

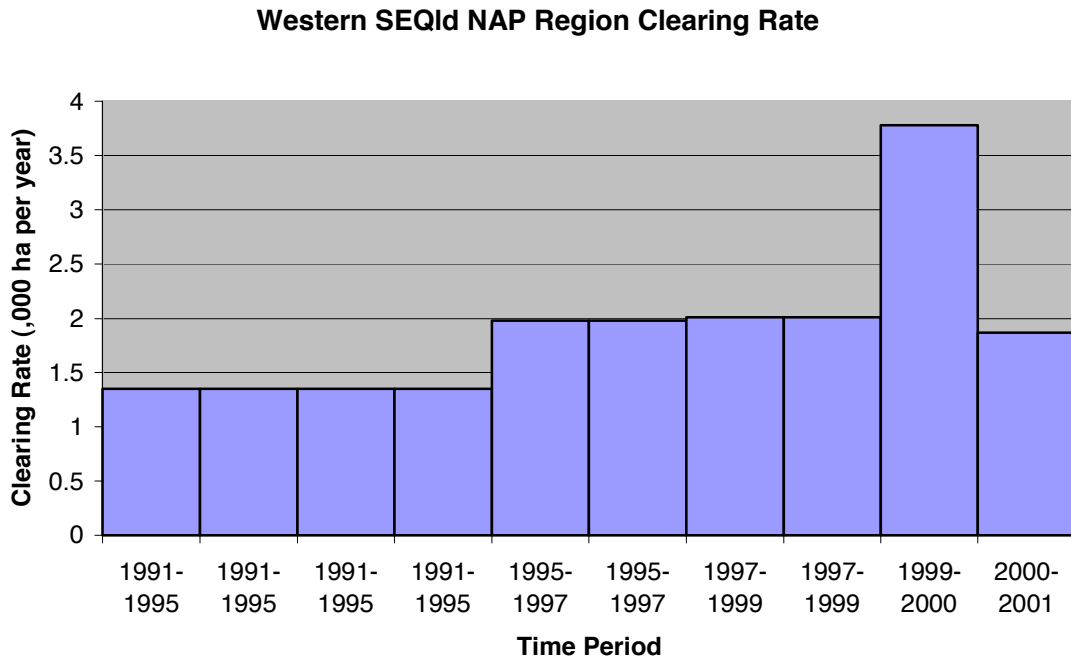
**Land Cover Change in the  
Western South-East Queensland  
National Action Plan (NAP) Region  
1999-2001**

February 2003

Natural Resource Sciences  
Department of Natural Resources and Mines  
80 Meiers Road, Indooroopilly, 4068.  
<http://www.nrm.qld.gov.au/slats>

## SUMMARY

- The Western SEQld National Action Plan (NAP) Region woody vegetation clearing rate for the 1999-2000 period was 3,780 ha/year, and for 2000-2001 was 1,870 ha/year, giving a combined rate for 1999-2001 of 2,820 ha/year (see Figure 1 and Table 1).



**Figure 1 : Change in clearing rate for the Western SEQld NAP Region from 1991 to 2001**

- Compared with the 1997–1999 clearing rate, the 1999-2000 rate increased 88% (before the Vegetation Management Act was proclaimed in 2000), followed by a 51% decrease for the period 2000-2001. The overall 1999-2001 clearing rate was 40% higher than the 1997-1999 rate. This pattern of clearing rate increase to 2000, followed by a decrease after 2000 is similar to that reported for other catchments.
- These woody vegetation change rates include clearing of both remnant and non-remnant vegetation. The woody vegetation change data were intersected with the Queensland Herbarium’s 1999 regional ecosystem mapping (Accad *et al*, 2001). SLATS analysis indicates that for the Western SEQld NAP Region, 40% of the vegetation clearing for 1999-2000, and 32% of the vegetation clearing for 2000-2001 was “remnant” vegetation. The remaining 60% and 68% of vegetation cleared during 1999-2000 and 2000-2001 was non-remnant woody vegetation. Hence, a higher proportion of remnant clearing was carried out before the VMA proclamation, followed by a drop in remnant clearing following. This pattern is similar to other catchments previously reported.
- Examining the vegetation remaining in the Region in 2001, 49% of the total catchment is woody vegetation, and 32% is remnant vegetation (see Table 2). Further analysis using these SLATS data will be done by the Herbarium when updating their 2001 Regional Ecosystem mapping. Two of the sub-catchments (Brisbane River and Bremer River) have Remnant cover at or below the 30% level.

