Appendix 16: Terrestrial Biodiversity Forecasting Tool methodology

The Biodiversity Forecasting Tool generated priorities by estimating the relative differences in the persistence of biodiversity across the Region as a consequence of changing landuse or management at different locations. For this Plan, information on the pre-1750 and current extent, condition and configuration (connectivity, size and shape) of vegetation was coupled with information on threats and ecological processes (Turbill & Steed 2006). The Biodiversity Forecasting Tool provides maps of priority values indicating the potential contribution of each location to the overall priorities for the Region that would arise from a predefined conservation action. A brief description of the process and the derivation of datasets used by the Tool are provided below. (For more detailed information, refer to DEC 2006). The application of the Tool involved three main interacting components:

1. Predicting the condition of future vegetation as a function of current vegetation condition, spatial distribution and magnitude of threats, and existing or proposed landuse and management (Drielsma & Ferrier 2006).
2. Predicting the likelihood of persistence for each vegetation community as a function of its spatial distribution (Drielsma et al. 2007) and the configuration of future vegetation condition for that community.
3. Aggregating the predicted persistence levels of each vegetation community into an overall estimate of persistence for biodiversity across the Region.

1.1 Data inputs

The Biodiversity Forecasting Tool uses the pre-1750 and current extent, condition and configuration of vegetation communities, together with threat consequence and probability estimates to predict the future condition for each one hectare grid cell of vegetation in the Region. The main data inputs used by the Tool are a map of existing vegetation communities, an estimate of the pre-1750 areal extent of these communities, a map of current vegetation condition, and a map of threats across the Region. These are briefly described here.

A spatial layer of vegetation communities and an estimate of the pre-1750 extent of each community. This spatial layer and estimate information was based on forest ecosystem mapping, modelling and estimations conducted for the Comprehensive Regional Assessment (NPWS 1999a). Subsequent to the Assessment process, the forest ecosystem layer was integrated with aerial photograph coverage to produce a new vegetation map for the Region. This represented a substantial improvement over the original forest ecosystem layer as it standardised nomenclature, incorporated new mapping, and improved the spatial rigour of forest ecosystem distribution (ELA 2005). This vegetation layer was further refined to include the most recent information on the location of timber plantations. Broad vegetation formations are shown in **Figure 10** of the main report.

The ***current vegetation condition map*** was derived using the following:

- For the majority of sclerophyll forests, growth stage mapping conducted during the Comprehensive Regional Assessment (NPWS 1999b) was used as a surrogate for vegetation condition. This was updated with information on the location of recent timber harvesting operations (where available) and plantation establishment. While there is likely to have been changes to the growth stage condition of some areas due to regrowth, logging, burning, clearing and other landuse changes, it is the best available regional assessment of forest condition.
- For non-sclerophyllous rainforest communities, a combination of logging and fire history, tenure, slope and soil fertility were used to estimate current condition.
- For all other areas, a combination of tenure, slope and soil fertility were used to infer condition.

- For all areas, where spatial data were available, the map was revised to reflect vegetation condition due to impacts by Bell Miner associated dieback, grazing and weeds.

For each class of vegetation condition, a relative score was assigned based on the above factors with variations within condition classes occurring due to differences in the degree of disturbance. The maximum and minimum relative condition scores and areal extent for each condition class are provided in **Table 1**. The broad current vegetation condition classes of the Region are shown in **Figure 1** below.

Table 1 Current condition class scores and areal extent

Vegetation condition class	Broad condition class	Min	Max	Area (Ha)
Candidate old growth	Old growth forest	78	95	983 619
Disturbed old growth	Old growth forest	68	85	526 945
Mature forest	Mature forest	58	75	150 674
Disturbed mature forest	Mature forest	47	65	377 585
Young forest	Young forest	37	55	262 572
Recently disturbed	Young forest	28	45	186 500
Rainforest - national park (NP)	National park	73	90	67 626
Rainforest - NP & historic fire	National park	70	89	1 413
Rainforest - NP & old fire	National park	63	84	6 598
Rainforest - NP & recent fire	National park	58	75	16 174
Rainforest - historic logging	Private land vegetated	68	90	67 880
Rainforest - historic logging & fire	Private land vegetated	65	87	2 835
Rainforest - historic logging & old fire	Private land vegetated	58	84	5 610
Rainforest - historic logging & recent fire	Private land vegetated	50	75	13 645
Rainforest - old logging	Private land vegetated	58	80	62 640
Rainforest - old logging & historic fire	Private land vegetated	60	79	3 548
Rainforest - old logging & fire	Private land vegetated	50	74	6 854
Rainforest - old logging & recent fire	Private land vegetated	43	65	10 676
Rainforest - recent logging & historic fire	Private land vegetated	67	69	29
Rainforest - recent logging	Private land vegetated	58	69	4 747
Rainforest - recent logging & old fire	Private land vegetated	45	64	718
Rainforest - recent logging & fire	Private land vegetated	45	55	787
Rainforest - low fertility public	Public land vegetated	48	90	7 434
Rainforest - low fertility private	Private land vegetated	30	90	34 030
Rainforest - mod fertility public	Public land vegetated	38	80	5 203
Rainforest - mod fertility private	Private land vegetated	20	85	40 923
Rainforest - high fertility public	Public land vegetated	30	65	610
Rainforest - high fertility private	Private land vegetated	10	65	5 767
Rainforest - high fertility private & old fire	Private land vegetated	20	35	68
Low fertility private	Private land vegetated	50	90	22 561
Low fertility other public	Public land vegetated	58	90	3 057
Mod fertility private	Private land vegetated	35	85	142 347
Mod fertility other public	Public land vegetated	45	80	10 715
High fertility private	Public land vegetated	25	65	133 662
High fertility other public	Public land vegetated	35	65	14 592
Old logging	Private land vegetated	60	80	4 198
Recent logging	Private land vegetated	59	70	1 707
National parks	National park	75	90	66 671
Hardwood plantations	Plantation	15	30	58 697

