Catchment Trial Wungong

Simulation of Forest Management on 31 Mile Brook Catchment

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Summary

What-if scenario modelling was undertaken for the 31 Mile Brook catchment to assess the effects of various forest-management practices. It was determined that if the forest continues to grow naturally and the present below-average rainfall period continues, then the streamzone hydrology and ecology will be considerably altered from what it is today; the groundwater system would fully disconnect from streamflow-generation processes and swamp-zone hydrology. Various thinning treatments can partially and fully reverse this process. In particular, a 12 to 15 year treatment cycle across the catchment slopes thinning to an LAI of 0.6 would fully restore past hydrology.

Introduction

Thinning of the forest has been proposed as a means to restore stream flows; however, we will need to wait some years before monitoring results will be available. To anticipate these results, we have applied the WEC-C model to the 31 Mile Brook catchment. WEC-C is a detailed process-model of catchment hydrology, which has been extensively applied in the south-west of W.A. The simulations successfully reproduced historical flows, and we then ran forecast, or what-if, scenarios of the catchment to assess the hydrological effects of various forest-management scenarios.

Modelling Methodology and What-if Scenarios

The parameter set used for modelling 31 Mile Brook was a generic one developed from modelling other catchments in the south-west of WA. Vegetation density was an important model input with this being provided via LANDSAT. Three future rainfall series were used but the one discussed below is the DoW series, the historical data for 1975 to 2008 repeated twice to generate a 68 year series. For vegetation, two treatment scenarios were considered: all-slope logging, and lower-slope only. For these two vegetation scenarios, six densities of treatment were simulated from LAI of 0.4 to 1.4 by 0.2 increments. It was assumed that there was 15 years between treatments with the forest regrowing during this period. The untreated forest was assumed to grow at a rate of 0.01 LAI units per year, which was the average forest-growth from the historical period 1973 to 2008.

Results

Table 1 lists the simulated streamflows for the various treatment scenarios along with the historical flows. It can be seen that if the do-nothing option is taken (normal growth scenario) then streamflow will halve in the first rainfall cycle (2009 to 2042) compared with historical, and then halve again in the second (2043 to 2076). However, if an all-slope logging treatment to an LAI of 0.6 is applied (logging LAI 0.6), then streamflows will essentially be maintained at historical levels. For lower-slope logging, a treatment to an LAI of 0.6 will essentially maintain streamflows at a level similar to what they would be if the forest did not grow, that is frozen at the 2008 LAI (no growth scenario).

For depths to groundwater, Figure 1 shows the historical and future simulated levels for the normal-growth scenario, that is where the forest is allowed to grow naturally. It can be seen by 2042 the discharge of groundwater would have ceased due to all depths being positive, that is below ground level, and by 2076 all groundwater is at a depth of four metres or more from the surface, thereby completely disconnecting the groundwater system from streamflow generation and swamp-zone hydrology.

Table 1: Average simulated-streamflows for the various what-if scenarios.

	Average Streamflow (mm/yr)		
Period	1975 to 2008	2009 to 2042	2043 to 2076
Normal growth	135	66	29
No growth		88	86
Logging LAI 0.4		176	180
Logging LAI 0.6		139	130
Logging LAI 0.8		112	89
Logging LAI 1.0		92	60
Logging LAI 1.2		80	44
Logging LAI 1.4		73	37
Lower Slope Logging LAI 0.4		111	86
Lower Slope Logging LAI 0.6		98	69
Lower Slope Logging LAI 0.8		87	56
Lower Slope Logging LAI 1.0		79	45
Lower Slope Logging LAI 1.2		73	38
Lower Slope Logging LAI 1.4		70	34

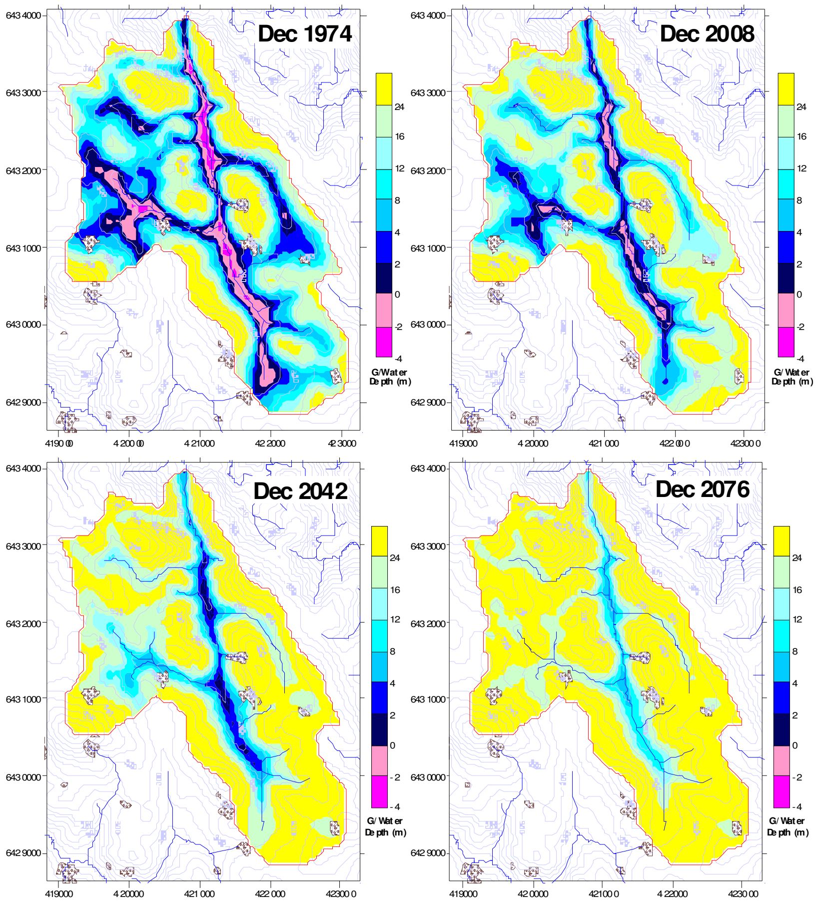

Figure 1: Simulated depths-to-groundwater for the normal-growth scenario.

Discussion and Conclusion

It can be seen that if the present low-rainfall periods continues, as it is predicted to do, then the hydrology of catchments like 31 Mile Brook will be radically altered unless the forest is managed. Reducing the forest density through thinning can, depending on the treatment layout and intensity, partially or fully reverse this trend. The modelling undertaken for 31 Mile Brook has shown that thinning of the catchment slopes to an LAI of 0.6 on a 15 year cycle would fully restore catchment hydrology, while undertaking a similar treatment on just the lower slope areas would maintain catchment hydrology at close to its present state.