## Introduction

The Statewide Landcover and Trees Study (SLATS) is a major vegetation monitoring initiative of the Queensland Department of Natural Resources and Mines (NR&M). SLATS provides accurate woody vegetation cover and land cover change information for vegetation management planning and for greenhouse gas inventory purposes. Landsat Thematic Mapper (TM) and Enhanced Thematic Mapper (ETM+) satellite imagery has been used to compare the woody vegetation cover between 1988, 1991, 1995, 1997, 1999, 2000 and 2001, and to provide baseline landcover mapping over the entire State of Queensland. The Landsat TM and ETM+ imagery has a spatial resolution of 30 metres, enabling most areas of vegetation change (one hectare or greater) to be detected. Typically, it is used to produce maps at a scale of 1:100 000 or smaller. This study provides a consistent data set covering the entire State at a medium spatial resolution, but it is not intended to be a substitute for high resolution studies of patchy remnant bushland which would conventionally use aerial photography. Landsat TM and ETM+ satellite imagery should be used with caution when mapping narrow vegetation corridors, such as riparian vegetation, as the resolution of the imagery may be less than the spatial extent of the vegetation to be mapped.

The results contained in this report are only part of the Statewide assessment of woody vegetation change in Queensland for the 1999-2001 period. They refer to the area covered by the Western SEQld NAP Region. Reports on the Queensland Murray Darling Basin, the Fitzroy and Burdekin catchments, and the Burnett/Mary NAP Region are also being completed. The change assessment for the Landsat satellite scenes covering this area have been fully analysed, field checked and validated by remote sensing scientists (Wedderburn-Bisshop *et al*, 2002). Analysis of 1999-2001 land cover change for the entire State is completed and will be released in a separate report.

Previous differences between SLATS clearing statistics and the Queensland Herbarium Regional Ecosystem clearing statistics have been observed. These differences primarily exist because SLATS does not take into account the modification of grasslands nor the gaps in sparse woodland canopies in areas being modified. SLATS measures woody clearing only, measured as foliage projective cover using the SLATS methodology described in Wedderburn-Bisshop *et al* (2002). The Queensland Herbarium records changes in Regional Ecosystems, i.e. change (conversion) of native vegetation, which includes grassland and sparse woodland. This means that usually the Herbarium “conversion” figures are usually higher than the SLATS “woody vegetation clearing” figures, for the same area and time sequence. See Accad *et al* for an illustrative explanation.

## Methods

The methods used by SLATS to map woody vegetation change for the 1999-2001 period are similar to those described in the previous 1997-1999 change report (QDNR, 2000) but incorporate a number of recent improvements to image analysis techniques, as described in Wedderburn-Bisshop *et al* (2002), Goulevitch *et al* (2002), Danaher *et al* (2002), and Armston *et al* (2002). This report and other scientific papers are available at the project web site. When issued, the Statewide 1999-2001 Land Cover Change report will contain full details of the methods used. The SLATS method has been independently verified as highly accurate in the Bureau of Resource Sciences, Remote Sensing of Agricultural Land Cover Change project.

The vegetation change figures contained in this report were based on the analysis of six Landsat ETM+ scenes captured in 1999, 2000 and 2001. The acquisition dates for the images varied between June 1999 and December 1999 for the earlier images and July and September 2001 for the latest imagery. However, the change figures reported are all reduced to annual rates of change. The variation in image capture dates is dependent on availability of suitable cloud free imagery.