Vegetation condition class	Broad condition class	Min	Max	Area (Ha)
Softwood plantations	Plantation	17	20	22 399
Major exotics	Introduced exotics	16	40	13 416
Camphor laurel	Introduced exotics	28	30	2 367
Cleared	Cleared	5	5	1 638 310

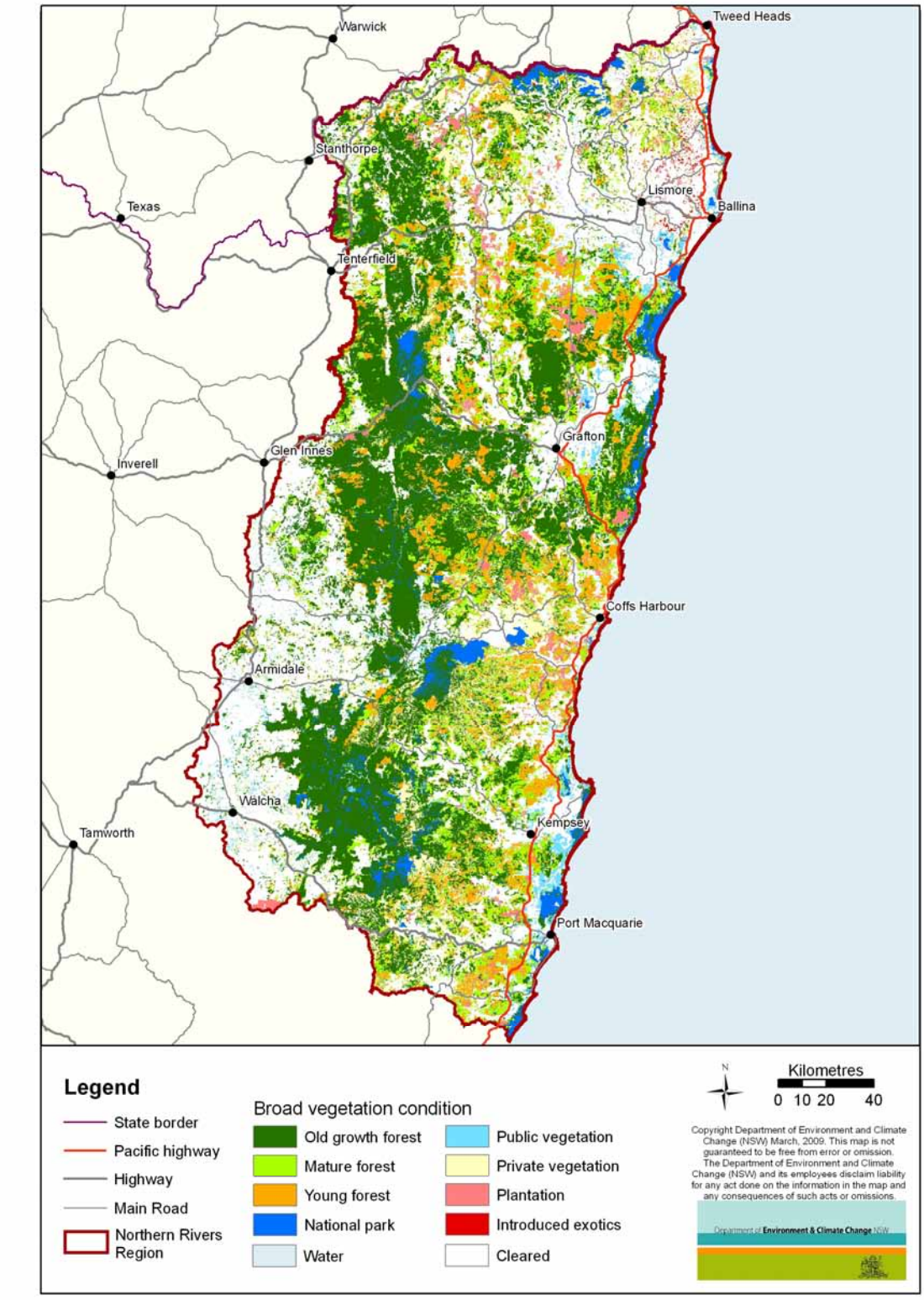

Figure 1 Broad vegetation condition classes

The Tool requires that ***threats to biodiversity*** be represented spatially across the Region. However, the complexity of some threats, such as inappropriate fire frequencies and weeds, meant that not all were able to be mapped. The threats that were able to be mapped for this Region were clearing, grazing, infrastructure and logging. For each of these broad threats, a number of classes were mapped to provide finer detail or definition of each threat type. The datasets used to derive these layers are listed in **Table 2**.

Table 2 Datasets used to derive threat layers

Threat layer	No. of classes (examples)	Datasets used in derivation
Clearing	12 (e.g. urban, rural residential, rural)	Tenure Local environment plan zones Agricultural land capability
Grazing	9 (e.g. very high, medium, very low threat)	Tenure Slope and fertility (e.g. flatter more fertile areas more likely to be grazed)
Infrastructure	26 (e.g. powerlines, highway)	Tenure Wilderness – declared or identified Proximity to urban areas, roads, railways, powerlines, recreation and community facilities
Logging	20 (e.g. private/public forest, native forest, timber plantation)	Exclusion zones in Forests NSW's Integrated Forestry Operations Approval Exclusion zones in the Private Native Forestry Code of Practice Slope Commercial forest types Plantations

For each threat class, the relative impact on biodiversity and the length of time before that impact would be fully realised were estimated. This provided an estimate of the ***consequence*** of the threat and the ***probability*** of its occurrence on an annual basis. These inputs provided the necessary requirements for modelling changes in vegetation