Chapter 8

Agricultural and Environmental Priority Scenario

Sugar Cane near Ballina

"It is not the strongest of the species that survives, nor the most intelligent, but the one most responsive to change."

Charles Darwin

CHAPTER 8 AGRICULTURAL AND ENVIRONMENTAL PRIORITY SCENARIO

To balance future urban development with the protection of the regions natural environment and agricultural productivity the Agricultural and Environmental Priority scenario combined the constraints of the previous three scenarios. As in the Agricultural Priority Scenario (Chapter 7), the growth of orchards was projected and given priority whilst the imposed constraints to development included;

- Land recognised as being of high agricultural value (Chapter 7);
- The current national parks estate inc. world heritage areas (Chapter 6);
- Riparian vegetation (Chapter 6);
- Recognised key habitats and corridors (Chapter 6);
- RAMSAR and other important wetlands (Chapter 6);
- Land used by major roads (Chapter 5); and
- Areas that have a slope greater than 25% (Chapter 5)

8.1 BUILDABLE AREA

The combination of these constraints reduced the buildable area to 797,806 hectares (Figure 8.1), about half of the 1,628,330 hectares available using the minimal constraints scenarios. The impact of applying

these constraints on future development within the region is visually apparent when compared to the minimal constraints buildable area from Chapter 5 (reproduced as Figure 8.2 for comparison).

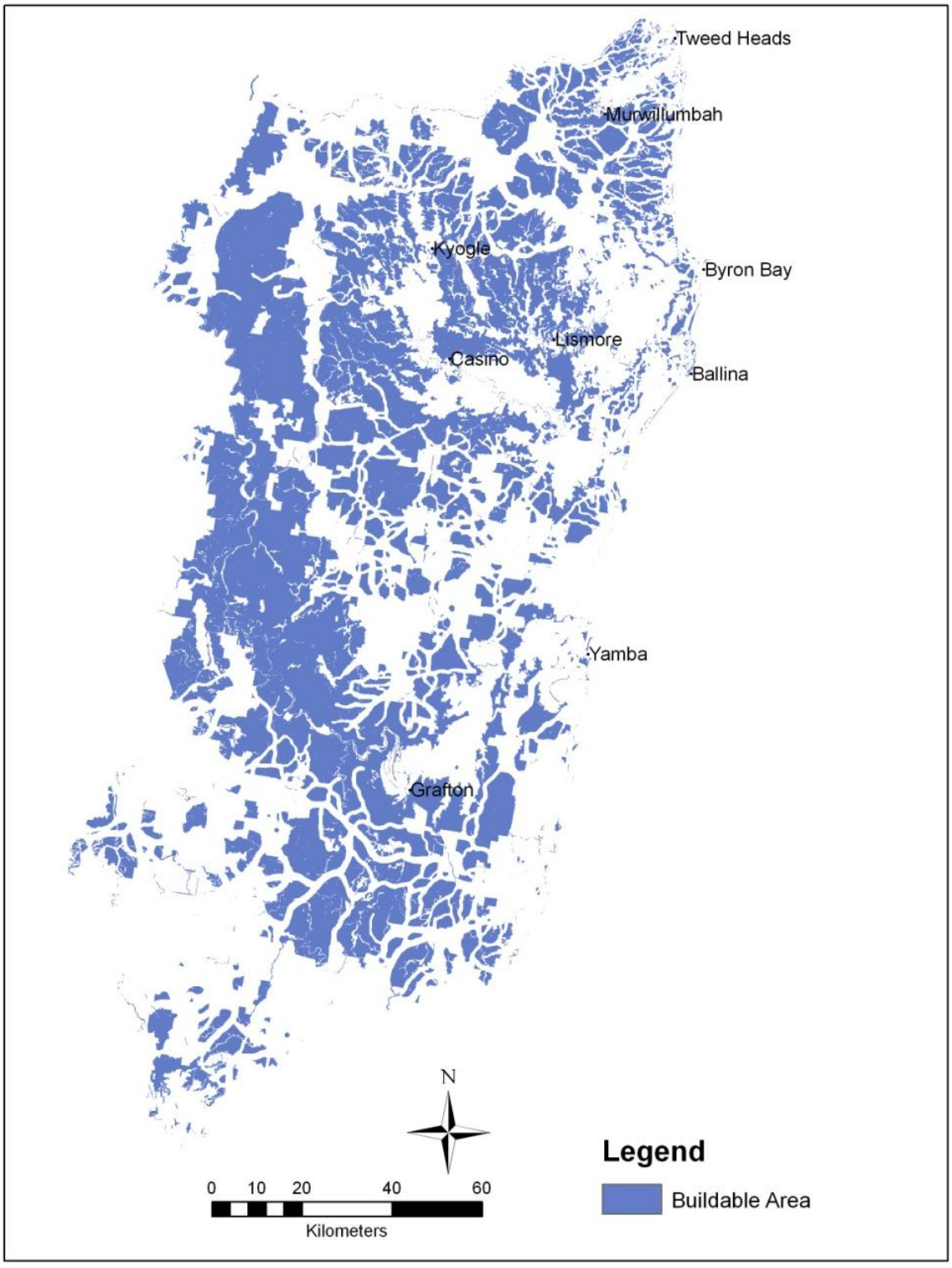

FIGURE 8.1: BUILDABLE AREA FOR AGRICULTURAL AND ENVIRONMENTAL PRIORITY SCENARIOS

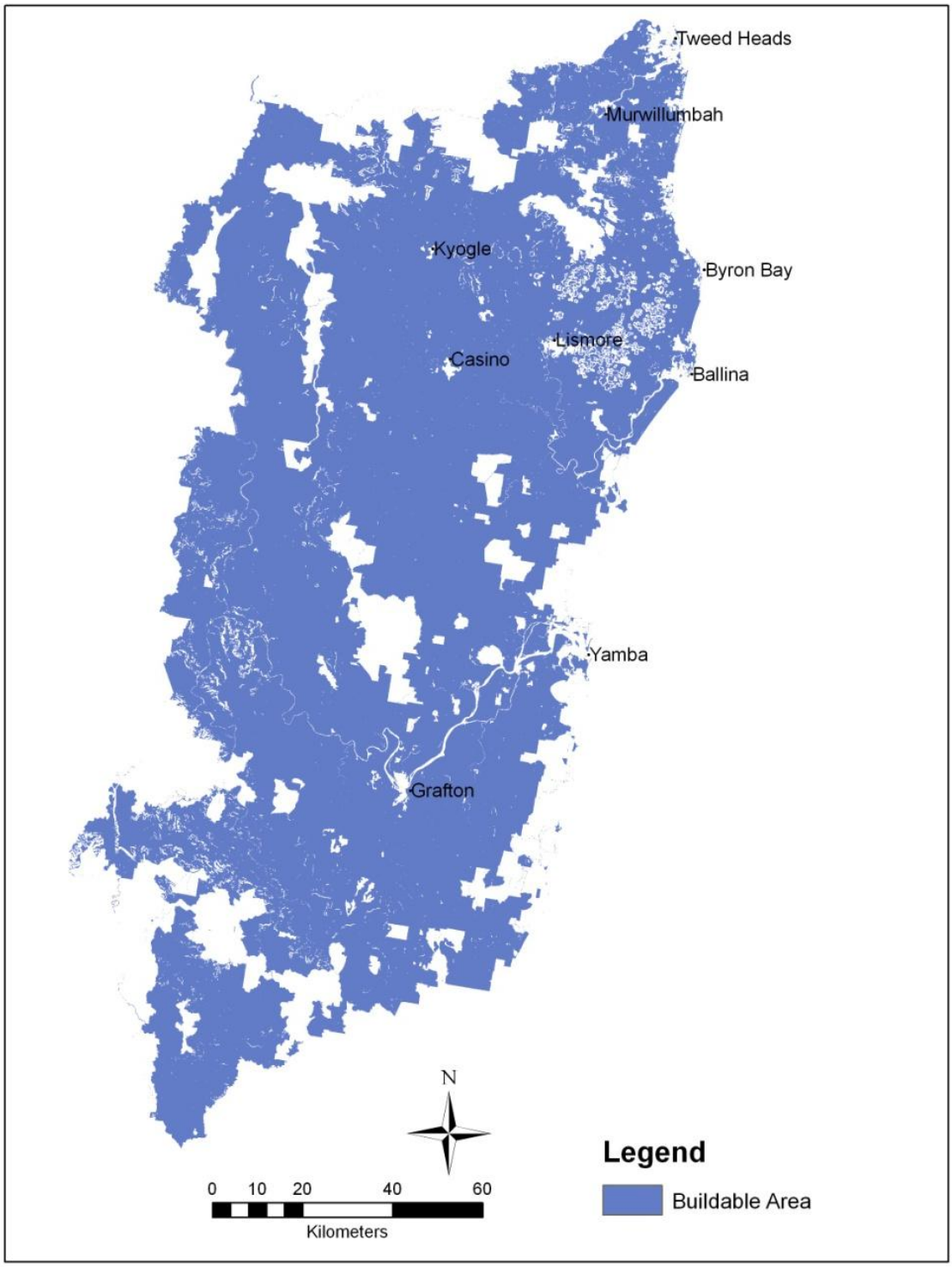

FIGURE 8.2: MINIMAL CONSTRAINTS BUILDABLE AREA

8.2 POPULATION

The considerable reduction of buildable area combined with an increasing urban area per person significantly reduced the capacity for population growth in the north eastern zone (zone 4). The potential area for new urban development in this area was reduced by these constraints to 422269 hectares which equated to 676296 25m x 25m cells.

At the time of the study, zone 4 had a population of approximately 144837 people who each utilised 1.03 urban cells (149438 cells in total). Density trend calculations in Chapter 4 demonstrated that between 2001 and 2031 a decrease in population density occurs for this zone reducing from 1.03 cells to 1.79 cells per person. Hence the 2004 population alone encompassed 258452 urban cells. This left 417844 cells of buildable area for future population growth and at a density of 1.79 cells per person the zone had a capacity to accommodate 461304 people. As a large proportion of the population growth in the past (1985-2004) and used as trend in future scenarios was in this area, the allocation of either 727656 or 955497 people to the entire region exceeded the maximum settlement population for this zone.

8.2.1 CONTROLLED POPULATION DENSITY

To overcome this problem, two solutions were designed. The first was a controlled population density scenario whereby in a regional population of 955497 the number of people projected in zone 4 was divided by the number of available cells. This accommodates the future population growth at the cost of a higher projected population density. The result of this calculation was a change from a projected 1.79 cells per person to 1.14 cells per person.

For consistency this population density was then used for all four population levels and the new allocation of cells for future population growth of urban areas is shown in Table 8.1.

TABLE 8.1: AGRICULTURE AND ENVIRONMENT PRIORITY CONTROLLED DENSITY POPULATION PROJECTIONS

Zone	Current (2004)			Population 403839			
	Number of Urban Cells	Number of People	Number of Cells / Person	Estimated Population	Estimated Cells / Person	Estimated Cells Required	Number of Cells to be added
1	3818	5705	0.67	6186	1.36	8387	4569
2	20783	19677	1.06	23348	1.63	37973	17190
3	36325	25742	1.41	31400	2.40	75391	39066
4	149438	144387	1.03	246550	1.14	281067	131629
5	45071	46833	0.96	60729	1.75	106533	61462
6	35765	22114	1.62	35626	2.70	96282	60517
Sum		264458		403839		765215	314433
Zone	Current (2004)			Population 558911			
	Number of Urban Cells	Number of People	Number of Cells / Person	Estimated Population	Estimated Cells / Person	Estimated Cells Required	Number of Cells to be added
1	3818	5705	0.67	6199	1.36	8404	4586
2	20783	19677	1.06	23945	1.63	38945	18162
3	36325	25742	1.41	32612	2.40	78303	41978
4	149438	144387	1.03	382186	1.14	435692	286254
5	45071	46833	0.96	65065	1.75	114139	69068
6	35765	22114	1.62	48902	2.70	132164	96399
Sum		264458		558911		1055021	516447
Zone	Current (2004)			Population 727657			
	Number of Urban Cells	Number of People	Number of Cells / Person	Estimated Population	Estimated Cells / Person	Estimated Cells Required	Number of Cells to be added
1	3818	5705	0.67	6288	1.36	8524	4706
2	20783	19677	1.06	25316	1.63	41174	20391
3	36325	25742	1.41	35074	2.40	84214	47889
4	149438	144387	1.03	525599	1.14	599183	449745
5	45071	46833	0.96	72028	1.75	126354	81283
6	35765	22114	1.62	63351	2.70	171214	135449
Sum		264458		727657		1030663	739463
Zone	Current (2004)			Population 955497			
	Number of Urban Cells	Number of People	Number of Cells / Person	Estimated Population	Estimated Cells / Person	Estimated Cells Required	Number of Cells to be added
1	3818	5705	0.67	6378	1.36	8646	4828
2	20783	19677	1.06	26765	1.63	43531	22748
3	36325	25742	1.41	37722	2.40	90571	54246
4	149438	144387	1.03	722826	1.14	824022	676296
5	45071	46833	0.96	79736	1.75	139876	94805
6	35765	22114	1.62	82069	2.70	221801	186036
Sum		264458		955497		1328448	1037248

8.2.2 URBAN SHIFT

The second method used to overcome the limitation of buildable area in zone 4 was a reallocation of excess population to other zones. In this scenario design the projected population density of 1.79 for zone 4 was retained, however any population over the maximum of 461304 people was divided evenly between zones 5 (further inland) and zone 6 (coastal south). This additional population added to each zone was allocated at the recipient zones urban density.

Allocation of population and cells is shown in Table 8.2. As the zone 4 maximum was not reached until the regional population of 727657 scenario, the projected urban area for the population levels of 403839 and 558911 is the same as presented in previous chapters for these levels. At a total population of 727657, 64295 people are evenly distributed to zones 5 and 6 while at population 955497, 261523 people have settlement patterns reallocated to zones 5 and 6.