Rather than reporting on the entire two year 1999-2001 period, it was possible to split the vegetation change rates into 1999-2000 and 2000-2001 periods using additional 2000 Landsat imagery. These 2000 images were acquired following the implementation of the Vegetation Management Act in September 2000. They were acquired as close as possible to September 2000. Hence, in broad terms the 1999-2000 period is the year leading up to the commencement of the Vegetation Management Act and 2000-2001 is the year following its introduction.

### Woody Vegetation Change by Catchment and Sub-Catchments

The overall rates of woody vegetation change in the Western SEQld NAP Region are summarised in Figure 1. This graph shows the total clearing that occurred in each of the time periods analysed by SLATS. Table 1 gives clearing rates for each of the sub-catchments in the Western SEQld NAP Region. The total area of the Western SEQld NAP Region is 1.36 million ha.

<b>Clearing Rates in the Western SEQ NAP Region Catchments (,000 ha per year)</b>					
	<b>1991-1995</b>	<b>1995-1997</b>	<b>1997-1999</b>	<b>1999-2000</b>	<b>2000-2001</b>
<b>Stanley R</b>	0.68	0.37	0.36	0.49	0.23
<b>Upper Brisbane R</b>	0.29	0.78	0.89	1.70	0.65
<b>Lockyer Ck</b>	0.22	0.58	0.51	1.44	0.91
<b>Bremer R</b>	0.16	0.25	0.26	0.15	0.09
<b>Total</b>	<b>1.35</b>	<b>1.98</b>	<b>2.01</b>	<b>3.78</b>	<b>1.87</b>

**Table 1: Woody vegetation clearing rate by catchment and sub-catchment from 1991 to 2001.**

### Remaining Vegetation by Sub-Catchment

The following Table 2 gives comparisons of remaining vegetation in 2001 in each of the sub catchments.

There are important differences in the definitions of “Remaining Woody” and “Remnant”. Woody vegetation is defined in the SLATS statewide report (DNR, 2000). It relates to the foliage cover of all perennial woody plants that can be distinguished with Landsat TM imagery and includes native vegetation, disturbed vegetation, regrowth, plantations and domestic vegetation. Remnant vegetation is defined in the Vegetation Management Act and includes both woody and non-woody vegetation that has not been disturbed or has greater than 50% cover and 70% of height of pre-clearing vegetation. This does not generally include small fragments of woody vegetation that cannot be mapped at a resolution of 1:100 000 (see Accad *et al*, 2001).

The catchment woody and remnant cover statistics will usually be different because they are different measurements. Typically in coastal areas which were covered in trees before clearing, the woody vegetation cover figures will be greater than the remnant figures because they include disturbed or regrowth vegetation. In areas containing open woodland and grasslands the remnant figures will be higher because they include the grasslands and open woodlands, whereas the woody vegetation cover

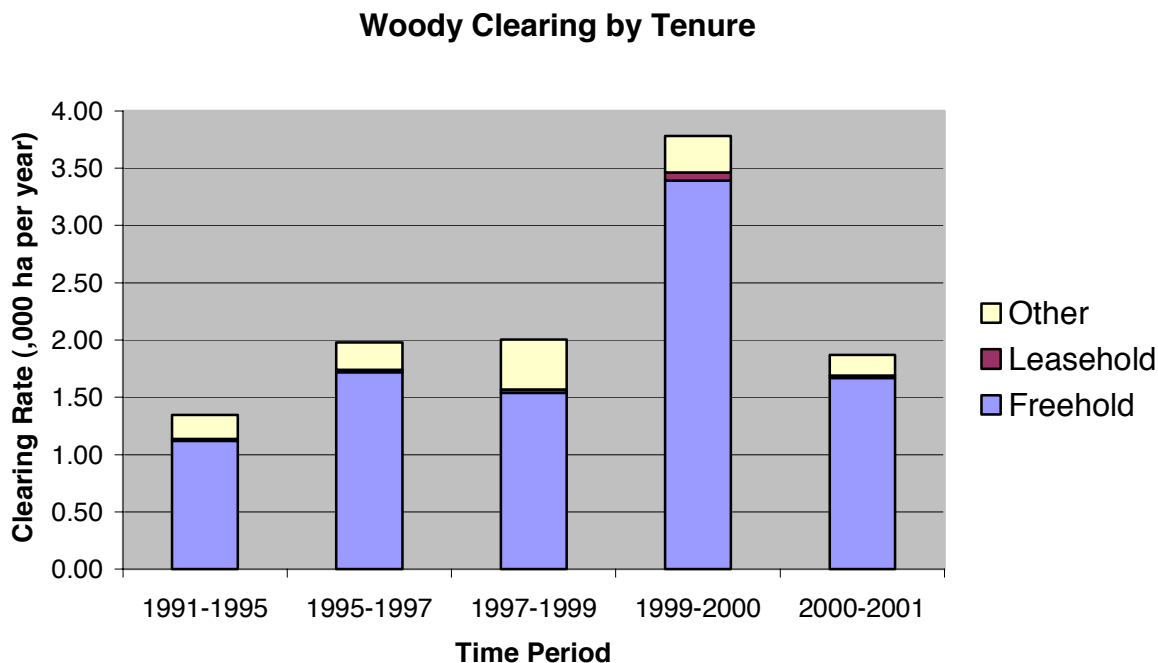
figures do not. In the far west of Queensland, remnant vegetation may approach 100% while the woody cover figures may approach 0%.