condition based on the interactions between regeneration and mapped threats (Drielsma & Ferrier 2006). The consequence and probability rankings for the classes in each of the four threat layers are provided in **Tables 3 to 6**. The broad threat classes for the threat layers used in the Biodiversity Forecasting Tool threats are shown in **Figures 2 to 5**.

Table 3 Broad threat classes for clearing threat

Threat class	Broad threat class	Consequence	Probability	Area (ha)
Urban/development	Urban development	Severe	Very High	11 304
Urban investigation	Urban development	Severe	High	1 770
Rural residential	Urban development	Severe	High	12 203
Rural high productivity	Rural high productivity	Severe	High	70 303
Rural mod productivity	Rural mod productivity	Severe	Very Low	861 738
Rural low productivity	Rural low productivity	Severe	Moderate	396 789
Open space	Open space	Severe	Moderate	1 955
Environment protection	Environment protection	Severe	Very Low	84 560
Crown lands	Crown lands	Severe	Minimal	191 658
State forests	State forests	Severe	Minimal	614 282
Proposed national parks	National parks	Severe	Very Low	1 395
National parks	National parks	Severe	Minimal	1 102 142
Cleared	Cleared	Severe	Very High	1 638 310

Table 4 Broad threat classes for grazing threat

Threat class	Broad threat class	Consequence	Probability	Area (ha)
Very high grazing threat	Very high grazing threat	Moderate	High	91 935
High grazing threat	High grazing threat	Moderate	High	313 945
Mod-high grazing threat	Mod-high grazing threat	Moderate	Mod - high	293 371
Moderate grazing threat	Moderate grazing threat	Moderate	Moderate	326 733
Mod-low grazing threat	Mod-low grazing threat	Moderate	Very Low	346 872
Low grazing threat	Low grazing threat	Moderate	Very Low	366 207
Very low grazing threat	Very low grazing threat	Moderate	Minimal	180 534
State forests no grazing	State forests no grazing	Moderate	Minimal	336 787
National parks	National parks	Moderate	Minimal	1 093 715
Cleared	Cleared	Severe	Very High	1 638 310