TABLE 8.2: AGRICULTURE AND ENVIRONMENT PRIORITY URBAN SHIFT POPULATION PROJECTIONS

Zone	Current (2004)			Population 403839			
	Number of Urban Cells	Number of People	Number of Cells / Person	Estimated Population	Estimated Cells / Person	Estimated Cells Required	Number of Cells to be added
1	3818	5705	0.67	6186	1.36	8387	4569
2	20783	19677	1.06	23348	1.63	37973	17190
3	36325	25742	1.41	31400	2.40	75391	39066
4	149438	144387	1.03	246550	1.79	440649	291211
5	45071	46833	0.96	60729	1.75	106533	61462
6	35765	22114	1.62	35626	2.70	96282	60517
Sum		264458		403839		765215	474015
Zone	Current (2004)			Population 558911			
	Number of Urban Cells	Number of People	Number of Cells / Person	Estimated Population	Estimated Cells / Person	Estimated Cells Required	Number of Cells to be added
1	3818	5705	0.67	6186	1.36	8387	4569
2	20783	19677	1.06	23348	1.63	37973	17190
3	36325	25742	1.41	31400	2.40	75391	39066
4	149438	144387	1.03	246550	1.79	440649	291211
5	45071	46833	0.96	60729	1.75	106533	61462
6	35765	22114	1.62	35626	2.70	96282	60517
Sum		264458		403839		765215	474015
Zone	Current (2004)			Population 727657			
	Number of Urban Cells	Number of People	Number of Cells / Person	Estimated Population	Estimated Cells / Person	Estimated Cells Required	Number of Cells to be added
1	3818	5705	0.67	6288	1.36	8524	4706
2	20783	19677	1.06	25316	1.63	41174	20391
3	36325	25742	1.41	35074	2.40	84214	47889
4	149438	144387	1.03	461304	1.79	825734	676296
5	45071	46833	0.96	104175	1.75	182749	137678
6	35765	22114	1.62	95499	2.70	258096	222331
Sum		264458		727657		1400491	1109291
Zone	Current (2004)			Population 955497			
	Number of Urban Cells	Number of People	Number of Cells / Person	Estimated Population	Estimated Cells / Person	Estimated Cells Required	Number of Cells to be added
1	3818	5705	0.67	6378	1.36	8646	4828
2	20783	19677	1.06	26765	1.63	43531	22748
3	36325	25742	1.41	37722	2.40	90571	54246
4	149438	144387	1.03	461304	1.79	825734	676296
5	45071	46833	0.96	210497	1.75	369263	324192
6	35765	22114	1.62	212831	2.70	575198	539433
Sum		264458		955497		1912944	1621744

Under these constraints, all available space for potential new urban development within zone 4 is converted to urban area for both variations of placement. For the 955497 population level 676296 cells are reallocated as opposed to 1142440 cells for the same population in the minimal constraints scenarios.

8.3 CONTROLLED DENSITY RESULTS

As in previous scenarios the new projected urban areas for each population level were merged into the 2004 LULC and are shown with extracts for the Far North Coast in Figures 8.3 to 8.10

Conversion to urban development within the inland areas was similar to previous scenarios with limited additional growth around the major population centres. In the southern parts of the region, new urban development occurred predominately along the Pacific Highway in a manner and extent similar to the environmental priority scenarios.

In the north east, the effect of increased population density and subsequent reduction in the number of cells converted to urban area is visually apparent (Figure 8.10). As in the environmental priority scenario (Chapter 6) the spatial growth of the major coastal population centres was reduced and environmental constraints limited new development along the coastline. This protected the coastal complex vegetation class and pushed development off the coastline by approximately 1-2

kilometres. The combined constraints reduced the impact on sugar cane fields and provided protection for agricultural priority areas. With the growth of orchards there was a reduction in the conversion of pasture and cropland in the area between Lismore, Ballina and Byron Bay.