	SLATS Remaining Woody	Herbarium Remnant
<b>Stanley River</b>	57.8%	42.4%
<b>Upper Brisbane River</b>	48.4%	31.0%
<b>Lockyer Creek</b>	54.3%	39.4%
<b>Bremer River</b>	35.6%	20.1%
<b>Total Western SEQld NAP Region</b>	49.0%	32.7%

**Table 2. Percent Remaining Woody and Herbarium Remnant in each of the Sub-Catchments.**

### Woody Clearing by Tenure

The rates of woody vegetation change in the Burnett/Mary NAP Region, grouped by tenure group are shown in Table 3. Change in clearing rate by tenure is shown in Figure 2. The tenure class Other, used in the figures and tables includes: state forest, timber reserves, national parks, Commonwealth lands, mining, main roads, railways, action pending etc.



**Figure 2 : Change in clearing rate by land tenure for the Western SEQld NAP Region from 1991 to 2001**

	<b>Western SEQld NAP Region Average Annual Clearing Rate (,000 ha per year )</b>			
	<b>Freehold</b>	<b>Leasehold</b>	<b>Other</b>	<b>Total Annual</b>
<b>1991-1995</b>	1.12	0.02	0.21	<b>1.35</b>
<b>1995-1997</b>	1.72	0.02	0.24	<b>1.98</b>
<b>1997-1999</b>	1.54	0.03	0.44	<b>2.01</b>
<b>1999-2000</b>	3.39	0.07	0.32	<b>3.78</b>
<b>2000-2001</b>	1.67	0.02	0.18	<b>1.87</b>

**Table 3 : Woody vegetation clearing rate by land tenure type.**

Most of the 1999-2000 clearing (90%) was on freehold land, and 2% was on leasehold land, and in the 2000-2001 period 89% of the clearing was on freehold and 1% was on leasehold. This relates to the fact that most of the catchment is freehold.