Table 5 Broad threat classes for infrastructure threat

Threat class	Broad threat class	Consequence	Probability	Area (Ha)
Urban	Urban	Moderate	High	25 208
Urban	Urban	Moderate	High	2 995
Urban	Urban	Moderate	High	19 860
Powerline	Powerline	Low	High	93 683
Railway	Railway	Low	High	2 592
Highway	Highway	Low	High	30 247
Road	Road	Low	High	114 876
Vehicle track	Road	Very Low	High	259 766
Building	Facility	Low	High	1 450
Camping area	Facility	Low	High	2 095
Day use area	Facility	Low	High	294
Helibase	Facility	Low	High	944
Lookout	Facility	Low	High	143
Tower	Facility	Low	High	1 937
Camping area informal	Facility	Very Low	High	6
Hang glider launch	Facility	Very Low	High	31
Walking track	Facility	Very Low	High	1 384
Private property	Private property	Minimal	Moderate	1 115 588
Private conservation	Private property	Minimal	Minimal	17 553
Commonwealth lands	Crown lands	Minimal	Moderate	1 556
Crown lands	Crown lands	Minimal	Moderate	107 337
State forests	State forests	Minimal	Minimal	412 833
National parks	National parks	Minimal	Minimal	304 425
Declared wilderness	Wilderness	Minimal	Minimal	478 968
Identified wilderness	Wilderness	Minimal	Minimal	247 470
Nominated wilderness	Wilderness	Minimal	Minimal	106 858
Cleared	Cleared	Severe	Very High	1 638 310

Table 6 Broad threat classes for logging threat

Threat class	Broad threat class	Consequence	Probability	Area (Ha)
Private softwood plantation	Softwood plantation	Very high	Mod - high	7 723
Public softwood plantation	Softwood plantation	Very high	Mod - high	15 766
Private hardwood plantation	Hardwood plantation	Very high	Mod - high	15 164
Public hardwood plantation	Hardwood plantation	Very high	Mod - high	32 530
Private commercial forest	Private commercial forest	Moderate	Moderate	831 551
Private commercial forest - mod steep	Private commercial forest	Moderate	Moderate	89 823
Private commercial forest - steep	Private commercial forest	Moderate	Low	49 007
Public commercial forest	Public commercial forest	Moderate	Moderate	259 334
Public commercial forest - mod steep	Public commercial forest	Moderate	Moderate	31 570
Public commercial forest - steep	Public commercial forest	Moderate	Low	6 885
Private non-commercial forest	Private non-commercial	Moderate	Moderate	125 604
Private non-commercial forest - mod steep	Private non-commercial	Moderate	Low	16 704
Private non-commercial forest - steep	Private non-commercial	Moderate	Low	3 368
Public non-commercial forest	Public non-commercial	Moderate	Moderate	3 424
Public non-commercial forest - mod steep	Public non-commercial	Moderate	Low	125
Public non-commercial forest - steep	Public non-commercial	Moderate	Low	268
Public exclusion zone	Public exclusion zone	Moderate	Minimal	254 265
Private exclusion zone	Private exclusion zone	Moderate	Very Low	513 280
National parks	National parks	Moderate	Minimal	1 093 715
Cleared	Cleared	Severe	Very High	1 638 310