The impact of these changes are shown in Table 8.3

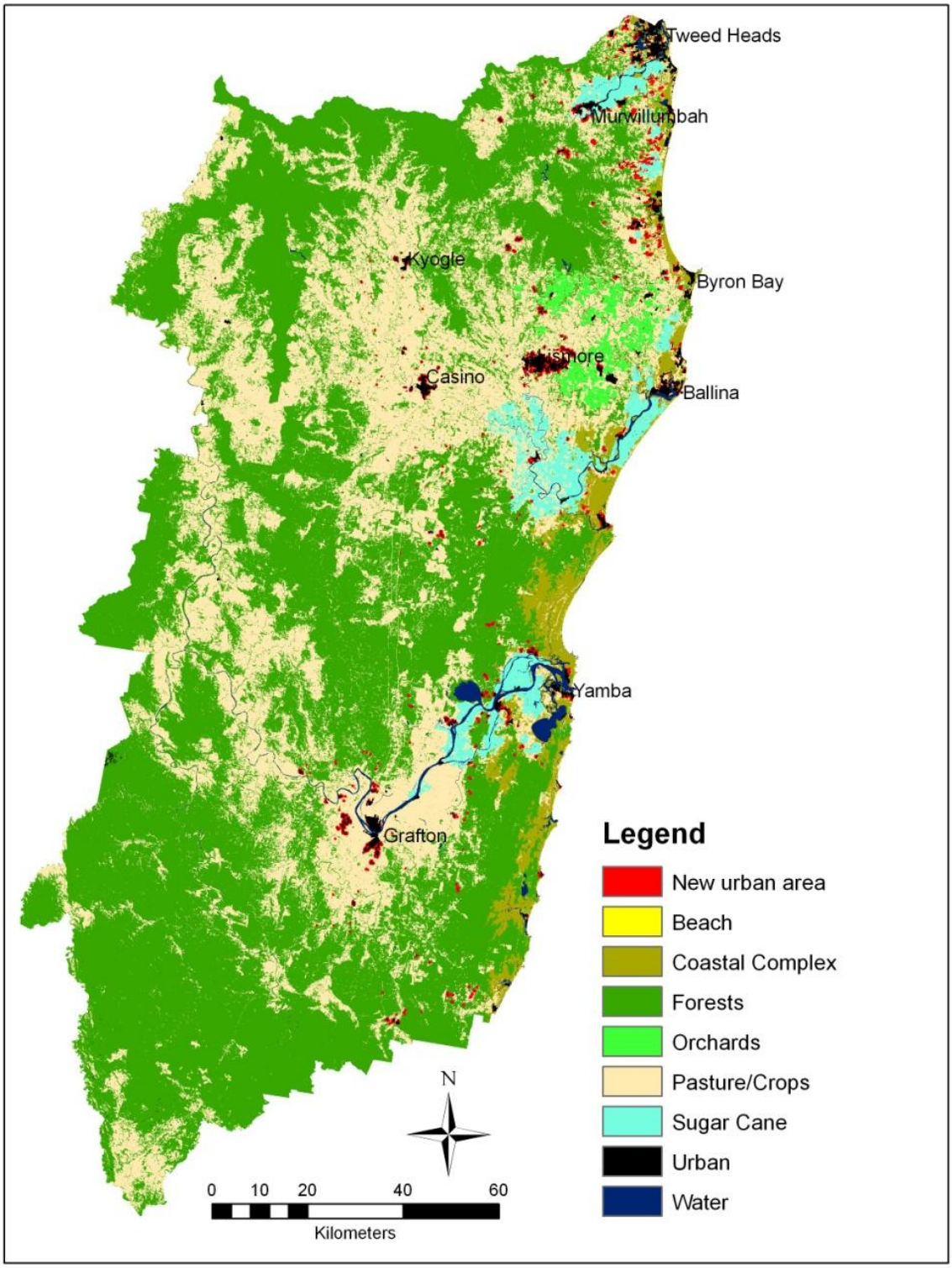

FIGURE 8.3: AGRICULTURE AND ENVIRONMENT PRIORITY CONTROLLED DENSITY LAND USE POPULATION 403839

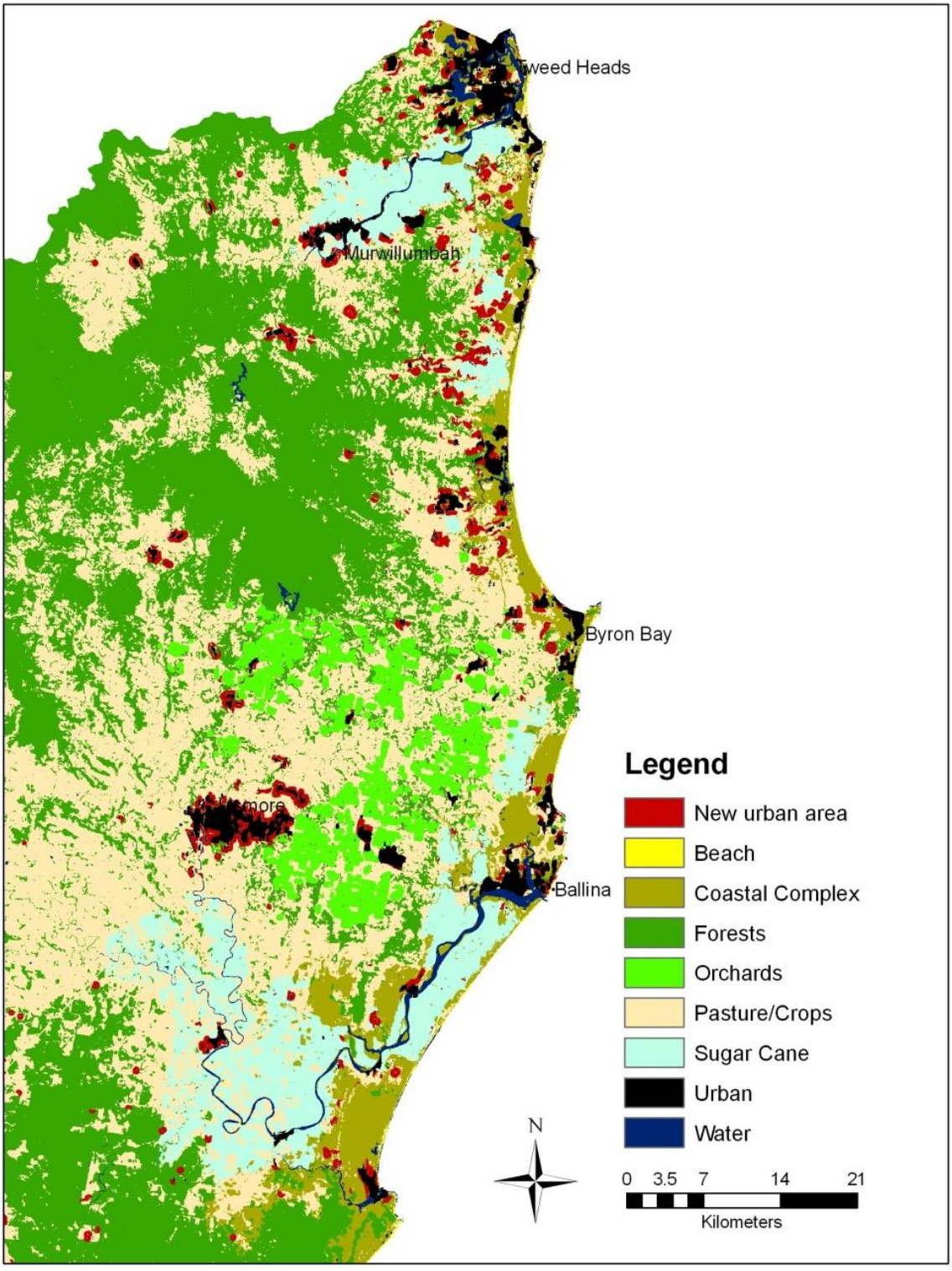

FIGURE 8.4: AGRICULTURE AND ENVIRONMENT PRIORITY CONTROLLED DENSITY LAND USE POPULATION 403839, FAR NORTH COAST PORTION

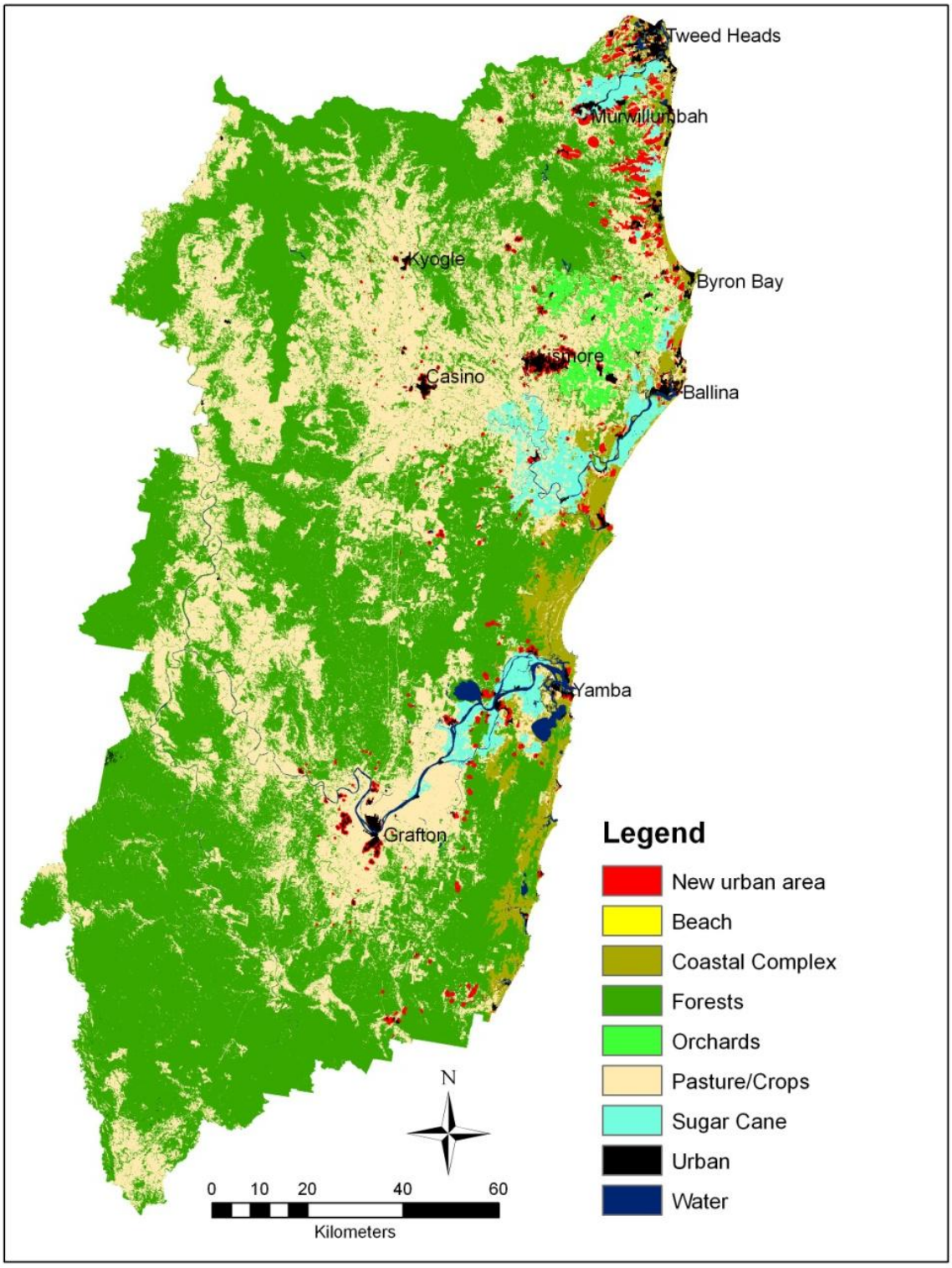

FIGURE 8.5: AGRICULTURE AND ENVIRONMENT PRIORITY CONTROLLED DENSITY LAND USE FIGURE POPULATION 558911

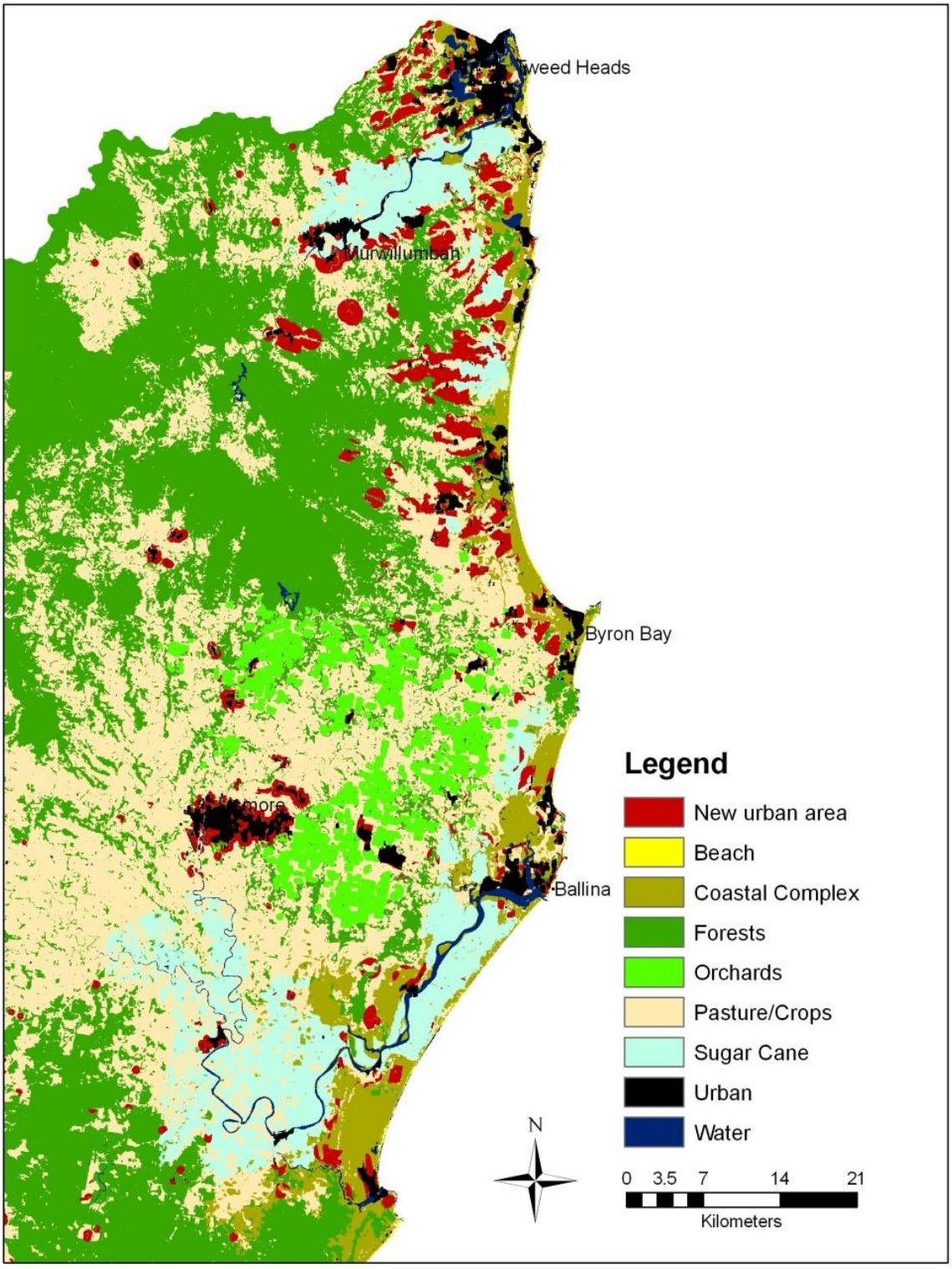

FIGURE 8.6: AGRICULTURE AND ENVIRONMENT PRIORITY CONTROLLED DENSITY LAND USE FIGURE POPULATION 55891, FAR NORTH COAST PORTION

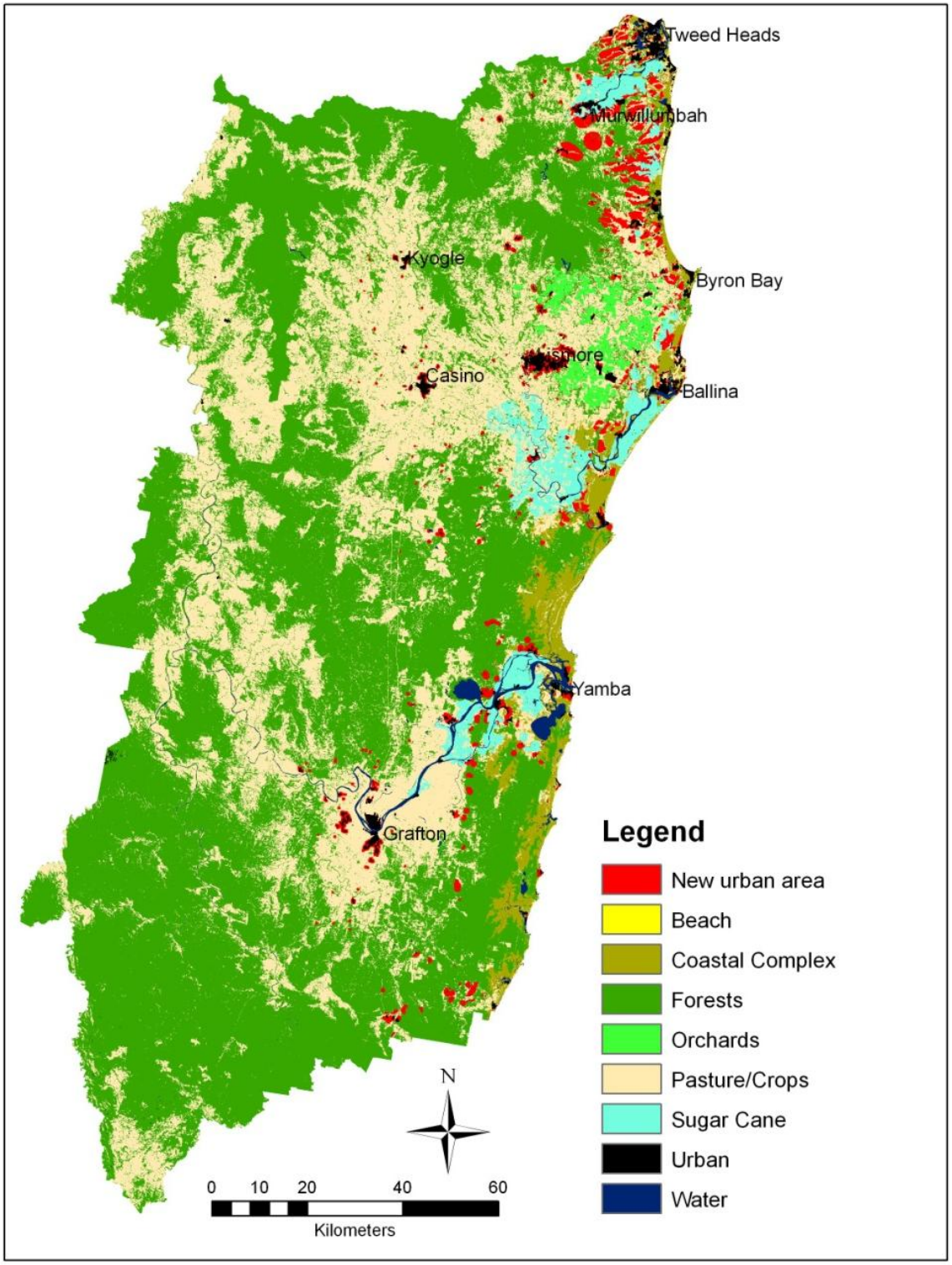

FIGURE 8.7: AGRICULTURE AND ENVIRONMENT PRIORITY CONTROLLED DENSITY LAND USE FIGURE POPULATION 727657

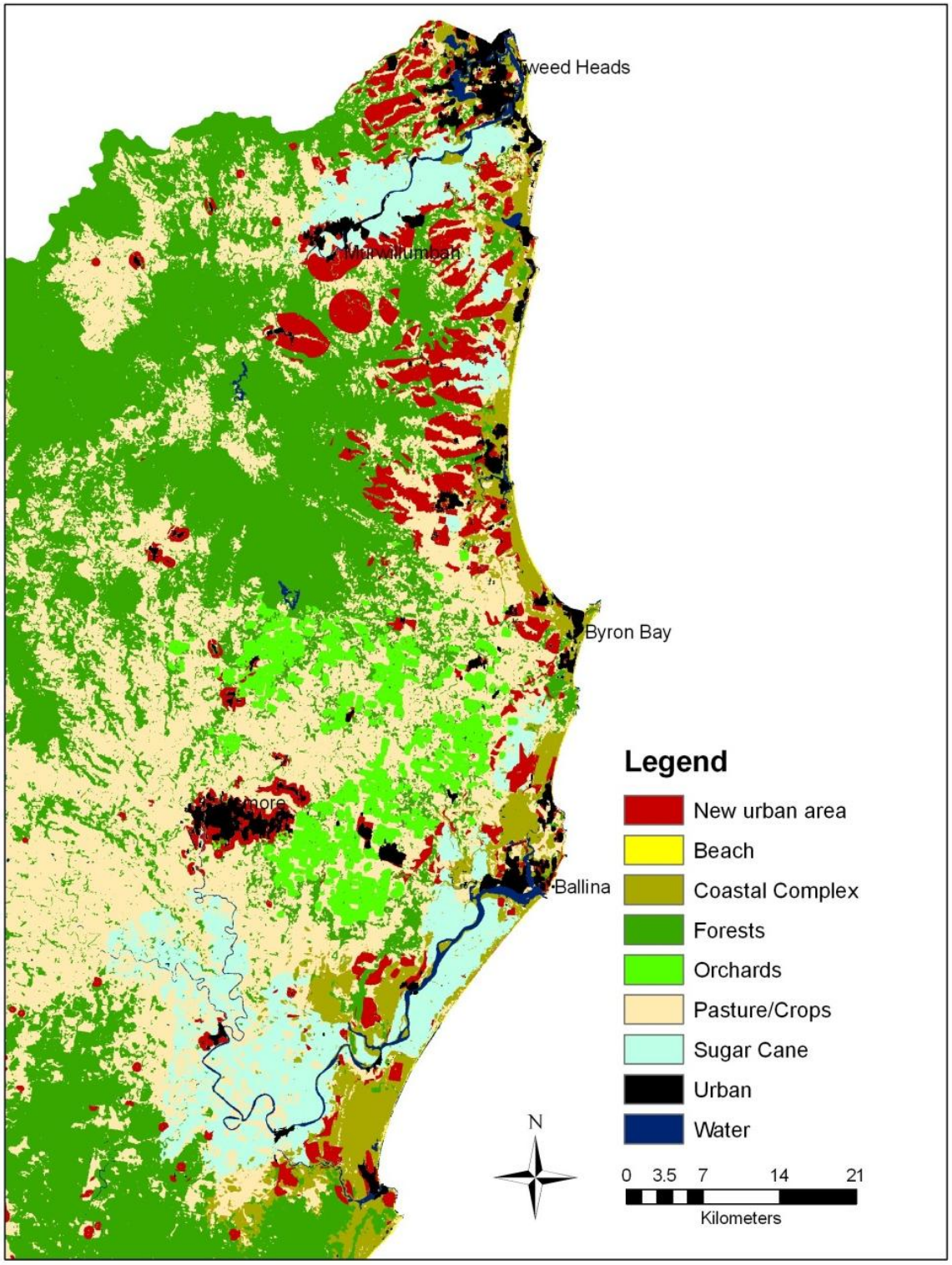

FIGURE 8.8 AGRICULTURE AND ENVIRONMENT PRIORITY CONTROLLED DENSITY LAND USE FIGURE POPULATION 727657, FAR NORTH COAST PORTION