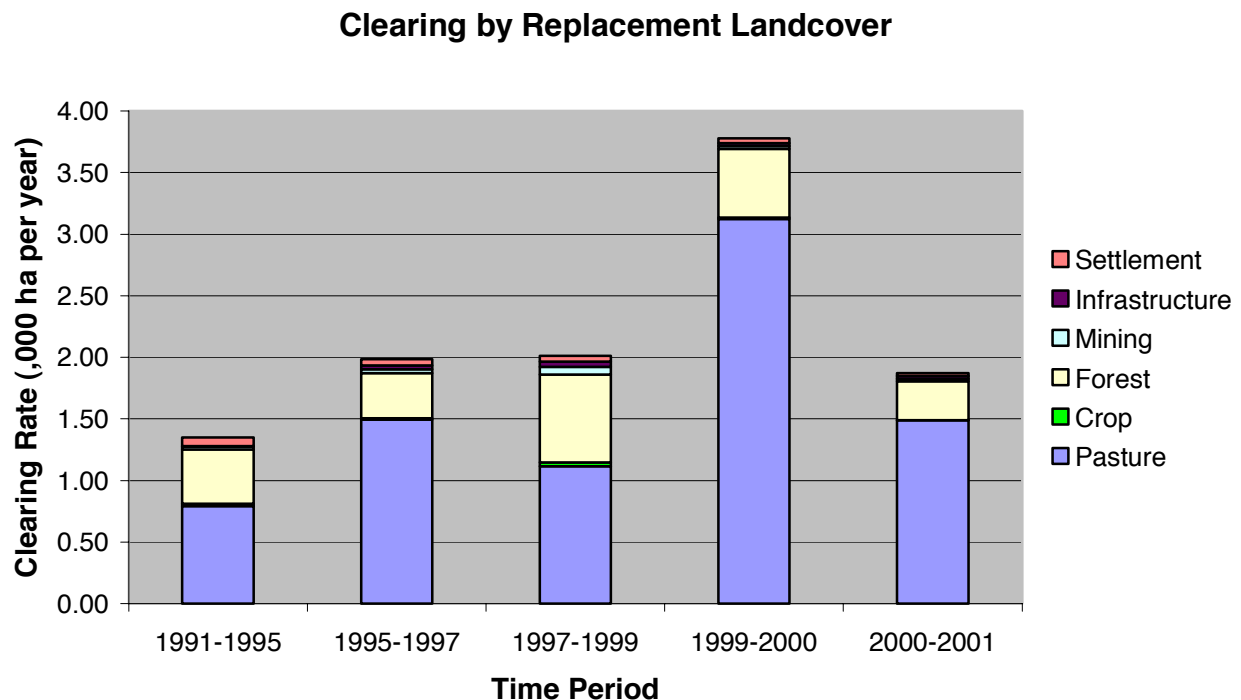
## Woody Vegetation Change by Land Use

Every patch of clearing identified in the SLATS change analysis was assigned a replacement land cover class. The assignment of these classes is primarily based on visual interpretation of the imagery. A description of these classes is contained in the SLATS 1997-1999 change report (QDNR, 2000).

Table 4 shows woody vegetation change rates by replacement land cover class for each of the SLATS change periods.

	Western SEQId NAP Region Average Annual Clearing Rate ( ,000 ha per year )						
	Pasture	Crop	Forest	Mining	Infrastructure	Settlement	Total
<b>1991-1995</b>	0.79	0.02	0.44	0.03	0.00	0.07	<b>1.35</b>
<b>1995-1997</b>	1.49	0.01	0.36	0.04	0.03	0.05	<b>1.98</b>
<b>1997-1999</b>	1.12	0.03	0.72	0.06	0.04	0.05	<b>2.01</b>
<b>1999-2000</b>	3.12	0.02	0.56	0.02	0.02	0.04	<b>3.78</b>
<b>2000-2001</b>	1.49	0.00	0.32	0.02	0.02	0.03	<b>1.87</b>

**Table 4 : Woody vegetation change by replacement land cover from 1991 to 2001.**



**Figure 3 : Change in clearing rate by replacement land cover for the Western SEQId NAP Region from 1991 to 2001.**

## Comparison to Queensland Murray Darling Basin, Fitzroy and Burdekin Catchments and Burnett/Mary NAP Region Clearing

Comparisons between the clearing areas of the Queensland Murray Darling Basin, the Burdekin and Fitzroy Catchments and the Burnett/Mary NAP Region are given in Figures 4 and 5.