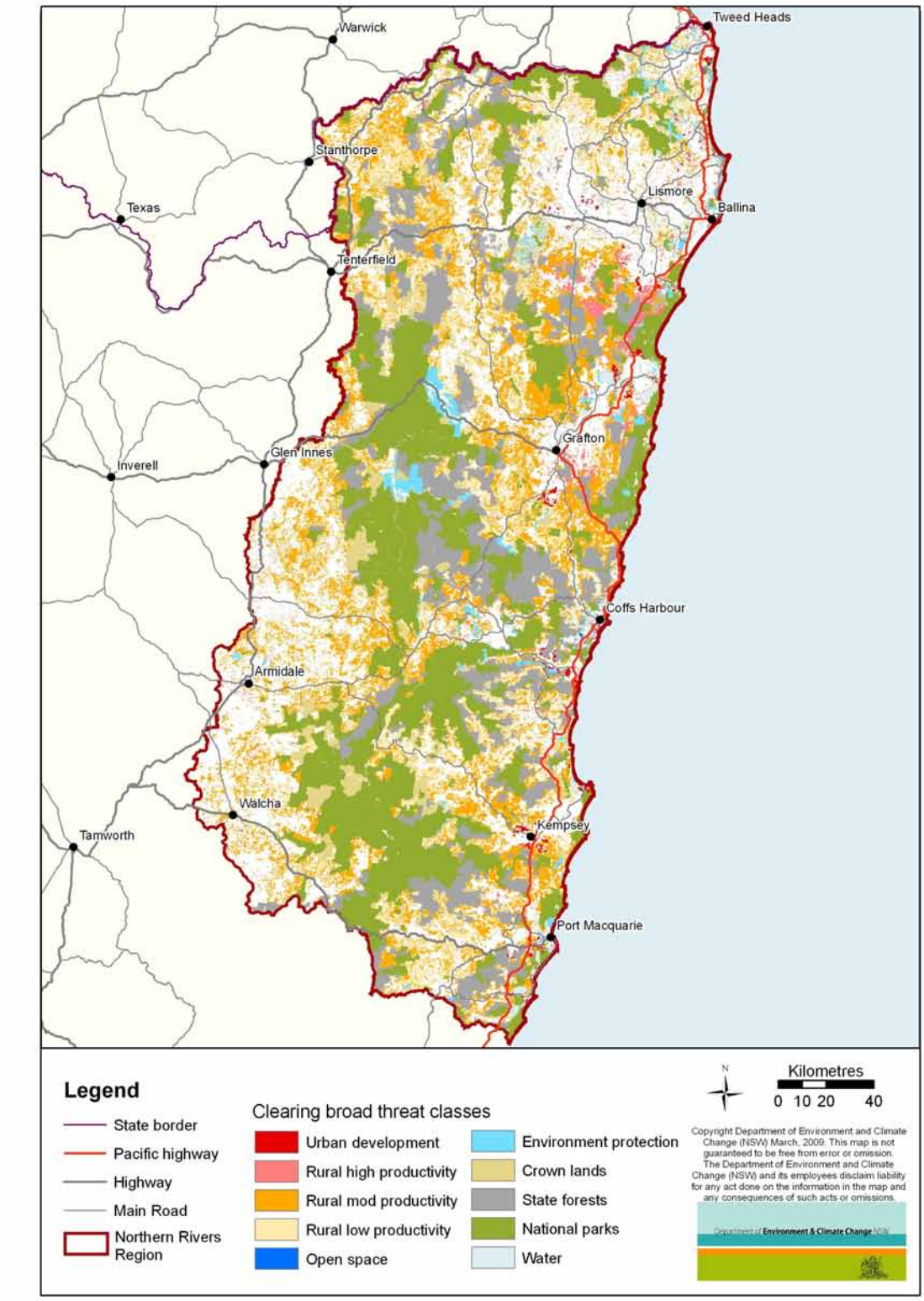

Figure 2 Broad clearing threat classes

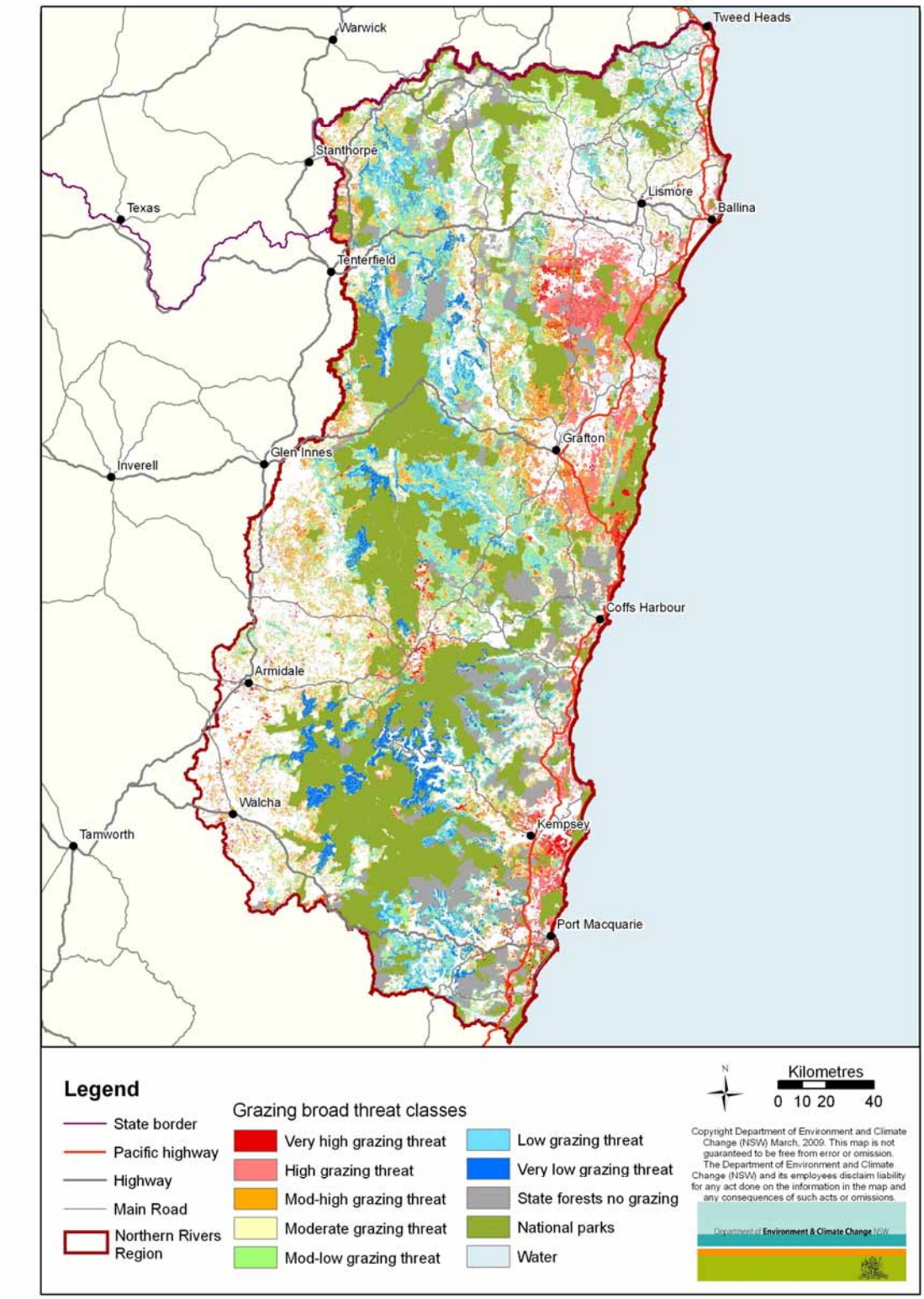

Figure 3 Broad grazing threat classes

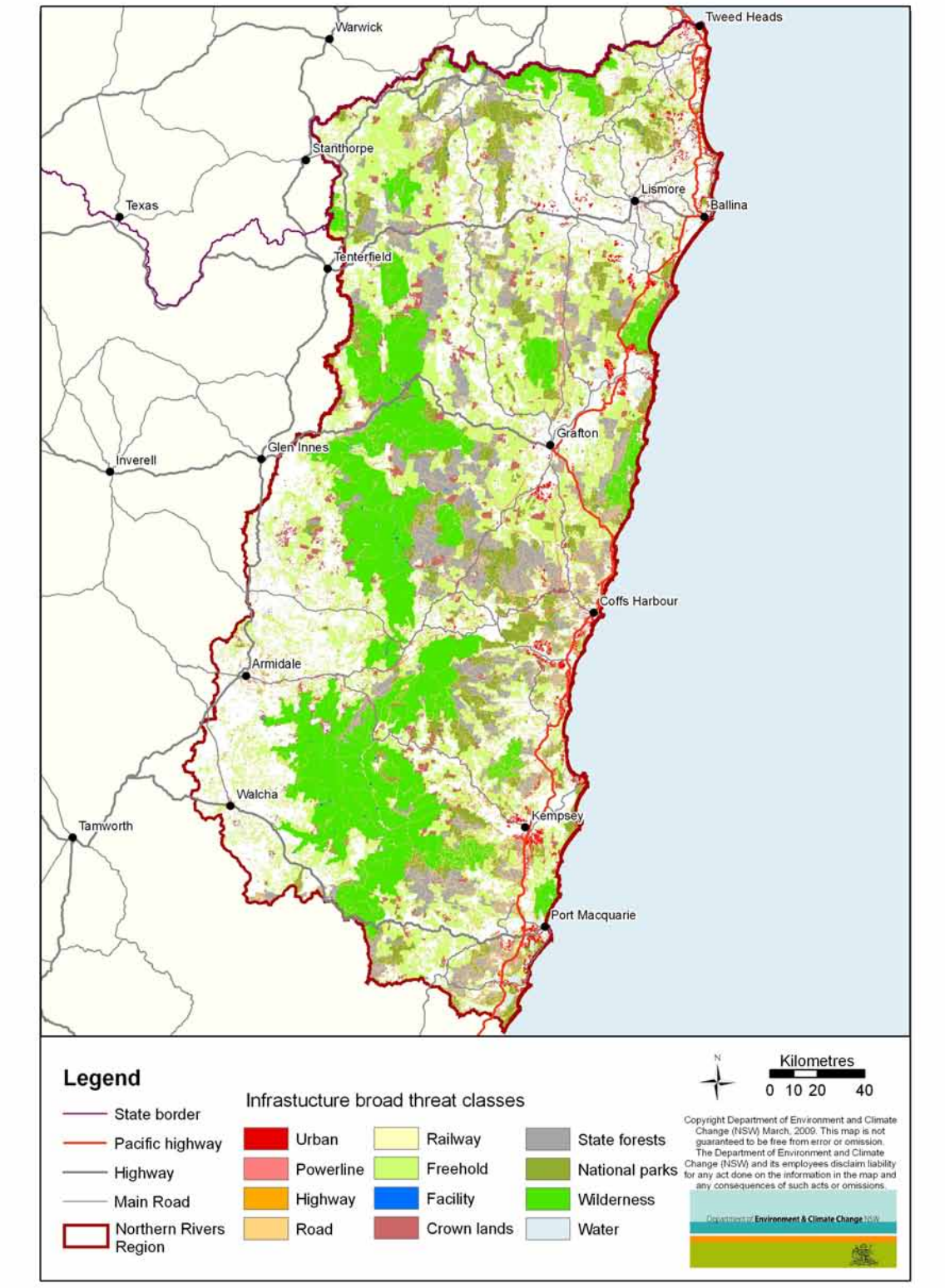