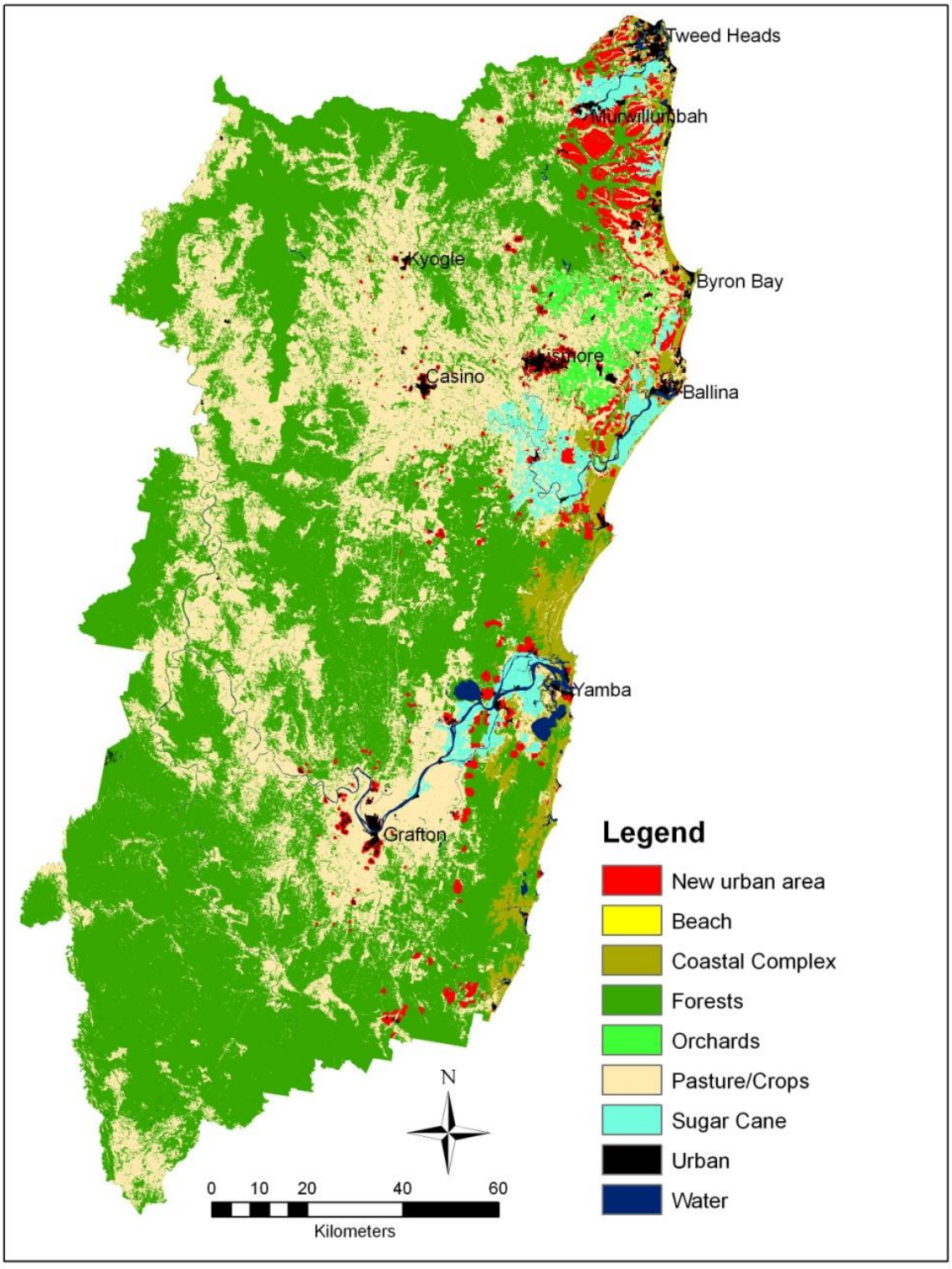

FIGURE 8.9: AGRICULTURE AND ENVIRONMENT PRIORITY CONTROLLED DENSITY LAND USE FIGURE POPULATION 955497

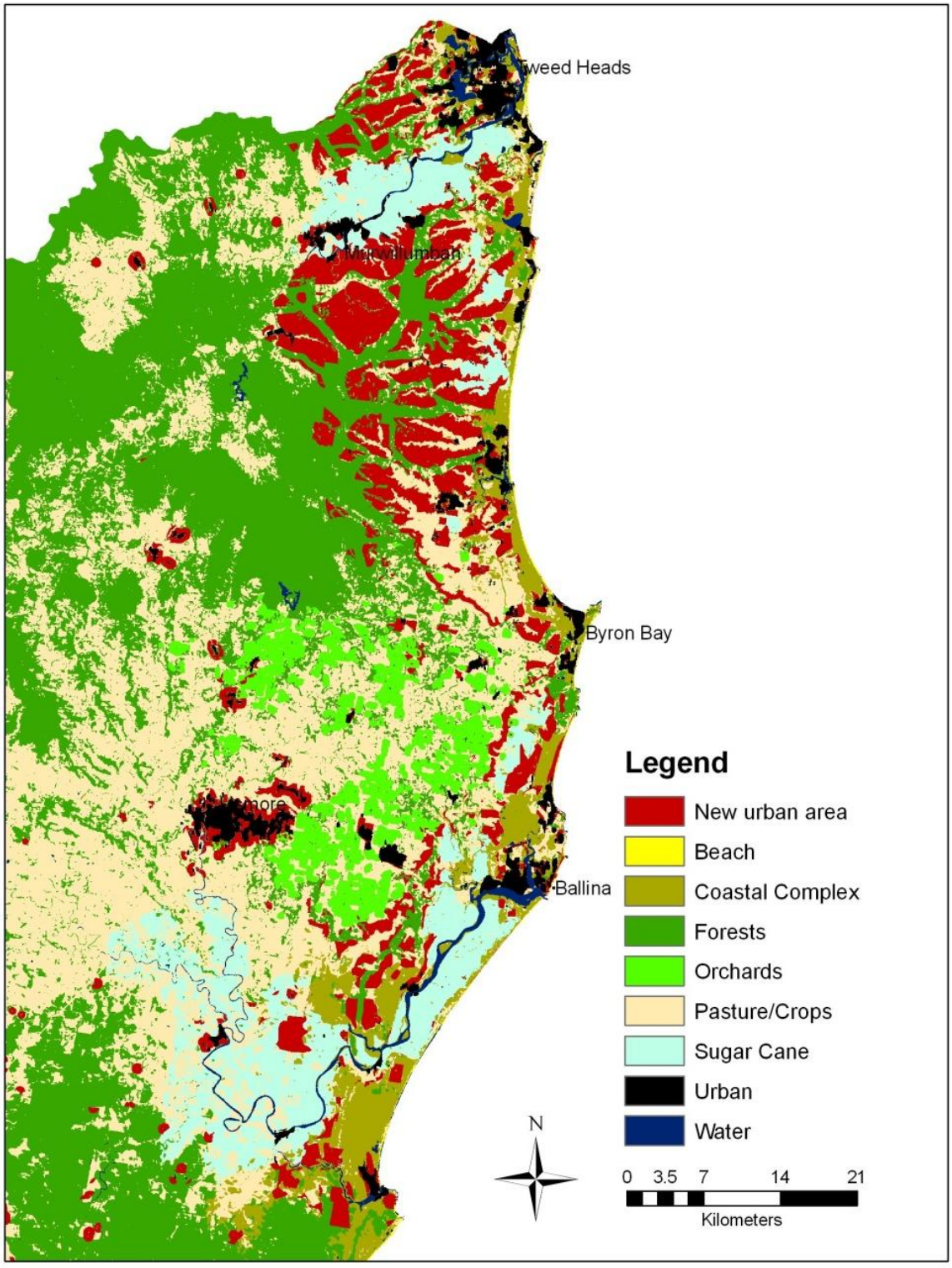

FIGURE 8.10: AGRICULTURE AND ENVIRONMENT PRIORITY CONTROLLED DENSITY LAND USE FIGURE POPULATION 955497, FAR NORTH COAST PORTION

8.3.1 CHANGE TABLES

TABLE 8.3: LAND USE CHANGE BY CLASS FOR AGRICULTURAL AND ENVIRONMENTAL PRIORITY CONTROLLED DENSITY SCENARIOS

Land Use / Population	2004	Population 403839			Population 558911			Population 727657			Population 955497		
	Total ha	Total ha	Change (ha)	% Change	Total ha	Change (ha)	% Change	Total ha	Change (ha)	% Change	Total ha	Change (ha)	% Change
Coastal Complex	67563	66105	-1458	-2.16%	64929	-2633	-3.90%	64172	-3391	-5.02%	63473	-4090	-6.05%
Forests	1205414	1197454	-7960	-0.66%	1193295	-12120	-1.01%	1187771	-17643	-1.46%	1178638	-26776	-2.22%
Pasture/ Crops	713725	691985	-21741	-3.05%	685278	-28447	-3.99%	678204	-35521	-4.98%	670300	-43425	-6.08%
Orchards	8730	21120	12391	141.94%	21120	12391	141.94%	21120	12391	141.94%	21120	12391	141.94%
Sugar Cane	56069	55510	-559	-1.00%	54937	-1132	-2.02%	54381	-1688	-3.01%	53554	-2514	-4.48%
Urban	20148	39514	19366	96.12%	52138	31990	258.78%	66070	45922	327.93%	84674	64527	420.27%

Overall, the urban area increased by 420.27% in the population 955497 scenario. This is a comparable amount to the 727657 population level of the previous (lower density) scenarios (433.46%) and caused considerable conversions of land use elsewhere.

At the population 955497 level, 2514 hectares of sugar cane was converted to urban area, however this was less than half of sugar production area lost in any other scenario. The coastal complex and pasture / crops LULC classes also had the lower levels of conversion to urban area when compared to previous scenarios. Forest areas amounting to 26776 hectares became urbanised which was higher than that of the minimal constraints and environmental priority scenarios, but less than observed in the agricultural priority scenario. A breakdown of the effect on areas of native vegetation ecosystems is provided in Table 8.4.

TABLE 8.4: LAND USE CHANGE BY VEGETATION TYPE FOR AGRICULTURAL AND ENVIRONMENTAL PRIORITY CONTROLLED DENSITY SCENARIOS

			Population 403839			Population 558911			Population 727657			Population 955497		
ECOSYSTEM	STATUS_A	LULC 2004	Total (ha)	Change (ha)	% Change	Total (ha)	Change (ha)	% Change	Total (ha)	Change (ha)	% Change	Total (ha)	Change (ha)	% Change
unclassified		151111	148157	-2954	-1.96%	145750	-5361	-3.55%	143129	-7982	-5.28%	139566	-11545	-7.64%
Baileys Stringybark		31076	30874	-203	-0.65%	30720	-357	-1.15%	30553	-523	-1.68%	30345	-732	-2.35%
Banksia	Rare	1336	1284	-53	-3.93%	1207	-129	-9.68%	1178	-159	-11.87%	1158	-178	-13.31%
Casuarina Woodland	Rare	21	21	0	-0.89%	21	0	-0.89%	21	0	-0.89%	21	0	-0.89%
Central Mid Elevation Sydney Blue Gum		3278	3277	-1	-0.03%	3277	-1	-0.03%	3277	-1	-0.03%	3277	-1	-0.03%
Clarence Lowland Needlebark Stringybark		10322	10254	-68	-0.66%	10183	-139	-1.35%	10102	-219	-2.13%	10005	-317	-3.07%
Lowlands Grey Box	Vulnerable	14455	14429	-25	-0.18%	14423	-31	-0.22%	14413	-42	-0.29%	14404	-51	-0.35%
Coast Cypress Pine	Rare	67	63	-4	-5.63%	63	-4	-5.63%	63	-4	-5.63%	63	-4	-5.63%
Coast Range Bloodwood-Mahogany		5177	5157	-20	-0.38%	5142	-35	-0.67%	5119	-58	-1.12%	5075	-102	-1.96%
Clarence Lowlands Spotted Gum		128339	127997	-342	-0.27%	127802	-537	-0.42%	127508	-831	-0.65%	126950	-1389	-1.08%
Coast Range Spotted Gum-Blackbutt	Rare	625	625	0	0.00%	625	0	0.00%	625	0	-0.05%	613	-12	-1.99%
Coastal Flooded Gum		8039	8039	0	0.00%	8038	0	0.00%	8032	-6	-0.08%	7981	-57	-0.71%
Coastal Sands Blackbutt		2821	2804	-17	-0.59%	2801	-20	-0.71%	2795	-26	-0.91%	2792	-29	-1.03%
Dry Foothills Blackbutt-Turpentine		2704	2693	-11	-0.42%	2683	-20	-0.76%	2677	-27	-0.99%	2659	-45	-1.66%
Dry Foothills Spotted Gum		73800	73796	-3	0.00%	73791	-9	-0.01%	73784	-15	-0.02%	73766	-34	-0.05%
Dry Grassy Blackbutt-		5353	5321	-32	-0.59%	5289	-63	-1.19%	5258	-94	-1.76%	5221	-131	-2.45%

Tallowwood														
Dry Grassy Tallowwood-Grey Gum		2167	2135	-33	-1.50%	2114	-54	-2.47%	2088	-79	-3.66%	2059	-108	-5.00%
Dry Heathy Blackbutt-Bloodwood		42039	41734	-305	-0.72%	41506	-533	-1.27%	41229	-810	-1.93%	40845	-1194	-2.84%
Dry Heathy Sandstone Blackbutt		16634	16572	-62	-0.38%	16521	-113	-0.68%	16471	-163	-0.98%	16404	-230	-1.38%
Dry open Redgum-Broad Leaved Apple		1129	1129	0	0.00%	1129	0	0.00%	1129	0	0.00%	1129	0	0.00%
Dunns White Gum	Rare	291	291	0	0.00%	291	0	0.00%	291	0	0.00%	291	0	0.00%
Eastern Red Gums	Vulnerable	1774	1774	0	0.00%	1774	0	0.00%	1774	0	0.00%	1774	0	0.00%
Escarpment Redgum		15211	15208	-3	-0.02%	15207	-3	-0.02%	15205	-5	-0.04%	15201	-10	-0.06%
Escarpment Scribbly Gum-Apple		3583	3581	-2	-0.07%	3580	-3	-0.08%	3579	-4	-0.12%	3579	-4	-0.12%
Wet Bangalow-Brushbox	Vulnerable	8312	8296	-16	-0.19%	8253	-58	-0.70%	8150	-162	-1.95%	7944	-368	-4.43%
Foothill Grey Gum-Ironbark-Spotted Gum		39837	39695	-141	-0.35%	39564	-273	-0.68%	39403	-434	-1.09%	39188	-649	-1.63%
Foothills Grey Gum-Spotted Gum		5947	5922	-26	-0.43%	5899	-48	-0.81%	5860	-87	-1.47%	5805	-142	-2.39%
Gorge Grey Gum		697	697	0	0.00%	697	0	0.00%	697	0	0.00%	697	0	-0.05%
Gorge Ironbark-Grey Gum		22685	22684	-1	0.00%	22682	-3	-0.01%	22680	-5	-0.02%	22671	-14	-0.06%
Heath	Vulnerable	8138	8051	-88	-1.08%	7968	-171	-2.10%	7903	-236	-2.90%	7862	-276	-3.39%
Heathy Scribbly Gum		7235	7197	-37	-0.51%	7157	-77	-1.07%	7096	-138	-1.91%	7022	-213	-2.94%
Herbfield and Fjaeldmark	Rare	25	25	0	0.00%	25	0	0.00%	25	0	0.00%	25	0	0.00%
High Elevation Open Spotted Gum		42550	42536	-15	-0.03%	42527	-23	-0.05%	42517	-34	-0.08%	42504	-46	-0.11%
Ironbark		5467	5451	-16	-0.29%	5447	-19	-0.36%	5442	-24	-0.44%	5436	-31	-0.56%