### Average Annual Clearing Rates 1991-2001

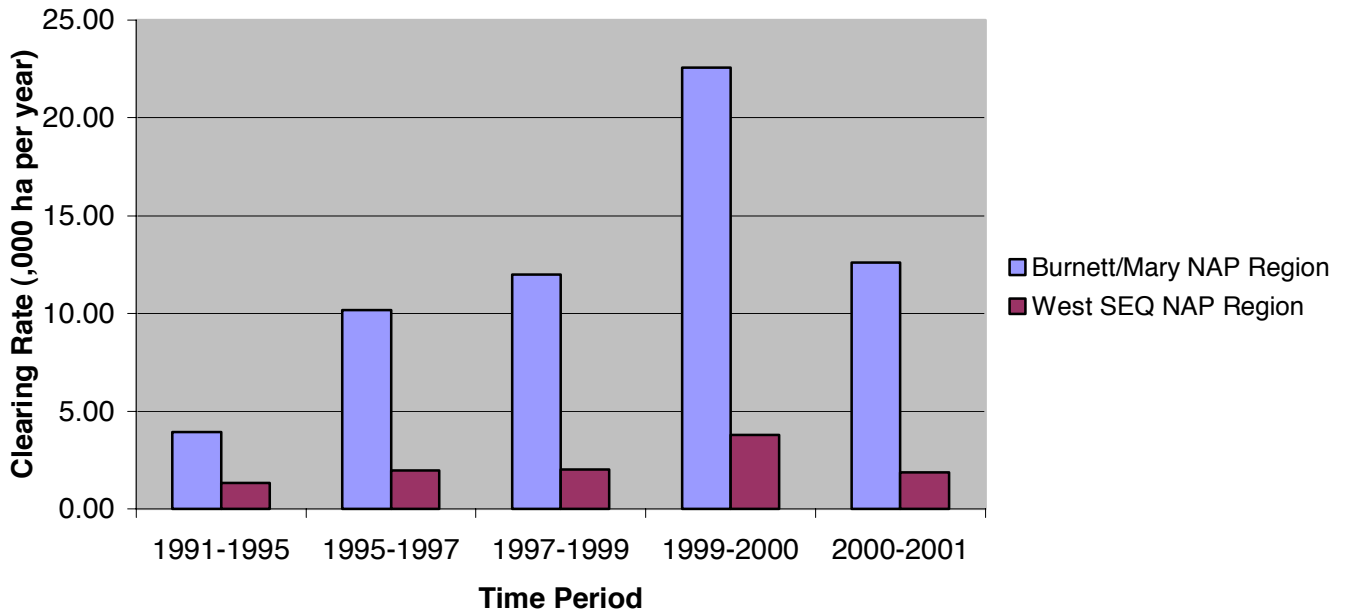


Figure 4 : Clearing Rate comparisons from 1991 to 2001 (Larger catchments have been omitted for clarity)

