Wungong Catchment Trial

Demonstration plots in native forest

Jarrahdale Road

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Acknowledgement

Prepared for Water Corporation by:

Frank Batini
Consultant
36 Juniper Way
Willetton WA 6155
Mobile: 0419 932 242
Email: fbatini@bigpond.net.au

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Summary
These two sets of demonstration plots (D and E) were specifically established so that interested parties could visit, view and discuss the results of various silvicultural prescriptions proposed for native forest in the Wungong Catchment Trial. This was successfully achieved and in five years, about 1000 persons have visited the plots accompanied by Water Corporation staff. Although thinning of native forest is opposed by some groups, the overall feedback has been positive and the plots have provided opportunities for face-to-face interaction on a range of issues within a forest setting. The plots have also been used for research purposes and for monitoring trends. The observed species richness in the understorey was found to be independent of thinning treatment and regardless of whether machinery had been used or not. Also, the Shannon-Wiener Diversity Index, which measures the evenness and diversity of species present between communities, was similar on both sites.

Introduction
The main purpose of the demonstration plots was to invite the public into the forest to view and discuss a range of silviculture prescriptions that could be used in the Wungong Catchment Trial. They would also be useful to train Water Corporation and staff from other departments. The plots were established in early 2007 — very soon after approval to proceed with the Trial was obtained. There are 11 plots in all, eight in uneven-aged native forest last cut 1940–1950 and logged with machinery; and three in native forest last cut in 1985–1990 and thinned with chainsaw. A report on the establishment of these plots was then prepared (Batini and Bradshaw 2007).

The plots were located well away from the water body, close to a bitumen road, with safe parking and walk trails were then constructed for safe access (see Figure 1, p. 7). They cover a range of stocking (33 to 512 stems per hectare) and basal area (5 to 37 square metres per hectare) treatments. They have also provided opportunity for monitoring and research.

Monitoring and research – Plot D
These eight, one-hectare plots were established in summer 2007 in forest that was last logged in the 1940–1950 decade. The vegetation type was described as 'S' and 'ST' as defined by Havel (1975a).

Inventory
In December 2008, a full inventory of all stems greater than 10 cm diameter breast height was completed on plots 60 m x 60 m (0.36 ha) located in the centre of each of the eight one-hectare (100m x 100m) plots. This inventory provided data on stocking rates and basal area (Table 1) and diameter class distribution. The correlation between stocking and basal area was strongly positive (r^2= 0.96).[1]

Changes in crown cover

Spec Terra
Spec Terra provided thematic remotely sensed imagery at a resolution of 0.5 x 0.5 m for these eight plots. The imagery was taken in mid-November, just before the annual leaf flush, in 2005 (prior to thinning) as well as 2007, 2008, 2009 and 2010 (post thinning). These data were converted into estimates of the area of each plot that was covered by canopy (see Figure 2, p. 8). These estimates include both over and understorey, however the understorey remained open and sparse (see Figure 3, p. 9) so most of the observed response was from the tree stratum.

[1] *The coefficient of correlation is used in statistical models to 'measure' how well one outcome (on the vertical axis, y) may be predicted by another (on the horizontal axis, x), and ranges in value from 0 to 1 – where 1 means that the outcome 'y' is completely predicted by 'x', and 0 means that 'y' is not at all predicted by the events described by 'x'.*

The data show the plots were reasonably even in 2005, averaging 62 per cent canopy cover (range 58 to 70 per cent). Post thinning, in November 2007, the canopy cover was reduced to 18 per cent in thinned plots (range 14 to 26 per cent) while the control plots averaged 59 per cent. Canopy cover was slightly higher in the lighter thinning treatments (blocks 3 and 8) and similar in the other four blocks (2, 4, 5 and 6). An increase in canopy cover in the period 2007 to 2010 was then observed in all the thinned blocks, when the average cover was 33 per cent — nearly double the 2007 cover calculated six months after thinning. Control block 1 remained at 64 per cent cover whereas control plot 7 decreased by 18 per cent. This was due to crown scorch as the result of a prescribed burn.