Low Relief Coastal Blackbutt	Rare	310	310	0	0.00%	310	0	0.00%	310	0	0.00%	310	0	0.00%
Lowland Red Gum		43876	43629	-247	-0.56%	43413	-463	-1.05%	43065	-811	-1.85%	42696	-1180	-2.69%
Lowlands Scribbly Gum	Vulnerable	3204	3181	-23	-0.70%	3164	-39	-1.22%	3135	-69	-2.14%	3048	-155	-4.84%
Lowlands Spotted Gum-Box		15578	15565	-13	-0.08%	15556	-21	-0.14%	15552	-26	-0.16%	15542	-36	-0.23%
Coastal Mallee	Vulnerable	1240	1232	-8	-0.68%	1223	-18	-1.42%	1218	-22	-1.78%	1217	-24	-1.91%
Mangrove	Rare	395	394	-1	-0.24%	394	-1	-0.33%	394	-1	-0.33%	394	-1	-0.33%
Moist Foothills Spotted Gum		30780	30775	-5	-0.02%	30771	-9	-0.03%	30766	-14	-0.05%	30758	-22	-0.07%
Northern Moist Blackbutt		8700	8691	-8	-0.10%	8655	-45	-0.52%	8591	-109	-1.25%	8221	-478	-5.50%
Natural Grassland	Rare	270	270	0	-0.02%	270	0	-0.07%	270	0	-0.07%	270	0	-0.12%
Needlebark Stringybark-Large Fruited Blackbutt		9547	9464	-83	-0.87%	9401	-146	-1.53%	9317	-231	-2.42%	9210	-337	-3.53%
New England Stringybark-Blakelys Red Gum		1067	1067	0	0.00%	1067	0	0.00%	1067	0	0.00%	1067	0	0.00%
Northern Grassy Sydney Blue Gum	Vulnerable	2856	2856	0	0.00%	2856	0	0.00%	2856	0	0.00%	2856	0	-0.02%
Northern Open Grassy Blackbutt		18876	18773	-103	-0.55%	18675	-201	-1.06%	18522	-354	-1.88%	18218	-658	-3.49%
Northern Ranges Dry Tallowwood		19608	19604	-5	-0.02%	19599	-9	-0.05%	19586	-22	-0.11%	19519	-90	-0.46%
Northern Wet Brushbox		10532	10532	-1	0.00%	10531	-1	-0.01%	10531	-1	-0.01%	10521	-12	-0.11%
Northern Wet Tallowwood-Blue Gum		14647	14646	0	0.00%	14646	0	0.00%	14645	-1	-0.01%	14641	-5	-0.04%
Open Coastal Brushbox		3440	3427	-14	-0.40%	3404	-36	-1.05%	3384	-56	-1.63%	3345	-95	-2.76%
Open Shrubby Brushbox-Tallowwood		9663	9662	-1	-0.01%	9662	-1	-0.01%	9662	-1	-0.01%	9662	-1	-0.01%
Paperbark	Vulnerable	22405	22305	-100	-0.45%	22128	-277	-1.24%	21936	-469	-2.09%	21753	-652	-2.91%

Red Bloodwood	Rare	207	207	0	0.00%	207	0	0.00%	207	0	0.00%	207	0	0.00%
Red Mahogany		1251	1248	-2	-0.18%	1248	-2	-0.19%	1248	-2	-0.19%	1248	-2	-0.19%
Richmond Range Spotted Gum		16415	16406	-9	-0.05%	16405	-10	-0.06%	16403	-12	-0.07%	16393	-22	-0.13%
Richmond Range Spotted Gum-Box		17197	17196	-1	-0.01%	17195	-2	-0.01%	17195	-2	-0.01%	17195	-2	-0.01%
River Oak	Vulnerable	824	824	0	-0.05%	822	-2	-0.24%	821	-3	-0.42%	820	-4	-0.49%
Rough-barked Apples	Vulnerable	1396	1396	-1	-0.05%	1395	-1	-0.09%	1393	-3	-0.20%	1392	-5	-0.34%
Saltbush	Rare	9	9	0	-3.97%	9	-1	-7.95%	8	-2	-15.89%	8	-2	-15.89%
Sandstone Spotted Gum-Blackbutt		3870	3858	-11	-0.29%	3851	-19	-0.49%	3844	-26	-0.67%	3834	-36	-0.92%
Sherwood Needlebark Stringybark		8249	8201	-48	-0.58%	8167	-82	-0.99%	8128	-121	-1.46%	8053	-196	-2.37%
South Coast Tallowwood-Blue Gum		2569	2567	-2	-0.06%	2565	-4	-0.16%	2563	-6	-0.23%	2551	-18	-0.68%
Stringybark-Apple		5044	5043	-1	-0.02%	5043	-1	-0.02%	5043	-1	-0.02%	5043	-1	-0.02%
Swamp	Endangered	11569	11423	-146	-1.26%	11278	-292	-2.52%	11243	-326	-2.82%	11188	-382	-3.30%
Swamp Mahogany	Rare	351	350	-1	-0.25%	350	-1	-0.27%	350	-1	-0.27%	350	-1	-0.29%
Swamp Oak	Rare	1946	1928	-18	-0.94%	1905	-41	-2.09%	1897	-49	-2.50%	1892	-54	-2.79%
Sydney Peppermint-Stringybark	Rare	205	203	-2	-0.92%	203	-2	-0.92%	203	-2	-0.92%	200	-4	-2.14%
Tallowwood		3563	3563	0	0.00%	3563	0	0.00%	3563	0	0.00%	3561	-2	-0.05%
Turpentine		2470	2448	-23	-0.91%	2397	-73	-2.94%	2310	-160	-6.47%	2169	-301	-12.18%
Very Wet New England Blackbutt-Tallowwood		434	434	0	0.00%	434	0	0.00%	434	0	0.00%	433	-1	-0.23%
Wattle		783	774	-10	-1.22%	765	-18	-2.33%	742	-41	-5.24%	700	-83	-10.57%

Wet Bloodwood-Tallowwood		25677	25651	-26	-0.10%	25574	-102	-0.40%	25454	-223	-0.87%	25115	-562	-2.19%
Wet Coastal Tallowwood-Brushbox		1526	1511	-16	-1.02%	1498	-29	-1.88%	1483	-44	-2.85%	1465	-61	-4.02%
Wet Flooded Gum-Tallowwood		5399	5367	-32	-0.59%	5294	-105	-1.94%	5160	-238	-4.42%	4872	-526	-9.75%
Wet Foothills Blackbutt-Turpentine		1014	1014	0	0.00%	1014	0	0.00%	1014	0	-0.02%	1012	-2	-0.20%
Yellow Box-Blakely's Red Gum	Vulnerable	38	38	0	0.00%	38	0	0.00%	38	0	0.00%	37	-1	-1.99%
Forestry Plantations		10325	10315	-10	-0.09%	10310	-15	-0.14%	10310	-15	-0.14%	10310	-15	-0.14%
Improved Pasture and Cropland		507	507	-1	-0.14%	507	-1	-0.14%	507	-1	-0.14%	507	-1	-0.14%
Introduced Scrub		989	989	0	0.00%	989	0	0.00%	984	-5	-0.49%	968	-21	-2.12%
Rainforest	Endangered	111641	111549	-92	-0.08%	111383	-258	-0.23%	111088	-553	-0.50%	110459	-1182	-1.06%
Scrub	Vulnerable	4202	4175	-27	-0.65%	4137	-65	-1.55%	4120	-82	-1.96%	4077	-125	-2.98%
Cleared-Partially Cleared		3118	3115	-3	-0.10%	3115	-3	-0.10%	3115	-4	-0.12%	3108	-10	-0.32%
Camphor Laurel		6159	5984	-175	-2.84%	5699	-460	-7.47%	5376	-783	-12.71%	4723	-1436	-23.31%

The effects of urbanisation upon the vegetation within the region was similar to the environmental priority scenario in both quantity and distribution. The class most affected was Camphor laurel which had 1436 hectares converted to urban development. Clarence lowlands spotted gum (1389 hectares) and dry heathy blackbutt-bloodwood (1194 hectares) had the next greatest area urbanised. In proportion to the 2004 extent, saltbush (15.89%), banksia (13.31%) and turpentine forests (12.18%) were the most affected with the former two classes being classified as rare.

Overall 3473 hectares of endangered, rare and vulnerable vegetation,including 652 hectares of paperbark forest, was lost to new urban growth. This was the smallest loss of these conservation important classes of all scenarios. The combination of environmental and agricultural constraints, and reduced urban area (increased settlement density) appeared to be a potentially valuable and plausible alternative landscape futures design.

8.4 URBAN SHIFT RESULTS

The urban shift model applied to this scenario shifts population growth to other adjacent zones rather than increasing population settlement density. The changes predicted for new settlement urban areas which were compared then merged with the 2004 LULC and Far North Coast maps are presented in Figures 8.11 to 8.18.

In the urban shift scenarios, the north eastern coastal zone (zone 4) demonstrated all of its buildable area converted to urban development (at the highest population levels). Reallocation of population to the west (zone 5) caused increased growth around Lismore and some small towns such as Nimbin. A large number of small urban settlements developed to the south of the sugar cane belt below Ballina and Lismore.

In the southern part of the region development along the Pacific Highway resulted in the development of larger urban areas along its length. Many of these are comparable to the 2004 area of Grafton and were created by the placement algorithm because of environmental constraints protecting the coastal areas of this zone.