### Percentage of Total Catchment Cleared per year 1991-2001

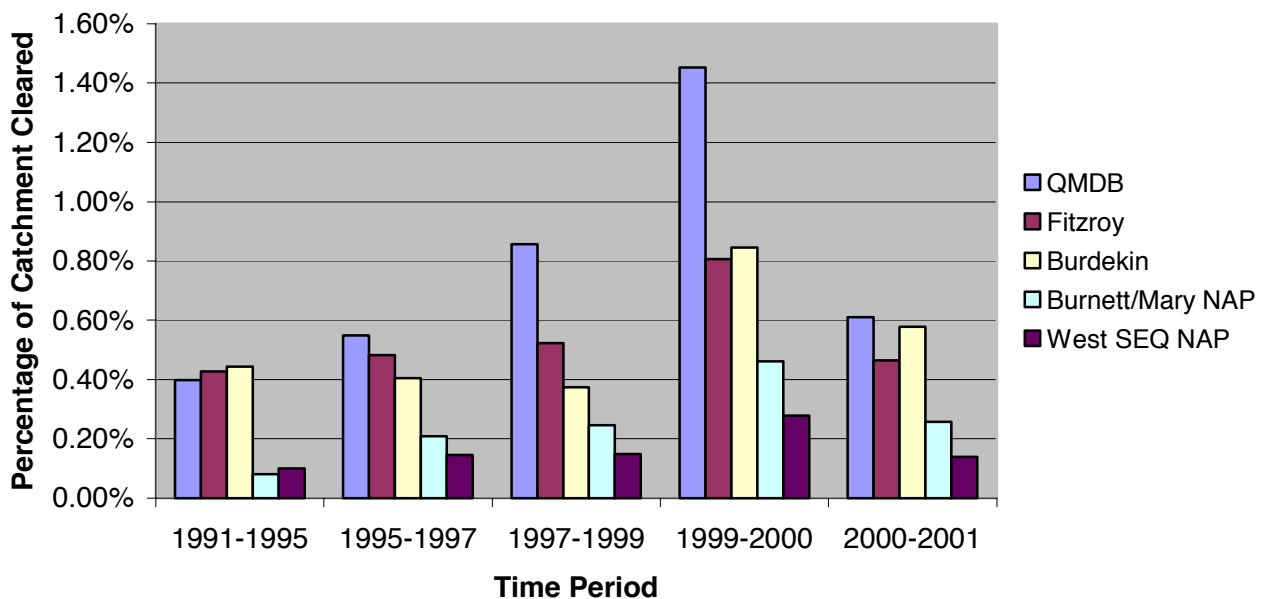


Figure 5 : Change in clearing rates as a percentage of the total area of the Basin/Catchment per year. (Note: This is not the percentage of remaining or original timber cleared, it is a percentage of the total basin/catchment area).

The basin and catchment areas are:

Qld Murray Darling Basin	25.93 million ha
Fitzroy Catchment	14.25 million ha
Burdekin Catchment	13.01 million ha
Burnett/ Mary NAP Region	4.90 million ha
Western SEQld NAP Region	1.36 million ha.

This pattern of clearing rate increase to 2000, followed by a decrease after 2000 is similar to that reported for other catchments.

Table 5 compares remaining vegetation in 2001 in each of the catchments reported on to date. There are important differences in the definitions of “Remaining Woody” and “Remnant”. See page 4 for more detail.

Remaining woody vegetation statistics in Table 5 are based on the woody cover as mapped by SLATS using 1991 imagery and include the regrowth and clearing mapped in change detection analyses since 1991.

	Qld Murray-Darling Basin	Fitzroy Catchment	Burdekin Catchment	Burnett/Mary NAP Region	Western SEQld NAP Region
<b>SLATS Remaining Woody</b>	47.2%	47.9%	70.6%	53.0%	49.0%
<b>Herbarium Remnant</b>	53.5%	42.2%	74.8%	41.0%	32.7%

**Table 5: Comparison of Remaining vegetation for QMDB, Fitzroy, Burdekin, Burnett / Mary and Western SEQ NAP Regions.**

### Woody Vegetation Change by 30' x 30' Grid Cell

A spatial view of where clearing is occurring within the Western SEQld NAP Region is shown in Figure 6. These maps show the rate of clearing (km<sup>2</sup>/year) per 30' x 30' (latitude/longitude) grid cell which is the same size as a 1:100,000 map sheet. (1 km<sup>2</sup> = 100 ha).

### References

Accad, A; Neldner, V.J; Wilson, B. A; and Niebus, R.E. (2001) Remnant Vegetation in Queensland. Analysis of Pre-clearing, Remnant 1997-1999 Regional Ecosystem Information, Brisbane, Queensland Herbarium,, Environmental Protection Agency.

Armston, J.D., Danaher, T.J., Goulevitch, B.M. and Byrne, M.I. (2002) Geometric correction of Landsat MSS, TM and ETM+ imagery for mapping woody vegetation cover and change detection in Queensland. In: *Proceedings of the 11th Australasian Remote Sensing and Photogrammetry Conference*, Brisbane, September 2 - 6, 2002.

Danaher, T. An empirical BRDF correction for Landsat TM and ETM+ imagery. In: *Proceedings of the 11th Australasian Remote Sensing and Photogrammetry Conference*, Brisbane, September 2 - 6, 2002.

Department of Natural Resources (2000) Land Cover Change in Queensland 1997-1999, A Statewide Landcover and Trees Study (SLATS) report, September 2000. pp. 56.

Natural Resources and Mines (2002A) Land Cover Change in the Queensland Murray Darling Basin 1999 to 2001, A Statewide Landcover and Trees Study (SLATS) report, July 2002.