Landsat
There are data published by CSIRO (Macfarlane and Silberstein 2011) that estimate Leaf Area Index (LAI) trends from Landsat imagery. Because the pixel size is large, the plot size is only one hectare and the plot orientation is inappropriate, the data were extracted only from pixels that were fully within a treated plot. These data show that LAI in the four years prior to treatment averaged 1.35. By January 2008 the controls averaged 0.9 and thinned areas 0.4. By January 2010, controls had grown to an LAI of 1.8 and thinned areas to 0.9, and were still about half of the Leaf Area of un-thinned stands.

Lidar
CSIRO staff from Canberra evaluated the value of using ground-based Lidar to determine the differences between plots, but the trial was unsuccessful due to too much 'noise'.

Densiometer
In 2007, estimates of leaf cover were made using a mirror, spherical densiometer. In the native forest, data were collected on four sub-plots, located in the centre of each 0.25 ha quadrat within each one-hectare treatment plot. Two readings were taken at each site giving a total of eight readings for each plot. A regression was calculated between stocking and per cent cover (r^2=0.95).

Vertical photography
In December 2008, Dr Macfarlane (CSIRO Perth) used vertical photography to estimate crown cover, foliage cover, crown porosity and LAI. The photos were taken at 5 m spacing on plots of 0.36 ha located centrally within each treatment. Several regressions were calculated from the data in Table 1 (see p. 12) as follows: stocking/basal area (r^2=0.96); stocking/crown cover (r^2=0.97); stocking/LAI (r^2= 0.96).

Biodiversity
Baseline vegetation monitoring in the demonstration site was carried out by Mattiske Consulting Pty Ltd in spring 2009, about 2.5 years after establishment (Mattiske 2010). Data were obtained on samples of both the overstorey trees (species, diameter, height, health) as well as understorey (species, number healthy/dead, cover healthy/dead). This allows calculation of species richness, diversity and cover.

Data on the species richness in the understorey were regressed against crown cover (r^2= 0.33), LAI (r^2=0.30), stocking (r^2=0.25) and basal area (r^2=0.18). All correlations have very low regression coefficients indicating that the observed species richness was quite independent of the thinning treatment.

The understorey in the native forest was more diverse and had a more even species distribution than did the rehabilitated bauxite pit. The lower species diversity is due to a predominance of re-seeding species in the rehabilitation.

Silviculture
Tree-marking was carried out by experienced staff from Forest Products Commission (four native forest plots) and the author (two plots). Tree-marking involves difficult choices in

selection of retained stems, with a need to consider many factors such as basal area requirements, tree spacing, tree form, crown health, stand structure, trees marked for retention (habitat/crop tree), trees to be thinned etc. Because these are natural stands, there is a high degree of heterogeneity which means that there always will be areas with a gap and areas where some trees are more clumped.

Post-logging in dry-soil conditions in summer 2007, the native forest demonstration site was prescribed burnt by Department of Environment and Conservation staff in early December 2008. The volume of logging debris, higher temperatures and a sudden change in wind direction and speed meant that the site was burnt hotter than desired, with a number of crowns being scorched. The retained trees have subsequently recovered, with good crowns (see Figure 4, p. 10).

The opening-up of the crowns meant that some of the lignotubers developed into dynamic shoots and many of the cut stumps coppiced. On half a hectare, located in the western half of each of the six treated plots (there are also two control plots) this coppice was controlled with herbicide and dynamic shoots were thinned to approximately a six-metre spacing. As a comparison, on the eastern half of these plots the coppice and dynamic shots were left to develop unhindered (see Figure 5, p. 11).

Monitoring

Plot E

In order to compare thinning with and without the use of machinery, three additional plots were established in native forest, to see whether compaction was an issue in relation to growth and response in the understorey species post thinning. These plots are 70m x 70m in size, located adjacent to Jarrahdale Road, near the post-1988 rehabilitated plots within a bauxite pit. This forest was last logged between 1985 and 1990 when the adjacent bauxite pits were clear-felled and mined. The site was prescribed burnt by DEC in spring 2006 resulting in a mild burn with minimal scorch. The vegetation type was described as 'S', as defined by Havel (1975a).