The changes in land use areas are tabulated in Table 8.5

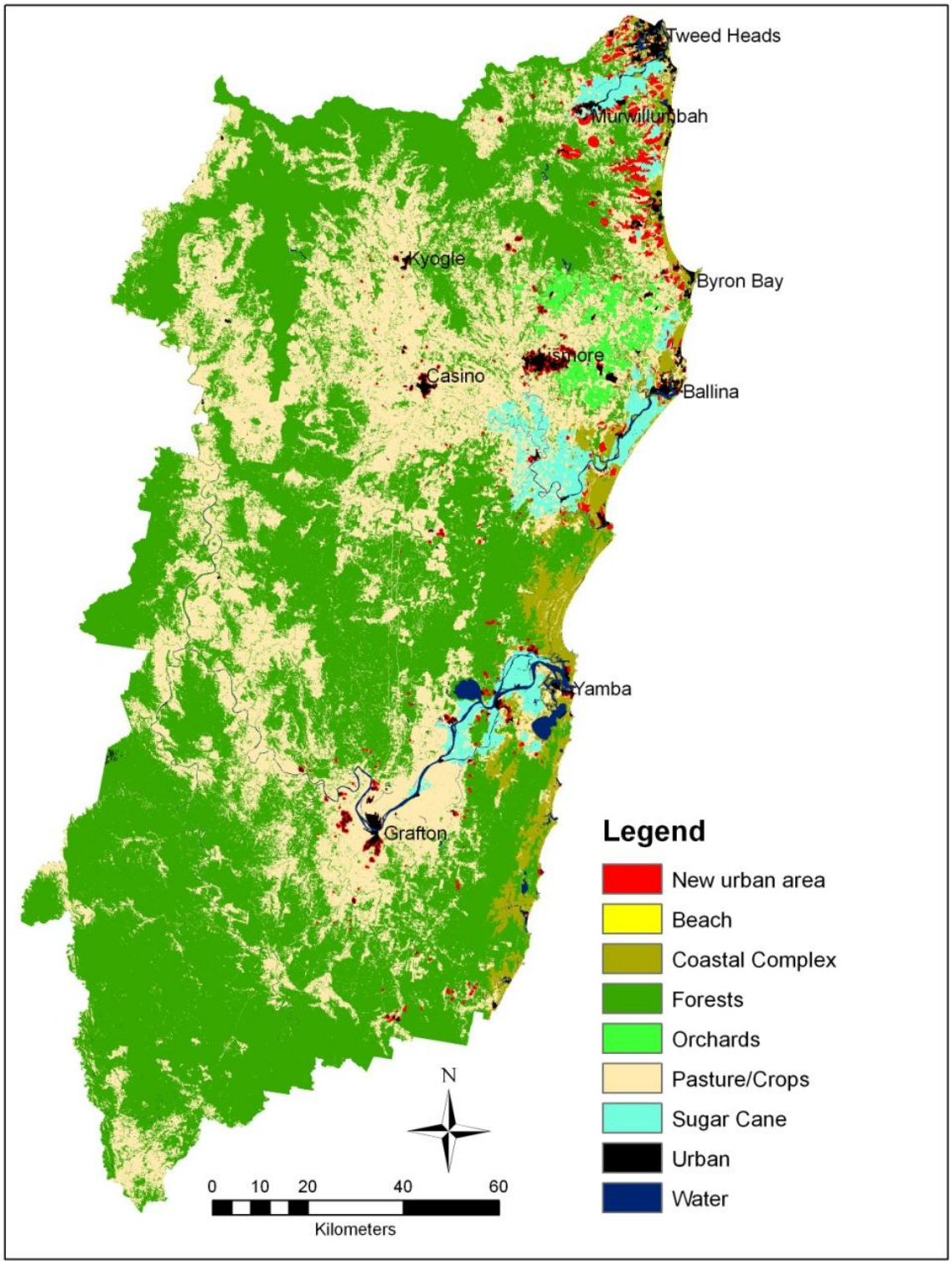

FIGURE 8.11: AGRICULTURE AND ENVIRONMENT PRIORITY URBAN SHIFT LAND USE POPULATION 403839

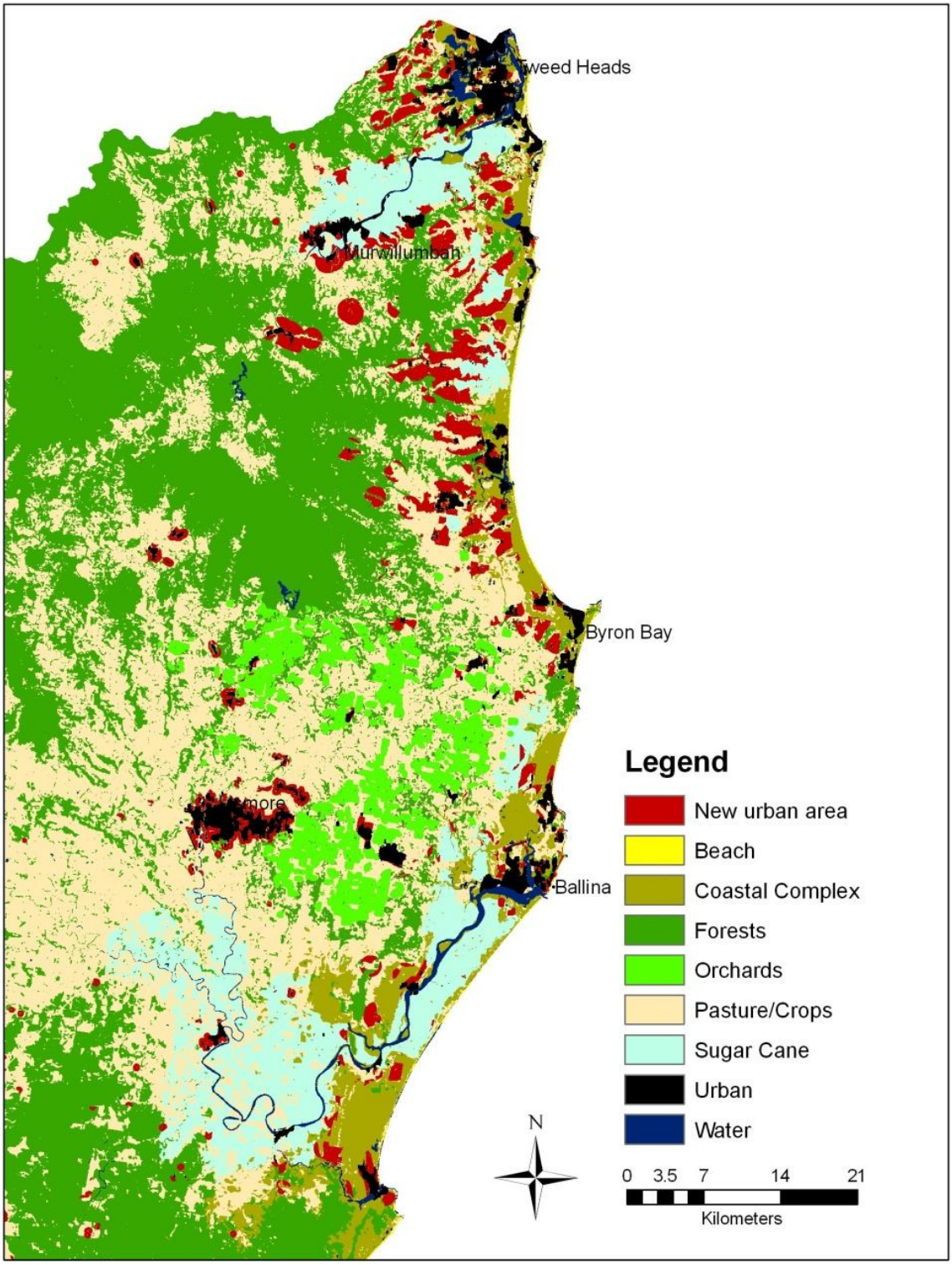

FIGURE 8.12 AGRICULTURE AND ENVIRONMENT PRIORITY URBAN SHIFT LAND USE POPULATION 403839 403839, FAR NORTH COAST PORTION

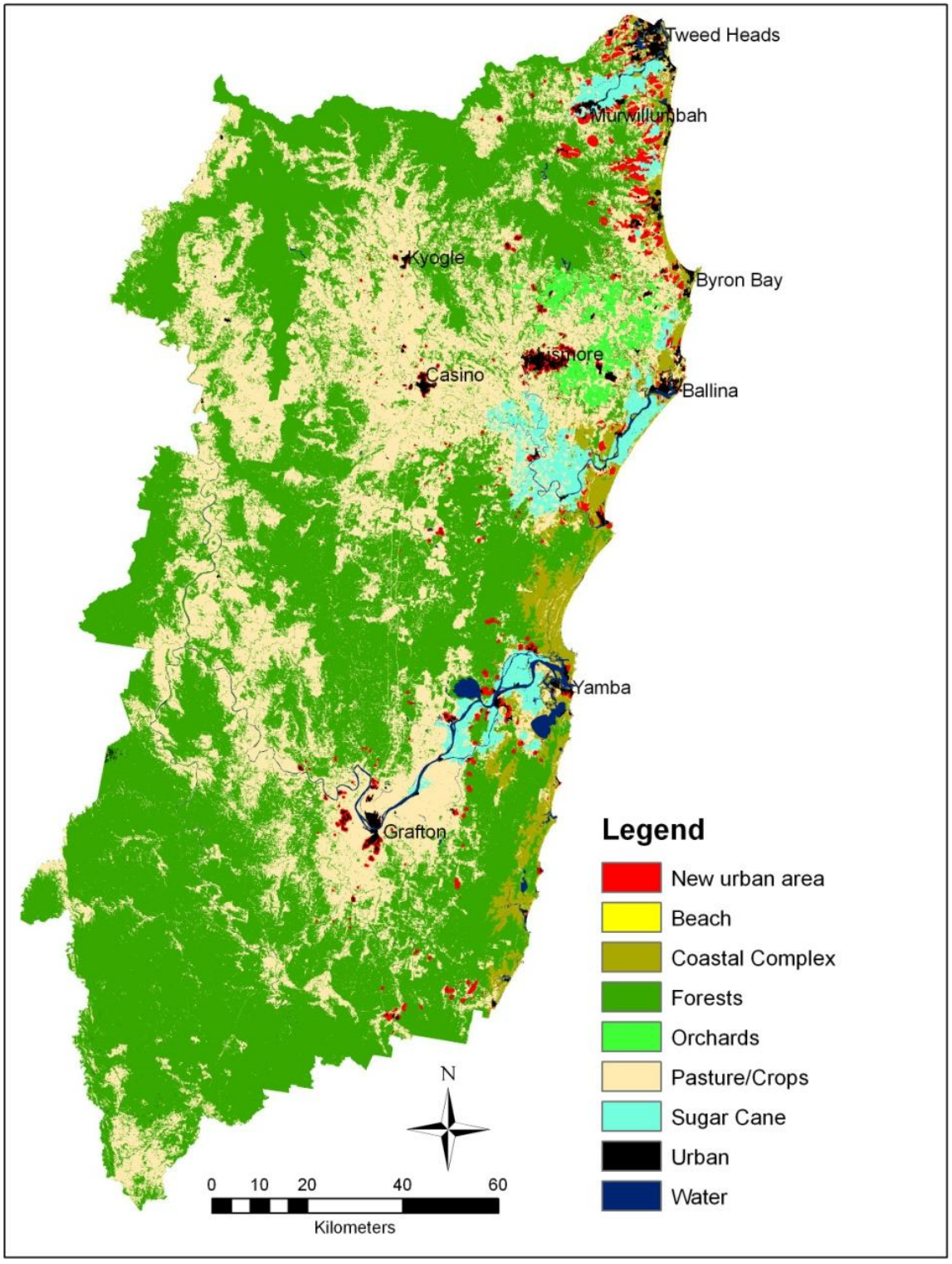

FIGURE 8.13: AGRICULTURE AND ENVIRONMENT PRIORITY URBAN SHIFT POPULATION 558911

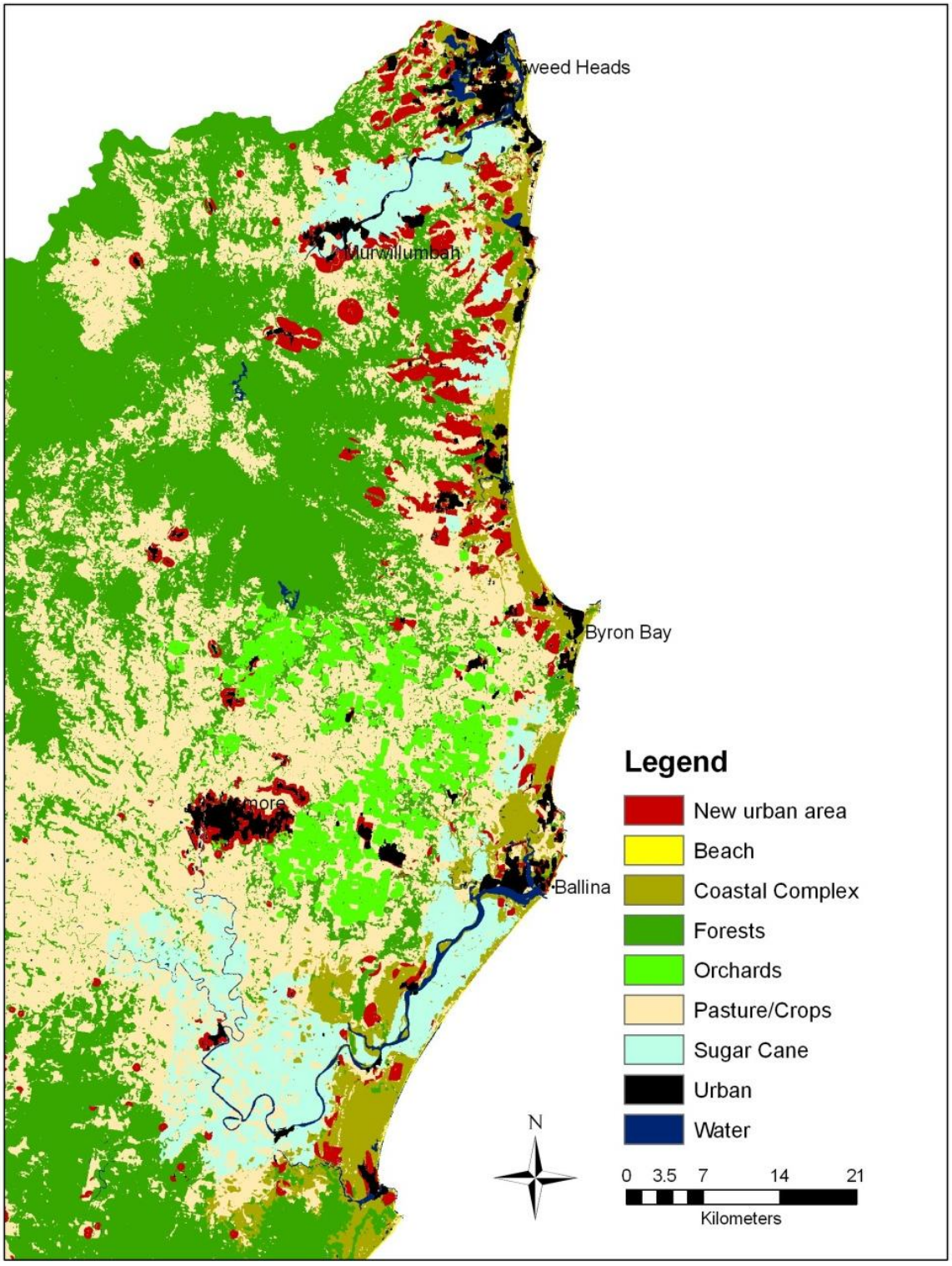

FIGURE 8.14: AGRICULTURE AND ENVIRONMENT PRIORITY URBAN SHIFT POPULATION 558911, FAR NORTH COAST PORTION

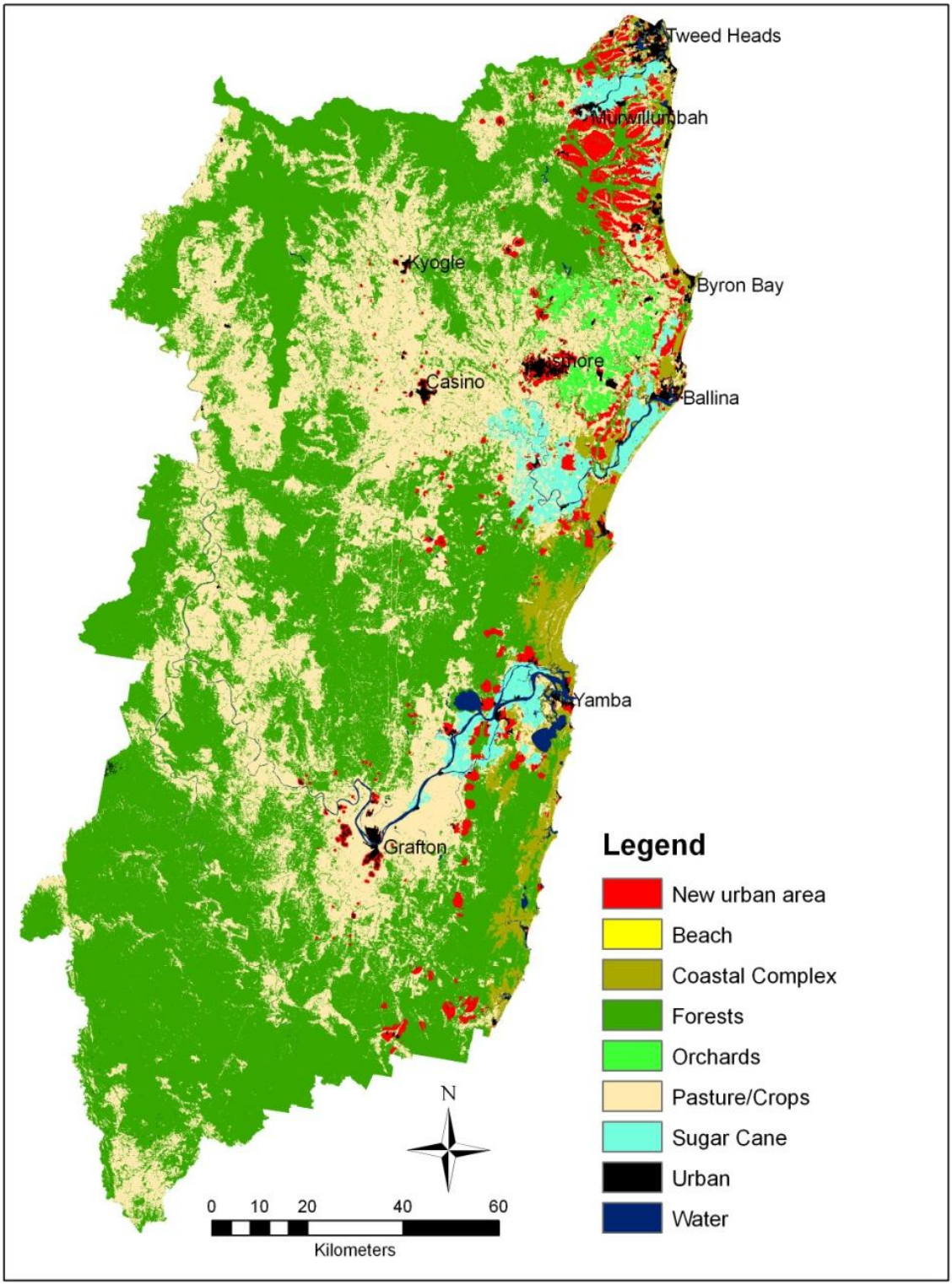

FIGURE 8.15: AGRICULTURE AND ENVIRONMENT PRIORITY URBAN SHIFT POPULATION 727657

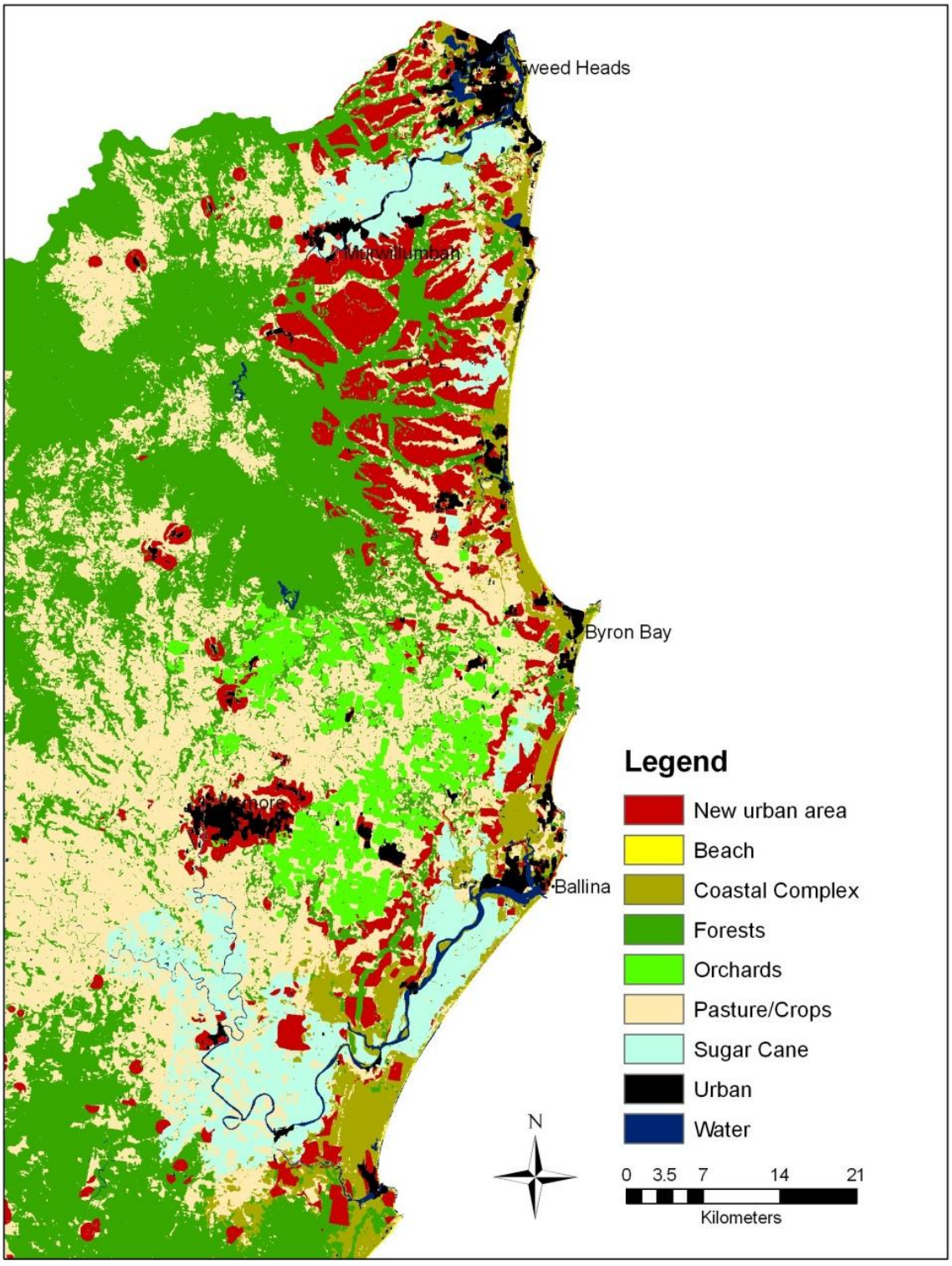

FIGURE 8.16: AGRICULTURE AND ENVIRONMENT PRIORITY URBAN SHIFT POPULATION 727657, FAR NORTH COAST PORTION

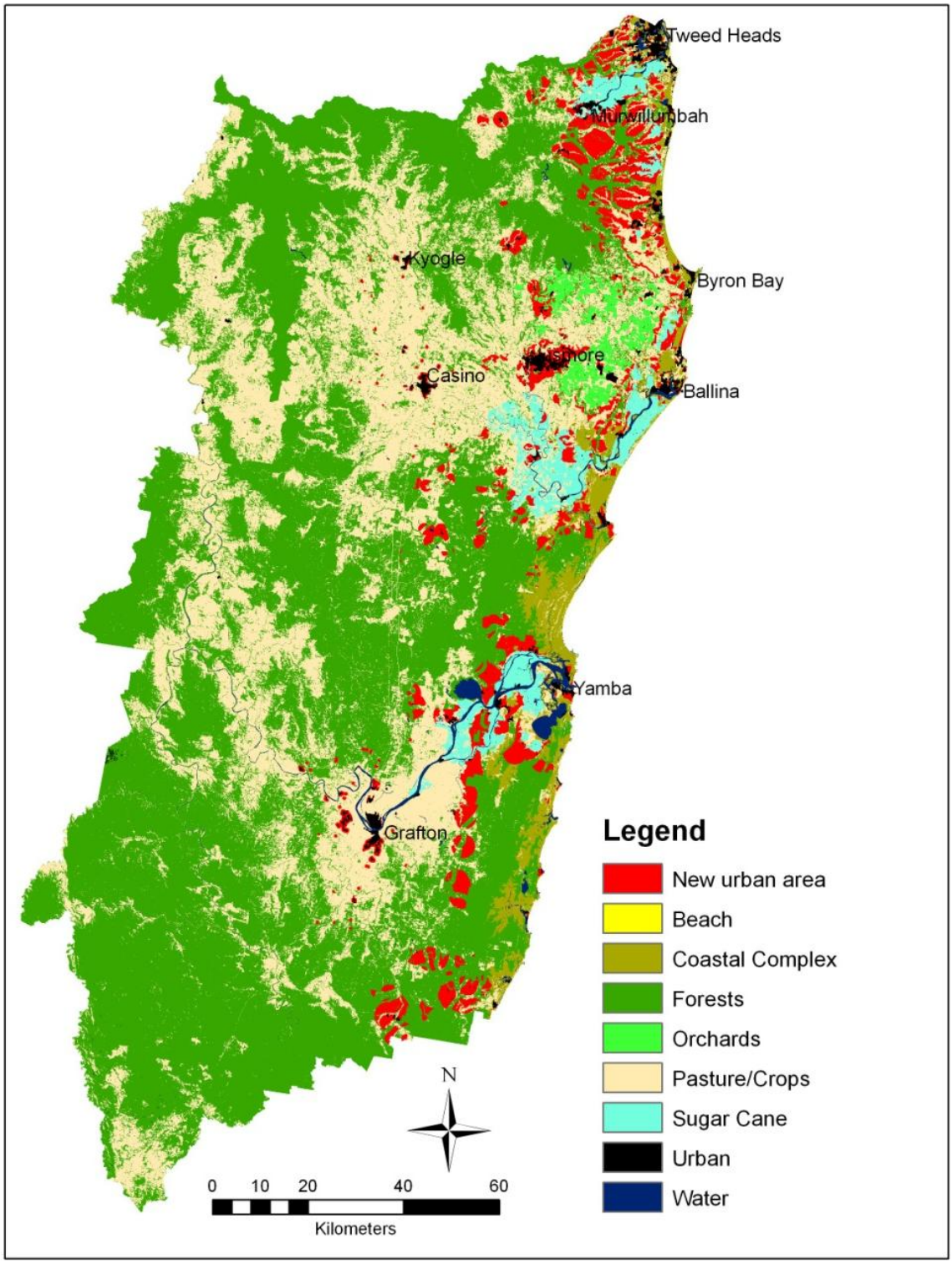

FIGURE 8.17: AGRICULTURE AND ENVIRONMENT PRIORITY URBAN SHIFT POPULATION 955497

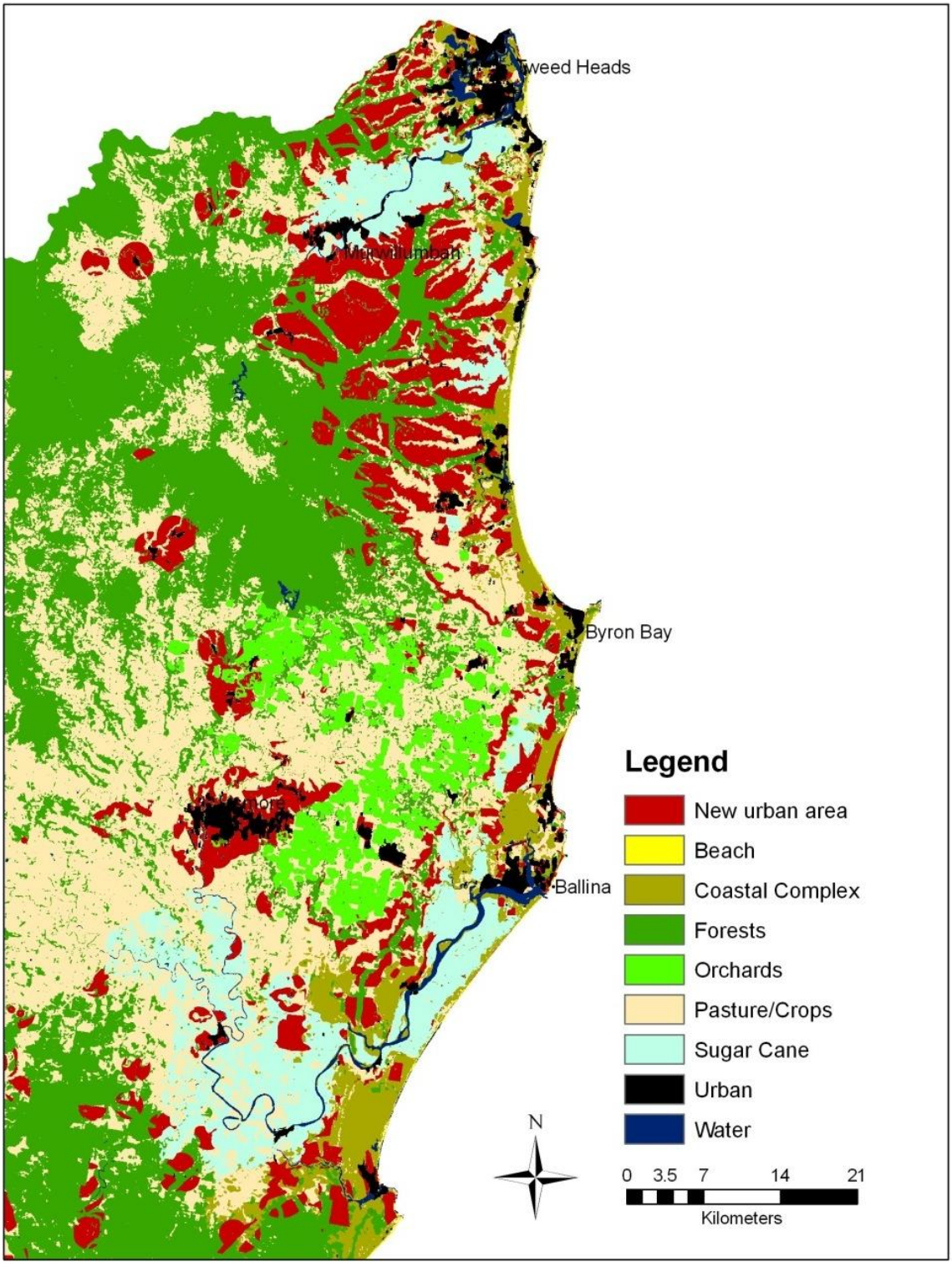

FIGURE 8.18: AGRICULTURE AND ENVIRONMENT PRIORITY URBAN SHIFT POPULATION 955497, FAR NORTH COAST PORTION

8.4.1 CHANGE TABLES

TABLE 8.5: LAND USE CHANGE BY CLASS FOR AGRICULTURE AND ENVIRONMENT PRIORITY URBAN SHIFT SCENARIOS

Land Use / Population	2004	Population 403839			Population 558911			Population 727657			Population 955497		
	Total ha	Total ha	Change (ha)	% Change	Total ha	Change (ha)	% Change	Total ha	Change (ha)	% Change	Total ha	Change (ha)	% Change
Coastal Complex	67563	65092	-2470	-3.66%	64929	-2633	-3.90%	63326	-4237	-6.27%	62374	-5188	-7.68%
Forests	1205414	1194747	-10668	-0.88%	1193295	-12120	-1.01%	1176337	-29078	-2.41%	1159062	-46352	-3.85%