Natural Resources and Mines (2002B) Land Cover Change in the Fitzroy Catchment 1999 to 2001, A Statewide Landcover and Trees Study (SLATS) report, October 2002.

Natural Resources and Mines (2002C) Land Cover Change in the Burdekin Catchment 1999 to 2001, A Statewide Landcover and Trees Study (SLATS) report, January 2003.

Natural Resources and Mines (2002D) Land Cover Change in the Burnett/Mary NAP Region 1999 to 2001, A Statewide Landcover and Trees Study (SLATS) report, January 2003.

Natural Resources and Mines (2002E) Land Cover Change in the Western SEQld NAP Region 1999 to 2001, A Statewide Landcover and Trees Study (SLATS) report, January 2003.

Goulevitch, B.M., Danaher, T.J., Stewart, A.J., Harris, D.P., and Lawrence, L.J. (2002) Mapping Woody Vegetation Cover over the State of Queensland using Landsat TM and ETM+ Imagery. In: *Proceedings of the 11th Australasian Remote Sensing and Photogrammetry Conference*, Brisbane, September 2 - 6, 2002.

Wedderburn-Bisshop, G.R., Walls, J., Senarath, U., and Stewart, A.J. Methodology for mapping change in woody landcover over Queensland from 1999 to 2001 using Landsat ETM+. In: *Proceedings of the 11th Australasian Remote Sensing and Photogrammetry Conference*, Brisbane, September 2 - 6, 2002.

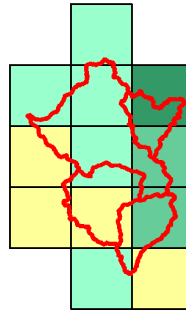
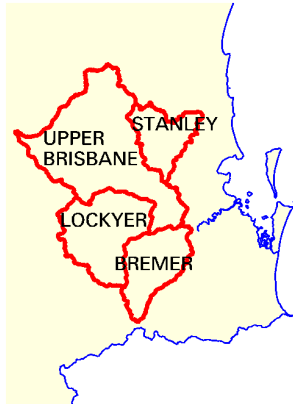


**Queensland  
Government**  
Natural Resources  
and Mines

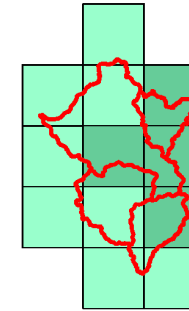
# WESTERN SEQ NATIONAL ACTION PLAN REGION

CLEARING RATE ('000 HECTARES PER YEAR)

BY 30' X 30' (LAT/LONG) GRID CELL



ANNUAL RATE 1991-1995



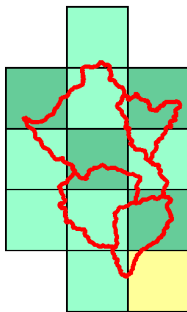
ANNUAL RATE 1995-1997

Clearing Rate  
( '000 ha per year)

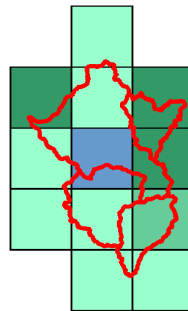
- 0 TO < 0.1
- 0.1 TO < 0.5
- 0.5 TO < 1.0
- 1.0 TO < 2.0
- 2.0 TO < 5.0
- > = 5.0

Each grid cell has an area of approximately 280 000 hectares.

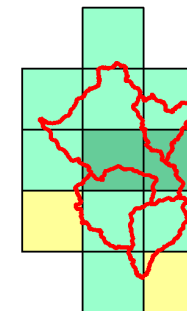
These rates were derived from computer classification and visual interpretation of Landsat image differences, with an accuracy of  $\pm 10\%$ .



ANNUAL RATE 1997-1999



ANNUAL RATE 1999-2000



ANNUAL RATE 2000-2001

© The State of Queensland (Department of Natural Resources and Mines) 2003.

**Figure 6 : Western SEQld NAP Region woody vegetation change by 30' x 30' grid cell**