In summer 2008, two plots were tree-marked by DEC staff and the author to a basal area of approximately 15 m^2/ha and the third was retained as a control. Retained trees were designated as either 'habitat' or as 'future crop' in accordance with the existing DEC Guideline (2007). In one plot, the unmarked trees were felled with chainsaw and the stump painted with herbicide (glyphosate), in the other they were notched using this herbicide. In spring 2009 the flora on these plots were assessed by Mattiske Consulting (Mattiske 2010). The assessment of basal area and stocking was originally done just after treatment, in summer 2008, but the data have been mislaid. A further assessment was carried out in August 2012 and these data are summarised in Table 2 (see p. 12). Basal areas were estimated with a factor 2 prism, crown cover with a spherical crown densiometer and stocking by counting the number of trees within an eight metre radius.

Trends are as expected, with the control plot having higher basal area and stocking than treated plots. Basal areas in treated plots were close to the 15 m^2/ha target. Crown cover estimates were similar, probably as the result of crown expansion in treated plots in the four years since thinning occurred.

The mean species richness in the understorey was 16.37, with no significant difference between the three plots. This is an improvement over the plots thinned by machinery where the average richness was 11.57, however the difference was not statistically significant (Mattiske 2010, p. 12). Also, the Shannon-Wiener Diversity Index, which measures the evenness and diversity of species present between communities, was similar — 3.6 and 3.5 respectively.

Combined data for Plots D and E
As expected for these eleven plots, there are strong correlations between stocking and basal area, crown cover and LAI, with coefficients exceeding 0.95. However there is no similar relationship between stocking and species richness (r^2 = 0.10) indicating that thinning has not had any effect on species richness.

Discussion

The demonstration plots were primarily established so that interested parties could visit, view and discuss the results of the Wungong Catchment Trial. They have proved to be extremely useful, both for internal communication within Water Corporation as well as with external stakeholders. In the past four years about 1000 persons have visited these sites accompanied by Water Corporation staff and or consultants. Groups have ranged in size from small groups to university parties of 30–40 students.

Some visitors have come from overseas — Scotland, USA, Vietnam, India and Italy; others were Australians from NSW, Victoria, Tasmania and the ACT. There were many local visitors representing a wide range of interests (see Appendix 1).

Pre- and post-visit questionnaires developed by Water Corporation have been used to provide feedback on the level of knowledge about the Wungong Catchment Trial, the effectiveness of the visits and how these presentations could be improved.

The Water Corporation has used several strategies to engage with the public on the Trial. These include formal public comment on the proposal and on all silvicultural guidelines, a regular newsletter Wungong Whispers, a Technical Reference Panel, the engagement of scientific research studies (on flora, fauna, aquatic biodiversity, streamflow, groundwater tables, remote sensing and public perceptions] and making all reports available on the Water Corporation website as well as conducting four forums on research outcomes (in 2006, 2007, 2009 and 2010).

While all these avenues have value, the demonstration plots offer the only opportunity to engage on a face-to-face basis, out in the forest environment. The feedback that we have received has been positive. Even people who are not necessarily convinced about the merits of the Trial, have at least indicated that they now have a much better understanding of the complexity of the issues, and the reasons why Water Corporation is undertaking these studies.

These plots have also been useful for various research and monitoring studies. The measurements to date do not show any differences in species richness between the plots harvested by machine or by hand falling; there is also no observable difference between very dense (512 sph) and very open (33 sph) plots.