Pasture/ Crops	713725	686285	-27440	-3.84%	685278	-28447	-3.99%	668383	-45342	-6.35%	655279	-58447	-8.19%
Orchards	8730	21120	12391	141.94%	21120	12391	141.94%	21120	12391	141.94%	21120	12391	141.94%
Sugar Cane	56069	54956	-1113	-1.98%	54937	-1132	-2.02%	53448	-2620	-4.67%	52817	-3252	-5.80%
Urban	20148	49488	29340	145.63%	52138	31990	258.78%	89182	69035	442.64%	121204	101056	601.58%

Reallocation of new urban development into zones 5 and 6 increased the overall urban area for the region due to the south coast area (zone 6) having a lower population density. At the population 955497 level, the extent of the zone 6 urban area is 1,010,56 hectares which is over 600% larger than the 2004 levels.

Conversion of sugar cane production land to urban areas was 5.80%, which is less than all the previous scenarios except for the controlled density version of this agricultural and environmental priority scenario. The area of coastal complex vegetation was reduced by 7.68%, which is 0.56% more than the environmental priority scenarios but less than half of the connected area in the minimal constraints and agricultural priority scenarios.

However, 58447 hectares of pasture and cropland was urbanised, which was the greatest area lost for this class. The large impact on this class was due to the new urban settlement areas around Lismore, to Casino and to small towns north of Lismore, such as Nimbin. Similarly, the amount of forests converted to urban development (3.85%) was higher than previous scenarios, notably more than double the area lost in the minimal constraints scenario. A large proportion of this change occurred as a result of development along the Pacific Highway and in southern parts of the region. The LULC change on areas of native vegetation ecosystems is provided in Table 8.6.