Figure 4 Broad infrastructure classes

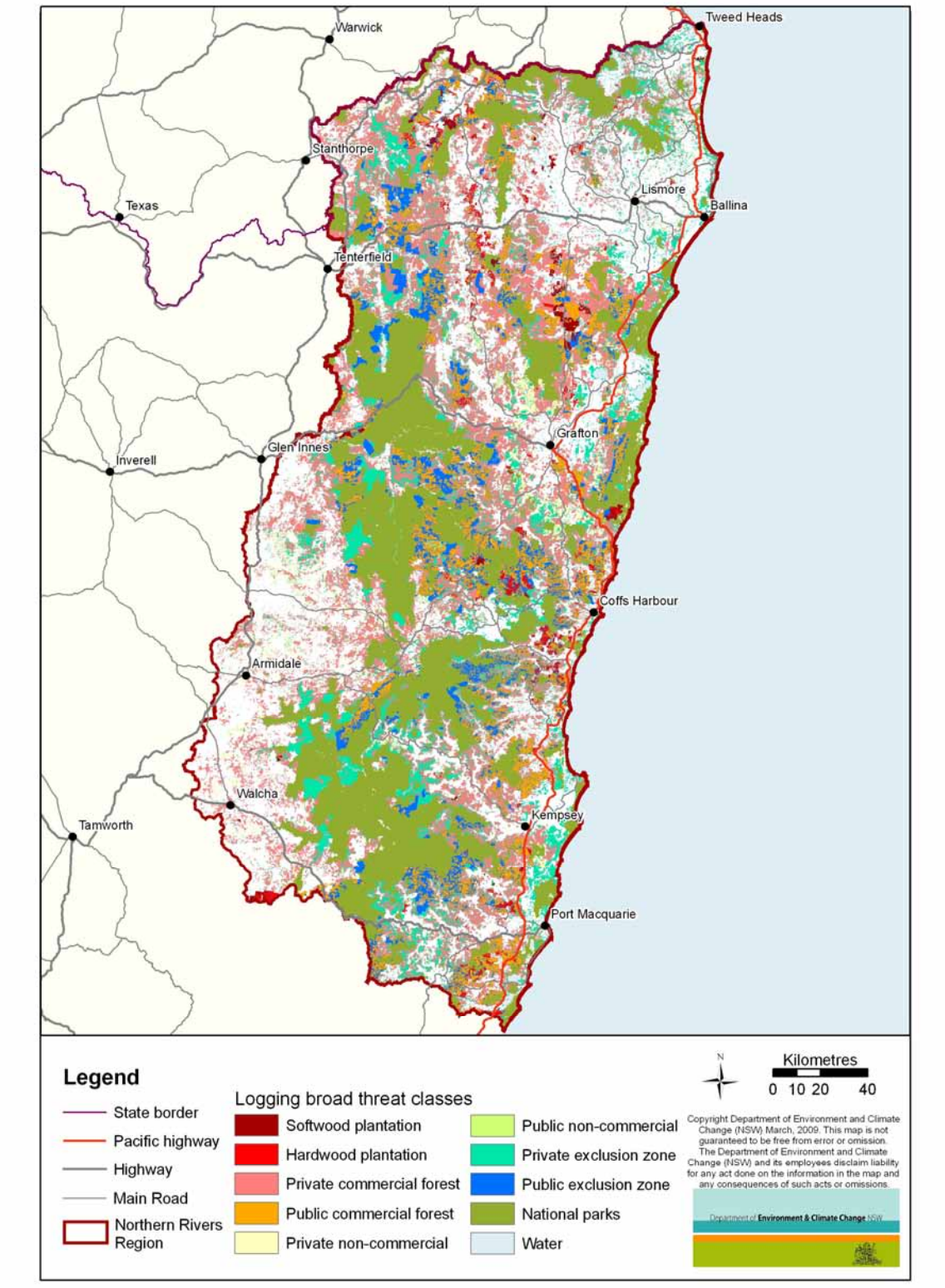

Figure 5 Broad logging threat classes

1.2 Data outputs

The primary outputs of the Tool are spatial layers which were used to map 'Conserve' and 'Repair' areas. **Figure 6** provides a diagrammatic explanation of the 'Conserve' and 'Repair' outputs for one demonstration grid cell under a specific example scenario. It is not the actual function that applies to each grid cell.