Figures

Figure 1 — Location diagram — Plots D and E

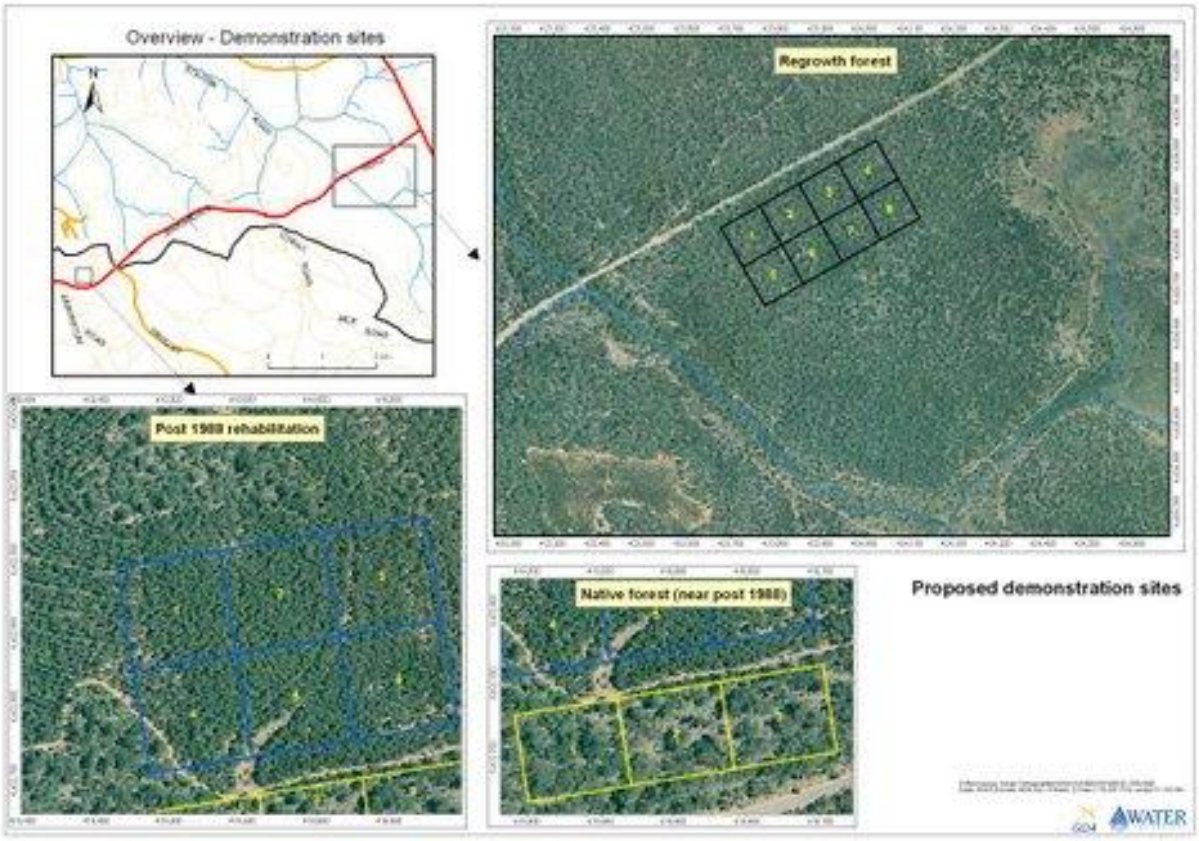

Figure 2 — Estimates of crown cover in November for 2005 (blue), 2007 (red) 2008 (green) 2009 (purple) and 2010 (orange). (Source: Spec Terra Pty Ltd.)

Blocks 1 and 7 are the unthinned controls. Block 7 was scorched by fire much more than Block 1. Each Block has an area of 10000 square metres.