TABLE 8.6: LAND USE CHANGE BY VEGETATION TYPE FOR URBAN SHIFT SCENARIOS

			Population 403839			Population 558911			Population 727657			Population 955497		
ECOSYSTEM	STATUS_A	LULC 2004	Total (ha)	Change (ha)	% Change	Total (ha)	Change (ha)	% Change	Total (ha)	Change (ha)	% Change	Total (ha)	Change (ha)	% Change
unclassified		151111	145937	-5174	-3.42%	145750	-5361	-3.55%	139088	-12023	-7.96%	136047	-15064	-9.97%
Baileys Stringybark		31076	30874	-203	-0.65%	30720	-357	-1.15%	30202	-874	-2.81%	29031	-2045	-6.58%
Banksia	Rare	1336	1208	-128	-9.60%	1207	-129	-9.68%	1153	-184	-13.73%	1120	-217	-16.22%
Casuarina Woodland	Rare	21	21	0	-0.89%	21	0	-0.89%	21	0	-0.89%	21	0	-0.89%
Central Mid Elevation Sydney Blue Gum		3278	3277	-1	-0.03%	3277	-1	-0.03%	3277	-1	-0.03%	3277	-1	-0.03%
Clarence Lowland Needlebark Stringybark		10322	10254	-68	-0.66%	10183	-139	-1.35%	9948	-374	-3.63%	9276	-1045	-10.13%
Lowlands Grey Box	Vulnerable	14455	14429	-25	-0.17%	14423	-31	-0.22%	14392	-62	-0.43%	14322	-133	-0.92%
Coast Cypress Pine	Rare	67	63	-4	-5.63%	63	-4	-5.63%	63	-4	-5.63%	61	-6	-8.26%
Coast Range Bloodwood-Mahogany		5177	5155	-22	-0.42%	5142	-35	-0.67%	5047	-130	-2.52%	4861	-316	-6.10%
Clarence Lowlands Spotted Gum		128339	127986	-353	-0.27%	127802	-537	-0.42%	126694	-1645	-1.28%	124689	-3650	-2.84%
Coast Range Spotted Gum-Blackbutt	Rare	625	625	0	-0.05%	625	0	-0.04%	613	-12	-1.99%	588	-38	-6.04%
Coastal Flooded Gum		8039	8039	0	0.00%	8039	0	0.00%	7980	-58	-0.73%	7977	-62	-0.77%
Coastal Sands Blackbutt		2821	2804	-17	-0.60%	2801	-20	-0.71%	2791	-30	-1.06%	2782	-39	-1.38%
Dry Foothills Blackbutt-Turpentine		2704	2693	-11	-0.42%	2683	-20	-0.76%	2645	-59	-2.18%	2528	-176	-6.52%
Dry Foothills Spotted Gum		73800	73796	-4	0.00%	73791	-9	-0.01%	73753	-47	-0.06%	73650	-150	-0.20%
Dry Grassy Blackbutt-		5353	5321	-32	-0.59%	5289	-63	-1.19%	5191	-161	-3.01%	4966	-387	-7.22%

Tallowwood														
Dry Grassy Tallowwood-Grey Gum		2167	2135	-33	-1.50%	2114	-54	-2.47%	2029	-139	-6.39%	1799	-369	-17.01%
Dry Heathy Blackbutt-Bloodwood		42039	41718	-321	-0.76%	41506	-533	-1.27%	40580	-1459	-3.47%	38657	-3381	-8.04%
Dry Heathy Sandstone Blackbutt		16634	16572	-63	-0.38%	16521	-113	-0.68%	16341	-293	-1.76%	15940	-694	-4.17%
Dry open Redgum-Broad Leaved Apple		1129	1129	0	0.00%	1129	0	0.00%	1129	0	0.00%	1129	0	0.00%
Dunns White Gum	Rare	291	291	0	0.00%	291	0	0.00%	291	0	0.00%	291	0	0.00%
Eastern Red Gums	Vulnerable	1774	1774	0	0.00%	1774	0	0.00%	1774	0	0.00%	1773	0	-0.01%
Escarpment Redgum		15211	15208	-3	-0.02%	15207	-3	-0.02%	15198	-12	-0.08%	15173	-38	-0.25%
Escarpment Scribbly Gum-Apple		3583	3581	-2	-0.07%	3580	-3	-0.08%	3578	-5	-0.14%	3569	-15	-0.40%
Wet Bangalow-Brushbox	Vulnerable	8312	8252	-60	-0.72%	8253	-58	-0.70%	7934	-378	-4.54%	7910	-402	-4.83%
Foothill Grey Gum-Ironbark-Spotted Gum		39837	39692	-145	-0.36%	39564	-273	-0.68%	39055	-782	-1.96%	38126	-1711	-4.29%
Foothills Grey Gum-Spotted Gum		5947	5922	-26	-0.44%	5899	-48	-0.81%	5782	-166	-2.78%	5501	-446	-7.50%
Gorge Grey Gum		697	697	0	0.00%	697	0	0.00%	697	0	0.00%	692	-6	-0.80%
Gorge Ironbark-Grey Gum		22685	22684	-1	0.00%	22682	-3	-0.01%	22671	-14	-0.06%	22663	-23	-0.10%
Heath	Vulnerable	8138	7975	-163	-2.00%	7968	-171	-2.10%	7851	-287	-3.52%	7795	-343	-4.22%
Heathy Scribbly Gum		7235	7192	-43	-0.59%	7157	-77	-1.07%	6973	-262	-3.62%	6660	-575	-7.94%
Herbfield and Fjaeldmark	Rare	25	25	0	0.00%	25	0	0.00%	25	0	0.00%	25	0	0.00%
High Elevation Open Spotted Gum		42550	42536	-15	-0.03%	42527	-23	-0.05%	42495	-55	-0.13%	42364	-186	-0.44%
Ironbark		5467	5451	-16	-0.29%	5447	-19	-0.36%	5417	-49	-0.90%	5319	-147	-2.69%

Low Relief Coastal Blackbutt	Rare	310	310	0	0.00%	310	0	0.00%	310	0	0.00%	310	-1	-0.24%
Lowland Red Gum		43876	43492	-384	-0.88%	43413	-463	-1.05%	42528	-1349	-3.07%	41356	-2520	-5.74%
Lowlands Scribbly Gum	Vulnerable	3204	3166	-37	-1.17%	3164	-39	-1.22%	3038	-165	-5.16%	2980	-224	-6.98%
Lowlands Spotted Gum-Box		15578	15564	-14	-0.09%	15556	-21	-0.14%	15533	-45	-0.29%	15449	-129	-0.83%
Coastal Mallee	Vulnerable	1240	1224	-17	-1.36%	1223	-18	-1.42%	1217	-24	-1.91%	1216	-24	-1.94%
Mangrove	Rare	395	394	-1	-0.33%	394	-1	-0.33%	394	-1	-0.33%	394	-1	-0.33%
Moist Foothills Spotted Gum		30780	30775	-5	-0.02%	30771	-9	-0.03%	30748	-32	-0.10%	30694	-86	-0.28%
Northern Moist Blackbutt		8700	8654	-45	-0.52%	8655	-45	-0.52%	8209	-491	-5.64%	8188	-512	-5.88%
Natural Grassland	Rare	270	270	0	-0.02%	270	0	-0.07%	270	0	-0.12%	246	-24	-8.91%
Needlebark Stringybark-Large Fruited Blackbutt		9547	9463	-85	-0.89%	9401	-146	-1.53%	9122	-426	-4.46%	8328	-1219	-12.77%
New England Stringybark-Blakelys Red Gum		1067	1067	0	0.00%	1067	0	0.00%	1067	0	0.00%	1067	0	0.00%
Northern Grassy Sydney Blue Gum	Vulnerable	2856	2856	0	0.00%	2856	0	0.00%	2856	0	-0.02%	2856	0	-0.02%
Northern Open Grassy Blackbutt		18876	18751	-125	-0.66%	18675	-201	-1.06%	18100	-776	-4.11%	17209	-1667	-8.83%
Northern Ranges Dry Tallowwood		19608	19600	-9	-0.04%	19599	-9	-0.05%	19518	-91	-0.46%	19495	-113	-0.58%
Northern Wet Brushbox		10532	10532	-1	0.00%	10531	-1	-0.01%	10521	-12	-0.11%	10520	-12	-0.11%
Northern Wet Tallowwood-Blue Gum		14647	14646	0	0.00%	14646	0	0.00%	14640	-7	-0.05%	14635	-11	-0.08%
Open Coastal Brushbox		3440	3418	-22	-0.64%	3404	-36	-1.05%	3323	-118	-3.42%	3162	-278	-8.09%
Open Shrubby Brushbox-Tallowwood		9663	9662	-1	-0.01%	9662	-1	-0.01%	9662	-1	-0.01%	9659	-4	-0.04%
Paperbark	Vulnerable	22405	22174	-231	-1.03%	22128	-277	-1.24%	21708	-697	-3.11%	21194	-1210	-5.40%

Red Bloodwood	Rare	207	207	0	0.00%	207	0	0.00%	207	0	-0.15%	203	-4	-1.99%
Red Mahogany		1251	1248	-2	-0.19%	1248	-2	-0.19%	1248	-3	-0.24%	1238	-13	-1.01%
Richmond Range Spotted Gum		16415	16406	-9	-0.06%	16405	-10	-0.06%	16390	-25	-0.15%	16345	-70	-0.42%
Richmond Range Spotted Gum-Box		17197	17195	-1	-0.01%	17195	-2	-0.01%	17193	-4	-0.02%	17192	-5	-0.03%
River Oak	Vulnerable	824	824	0	-0.05%	822	-2	-0.24%	819	-5	-0.61%	808	-16	-1.90%
Rough-barked Apples	Vulnerable	1396	1396	-1	-0.05%	1395	-1	-0.09%	1389	-8	-0.55%	1375	-21	-1.50%
Saltbush	Rare	9	9	0	-3.97%	9	-1	-7.95%	8	-2	-15.89%	8	-2	-15.89%
Sandstone Spotted Gum-Blackbutt		3870	3858	-12	-0.30%	3851	-19	-0.49%	3820	-49	-1.28%	3762	-108	-2.79%
Sherwood Needlebark Stringybark		8249	8201	-48	-0.58%	8167	-82	-0.99%	7998	-251	-3.04%	7340	-908	-11.01%
South Coast Tallowwood-Blue Gum		2569	2567	-2	-0.06%	2565	-4	-0.16%	2546	-23	-0.91%	2490	-79	-3.06%
Stringybark-Apple		5044	5043	-1	-0.02%	5043	-1	-0.02%	5043	-1	-0.02%	5042	-2	-0.04%
Swamp	Endangered	11569	11285	-284	-2.46%	11278	-292	-2.52%	11168	-401	-3.47%	11021	-548	-4.74%
Swamp Mahogany	Rare	351	350	-1	-0.27%	350	-1	-0.27%	350	-1	-0.29%	350	-1	-0.29%
Swamp Oak	Rare	1946	1906	-40	-2.07%	1905	-41	-2.09%	1888	-58	-2.96%	1867	-79	-4.04%
Sydney Peppermint-Stringybark	Rare	205	205	0	0.00%	205	0	0.00%	200	-4	-2.14%	200	-4	-2.14%
Tallowwood		3563	3561	-2	-0.05%	3561	-2	-0.05%	3561	-2	-0.06%	3556	-7	-0.19%
Turpentine		2470	2396	-74	-3.00%	2397	-73	-2.94%	2165	-305	-12.35%	2152	-318	-12.87%
Very Wet New England Blackbutt-Tallowwood		434	434	0	0.00%	434	0	0.00%	433	-1	-0.23%	433	-1	-0.23%
Wattle		783	769	-14	-1.84%	765	-18	-2.33%	695	-88	-11.21%	664	-119	-15.21%

Wet Bloodwood-Tallowwood		25677	25573	-103	-0.40%	25574	-102	-0.40%	25104	-573	-2.23%	25037	-639	-2.49%
Wet Coastal Tallowwood-Brushbox		1526	1511	-15	-1.01%	1498	-29	-1.88%	1451	-75	-4.92%	1358	-168	-11.00%
Wet Flooded Gum-Tallowwood		5399	5299	-100	-1.85%	5294	-105	-1.94%	4858	-541	-10.02%	4766	-633	-11.72%
Wet Foothills Blackbutt-Turpentine		1014	1014	0	0.00%	1014	0	0.00%	1011	-3	-0.30%	1001	-13	-1.29%
Yellow Box-Blakely's Red Gum	Vulnerable	38	38	0	0.00%	38	0	0.00%	37	-1	-1.99%	37	-1	-1.99%
Forestry Plantations		10325	10310	-15	-0.14%	10310	-15	-0.14%	10310	-15	-0.14%	10309	-16	-0.15%
Improved Pasture and Cropland		507	507	-1	-0.14%	507	-1	-0.14%	507	-1	-0.14%	507	-1	-0.14%
Introduced Scrub		989	730	-259	-26.15%	732	-258	-26.03%	967	-22	-2.20%	961	-28	-2.84%
Rainforest	Endangered	111641	111575	-66	-0.06%	111576	-65	-0.06%	110412	-1228	-1.10%	110202	-1439	-1.29%
Scrub	Vulnerable	4202	4202	0	0.00%	4202	0	0.00%	4077	-125	-2.98%	4073	-129	-3.07%
Cleared-Partially Cleared		3118	3115	-3	-0.10%	3115	-3	-0.10%	3105	-13	-0.42%	3101	-17	-0.56%
Camphor Laurel		6159	5693	-466	-7.56%	5699	-460	-7.47%	4701	-1458	-23.67%	4620	-1539	-24.99%

Although this model created the greatest impact on the forest class, the distribution of the land use change was similar to the environmental constraints scenario and relatively evenly spread across vegetation classes. Clarence lowlands spotted gum was the most affected vegetation type with 3650 hectares of its extent being converted to urban. Dry heathy blackbutt-bloodwood was reduced in area by some 13381 hectares.

Proportionally, 15.89% of saltbush area was urbanised and 16.22% of banksia classes. Both of these vegetation types are classified as rare. Overall 4867 hectares of endangered, rare and vulnerable vegetation was converted to urban.

8.5 SUMMARY

Chapter 8 presented a combined agricultural land protection and environmental protection, alternative futures design with two scenario options to manage the historical trend of excessive population growth in the north east area corner. The first option increased population settlement density, while the second option shifted population growth to plausible settlement areas to the west and south.

These scenarios highlight the huge challenges for the whole region in decision making to balance the ongoing protection of natural heritage and resources with exponential population growth in accordance with the stated preferences of communities (NRRS 2003).

The alternative futures options presented demonstrated qualitatively and quantitatively the effects of maintaining a higher population density in high demand areas, and the effecs that promotion of other locations for human settlements could have for the region. Although the reallocation of urban growth resulted in a greater overall urban area and increased loss of forests, examination of the change tables derived from these models suggests that both solutions provided a relatively balanced mix of resource use and land allocation in comparison to other scenarios.

In particular, the redistribution of urban development from the north coast into the southern and more inland areas would provide a number of

social, economic and institutional benefits for many of the towns within the region. The encouragement of this population shift would also provide greater protection for resources and the environment in coastal areas.

Given the amenity and environmental values of the beachside, coastal strip and the potential for additional vulnerability from likely sea-level rise a coastal protection priorty scenario is examined in Chapter 9.