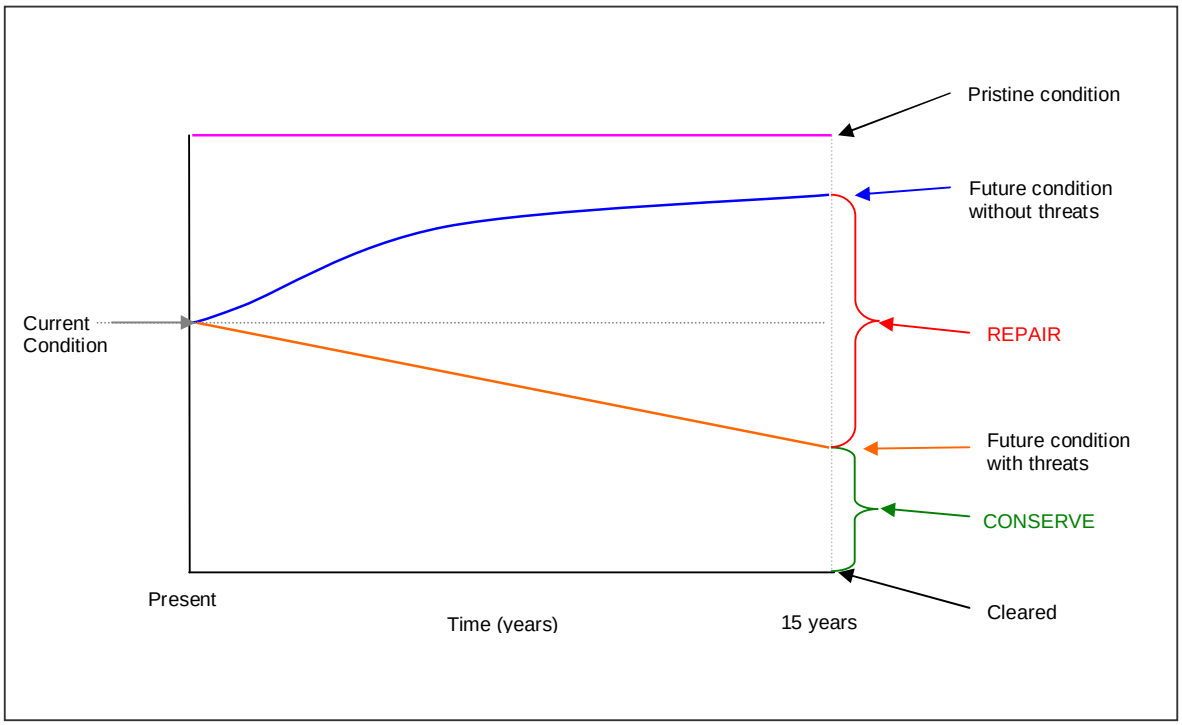

Figure 6 Diagrammatic representation of BFT 'Conserve' and 'Repair' outputs

Note the shape of the line shown in **Figure 6** varies for every grid cell, depending upon the current condition and the expected threats. The aggregation of these Conserve and Repair measures across the Region form the basis (once the consequences to spatial configuration and representation of vegetation communities is calculated) for estimating the priorities for conserving and repairing vegetation. **Figure 6** demonstrates how the Tool calculates the future condition for each grid cell of vegetation over a 15-year time frame for two management strategies:

1. Conservation: where no threats operate at that grid cell (the blue line).
2. Regeneration: where the predicted threats are operating at the expected probability and consequence (orange line).

The 'Conserve' value is the difference between a grid cell's predicted future condition if threats are not controlled, and future condition of that grid cell if it was cleared (i.e. at the minimum condition). So grid cells with a higher Conserve value are those where you would lose more biodiversity if that area was cleared, even after all threats had been operating in that area for 15 years. Even after threats had been operating, the condition of that grid cell is relatively higher than others—thus it is more important to biodiversity. That is because in these areas, the predicted future condition of these areas is greater than the predicted future condition in other, lower value Conserve areas.

Those grid cells with higher 'Conserve' values are those that, if they were cleared, would have the greatest adverse impact on the Region's biodiversity. They generally represent areas of high conservation value vegetation in relatively good condition. The conservation of biodiversity in these areas is important for the overall biodiversity of the Region. In particular, future threats which may not have been predicted (or included) in the Biodiversity Forecasting Tool should be circumvented

through incentives and investment to ensure their long-term value to biodiversity persistence in the Region.

The Repair value is the difference between a grid cell's predicted future condition where the threats have operated, and the grid cell's future condition where these threats have not operated. Those grid cells with higher 'Repair' values are those with greater predicted threats. They generally represent poorly conserved or over-cleared vegetation communities in lower condition. If the threats predicted to occur in the higher value 'Repair' cells were circumvented, this would prevent the greatest loss of biodiversity in the Region. Preventing the future degradation of these areas from predicted threats and restoring or improving their condition will make a significant contribution to the overall biodiversity of the Region.

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