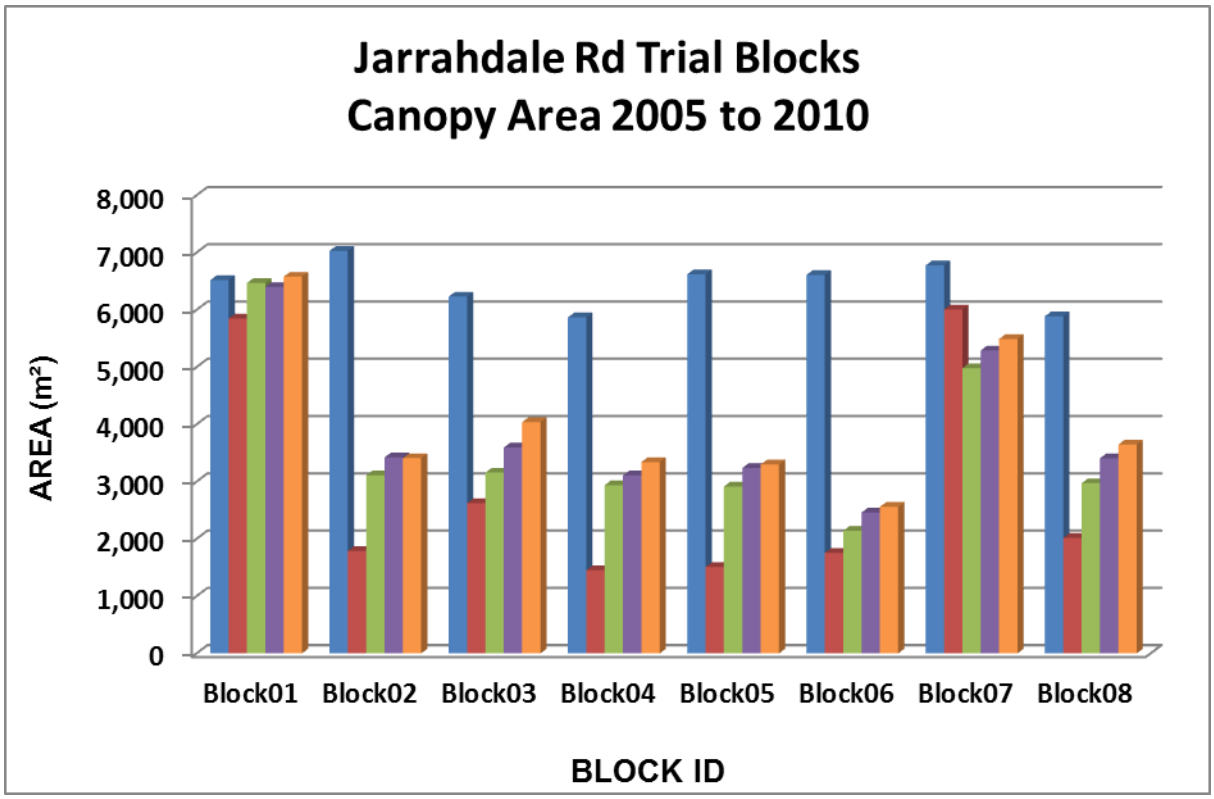

Figure 3 — Sparse understorey photographed five years after thinning — Block 4 thinned to 11 m^2/ha, coppice from stumps treated with herbicide and dynamic shoots thinned to 6 m spacing.

Figure 4 — Healthy and dense crowns photographed five years after thinning — Block 4 thinned to 11 m^2/ha, coppice from stumps treated with herbicide. Note regrowth of dynamic shoots thinned to about 6 m spacing

Figure 5 — Denser regeneration of jarrah mostly from coppice off stumps; Block 4 thinned to 11 m^2/ha, without coppice control or thinning of dynamic shoots.

Tables

Table 1 Inventory data for eight native forest plots — Plot A

Plot	Stocking	BAOB	Crown Cover	LAI	Species Richness
Native 7	512	37.4	59	2	12.8
Native 1	321	30.5	46	1.6	14.3
Native 8	190	23.5	20	0.8	8.0
Native 3	271	20.6	30	1.1	11.0
Native 5	98	12.7	18	0.7	15.2
Native 2	101	12.1	17	0.7	10.8
Native 4	77	11.3	20	0.8	8.5
Native 6	33	4.9	7	0.3	12.1

Table 2 Inventory data for three native forest plots — Plot B

Treatment	Stocking	Basal Area	Crown Cover	Species Richness
Control	280	26	34	16.6
Cut-stump	100	16.2	28	16.2
Notched	130	17.2	33	16.3

Basal area (m^2/ha), stocking (stems/ha), crown cover (per cent) and species richness estimates.
Basal area and stocking refer to live stems > 10 cm in diameter at breast height.
Data shown are the mean values of five estimates.

Appendix 1 – Visitors to Wungong demonstration sites

Visitors from within Western Australia include:

Ministers and Parliamentarians
Local government representatives
Catchment advisory groups

University staff and student groups from:

- Curtin University
- Edith Cowan University
- Murdoch University
- The University of Western Australia

Members and/or staff of:

- Alcoa of Australia
- Beekeepers' Association
- Conservation Commission
- Conservation and Environment
- Centre of Excellence for Climate Change Forest and Woodland Health
- Conservation Council
- CSIRO
- Department of Water
- Forest Products
- Environmental Protection Authority
- Institute of Foresters
- Jarrahdale Historical Society
- Office of the EPA
- Water Corporation

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