due to upslope activity from timber harvest provided roads traversing the stream reserve have adequate structures to manage surface water to prevent direct flow into the stream.

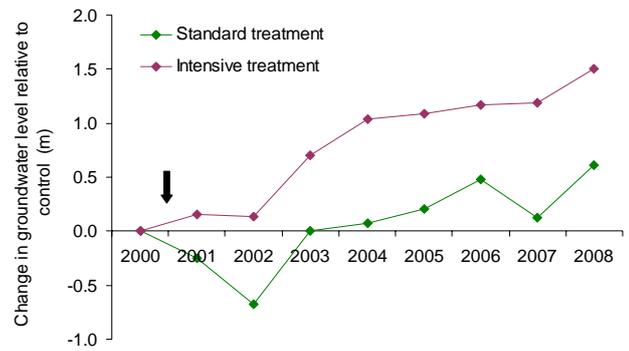


Fig. 2. Change in observed valley groundwater levels from the water levels predicted to occur if there was no treatment. A positive value indicates a rise in water level relative to the control. Arrow shows time of treatment.

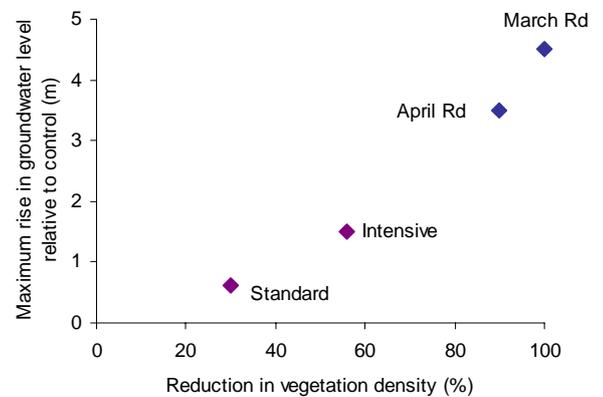


Fig. 3. Change in valley groundwater levels relative to control, in response to reduction in vegetation density, in this study compared with treatments in use in the 1970s and 80s (April Rd, March Rd).

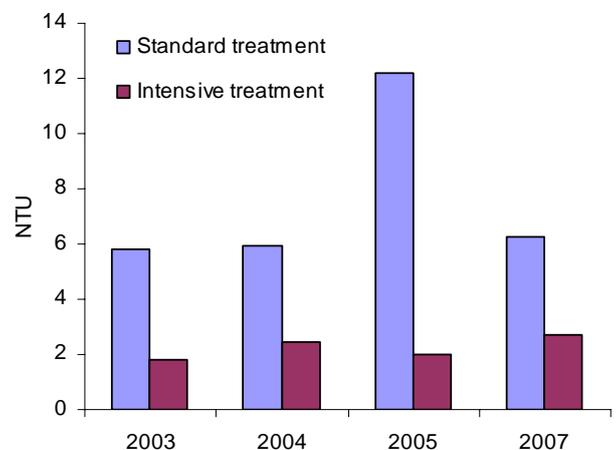


Fig. 4. Post-treatment annual stream turbidity.