SOUTH AFRICAN ESTUARIES:

CATCHMENT LAND-COVER

National Summary Report

Department of
Environmental
Affairs and
Tourism

CSIR
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DURBAN

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INTRODUCTION

The South African coastline stretches for some 3000 km from the Gariep (Orange) River at the Namibian border in the west to Kosi Bay near the Mozambique border in the east. Some 300 river outlets intersect this coastline and these range from small water bodies that are only occasionally connected to the ocean, to large, permanently open systems, and coastal lakes connected to the sea via a narrow channel (Heydorn, 1991). Being places where rivers meet the sea, estuaries are one of the most important features of the South African coastline; they are tranquil areas of high productivity and play a vital role in the life cycles of many plants and animals.

Apart from their ecological importance, estuaries are also popular sites for human activity and development. Recreational uses of estuaries include bait collection, bird watching, boating, fishing and swimming. Because of their great aesthetic value, areas around estuaries are often favoured for housing and tourist developments. The protected coastal waters of estuaries are also used for industrial and harbour development as well as domestic and industrial effluent discharges. Population growth and development in and around estuaries as well as the coastal zone in general, is placing increasing pressure on the health and function of these ecosystems.

In addition to development pressures in the coastal zone, activities taking place in the catchments of rivers that flow into estuaries also affect the health and functioning of these ecosystems. Runoff from the land enters streams and rivers, and eventually makes its way to estuaries, which act as sinks for materials, sediments, and nutrients derived from the catchment. Poor agricultural practices in the catchment can lead to increased nutrient and sediment loads in rivers and their estuaries while domestic and industrial waste discharge also introduce pollutants (e.g. trace metals) into these systems. Changes in river flow and natural flood events, through the construction of impoundments and water abstraction for irrigation, reduce the natural flushing of accumulated materials and sediment from estuaries.

Historically, conditions in the catchments of estuaries were difficult to recognise and quantify, however, the National Land-Cover Database Project (NLC), has produced standardised digital land-cover data for all of South Africa, Swaziland and Lesotho. This database has provided a unique opportunity to assess the state of land-cover in the catchments of rivers that flow into estuaries.

THE NATIONAL LAND-COVER DATABASE PROJECT

The National Land-Cover Database Project (NLC), undertaken by the CSIR and the Agricultural Research Council (ARC) collected land-cover data for all of South Africa,

Swaziland and Lesotho over the period 1994-1996. This information was mapped directly from a series of 1:250 000 scale, geo-referenced Landsat TM Spacemaps and was made available in a digital geographic information system (GIS) format (Thompson, 1996; Fairbanks *et al*., 2000).

Using this data, the nature and extent of land-cover in the catchments of selected estuaries was determined. Because of the scale at which the original data were captured (1:250 000), only those estuaries with relatively large catchments (mostly >500 km^2) were assessed.

LAND-COVER AND LAND-USE

Although somewhat related, land-cover and land-use are different. Land-cover refers to all the natural and man-made features that cover the earth's immediate material surface while land-use refers to the human activity that is associated with a specific land unit. There can only be one land-cover type associated with a point on the ground, but this may be associated with several land-uses. For example, a grassland may be used for communal grazing within a conservancy area (Thompson, 1996).

LAND-COVER CLASSIFICATION

The NLC has developed a standard land-cover classification scheme comprising 31 classes of land-cover. These land-cover classes are based on those developed by Thompson (1996) for southern Africa (Table 1) and has been designed to conform to internationally accepted standards and conventions in order to ensure cross-border compatibility and integration with existing national and international land-cover classifications systems and datasets.

Table 1. NLC land-cover classification (after Thompson, 1996).

NLC Code	Land-cover class	Description
1	Forest and Woodland	All wooded areas with greater than 10% tree canopy cover, where the canopy is composed of mainly self-supporting, single stemmed, woody plants >5 m in height. Essentially indigenous tree species growing under natural or semi-natural conditions.
2	Forest	
3	Thicket, scrub forest, bushland & high Fynbos	Communities typically composed of tall, woody, self-supporting, single and/or multi-stemmed plants (branching at or near the ground), generally with no clearly definable structure. Total canopy cover >10%, with canopy height between 2-5 m. Essentially indigenous species growing under natural or semi-natural conditions.
4	Shrubland & low Fynbos	Communities dominated by low, woody, self-supporting, multi-stemmed plants branching at or near the ground, between 0.2-2 m in height. Total tree cover <1.0%.
5	Herbland	Communities dominated by low, non-woody, self-supporting, non-grass like plants, between 0.2-2 m in height. Total tree cover <1.0%.
6	Unimproved grassland	Areas dominated by grass-like, non-woody, rooted herbaceous plants. Essentially indigenous species growing under natural or semi-natural conditions
7	Improved grassland	Planted grassland, containing either indigenous or exotic species, growing under man-managed conditions for grazing, hay or turf production, and recreation (e.g. golf courses).
8	Forest plantations	Areas of systematically planted, man-managed tree resources, composed of primarily exotic species (e.g. pine, eucalypt, wattle)
9	Waterbodies	Areas of open water including natural and man-made water bodies such as rivers, dams, permanent pans, lakes, lagoons and coastal waters.
10	Wetlands	Natural or artificial areas where the water level is at (or very near) the land surface on a permanent or temporary basis including saltmarsh, pans, reed-marsh, papyrus-swamp and peat bogs.
11	Barren rock	Natural areas of exposed sand, soil or rock with no, or very little, vegetation cover during any time of the year such as rock outcrops, dune and beach sand, dry river beds and gravel plains.
12	Dongas and sheet erosion scars	Permanent or seasonal, man-induced areas of very low vegetation cover (i.e. removal of tree, bush and/or herbaceous cover) in comparison with the surrounding natural vegetation cover. Typically associated with subsistence level farming and rural population centres, where overgrazing of livestock and/or wood-resource removal has been excessive. Often associated with severe soil erosion problems.
13	Degraded: forest and woodland	
14	Degraded: thicket & bushland etc.	
15	Degraded: unimproved grassland	
16	Degraded: shrubland and low Fynbos	
17	Degraded: herbland	
18	Cultivated: permanent - commercial irrigated	Lands cultivated with crops that occupy the area for long periods and are not replanted after harvest. Examples include tea plantations, vineyards, sugar cane, citrus orchards, hops and nuts.
19	Cultivated: permanent - commercial dryland	
20	Cultivated: permanent - commercial sugarcane	
21	Cultivated: temporary - commercial irrigated	Land under temporary crops that is harvested at the completion of the growing season, that remains idle until replanted. Examples include maize, wheat, legumes, potatoes, onions and Lucerne.
22	Cultivated: temporary - commercial dryland	
23	Cultivated: temporary - subsistence dryland	
24	Urban: residential	Areas in which people reside on a permanent or near-permanent basis including both formal and informal settlement areas, ranging from high to low building densities.
25	Urban: residential (smallholdings - forest & woodland)	
26	Urban: residential (smallholdings - thicket, bushland ...etc)	
27	Urban: residential (smallholdings - shrubland & low fynbos)	
28	Urban: residential (smallholdings - grassland)	
29	Urban: commercial	Non-residential areas used primarily for the conduct of commerce and other mercantile business, typically located in the central business district.
30	Urban: industrial/ transport	Non-residential areas with major industrial or transport related infrastructure. Examples include power stations, steel mills, dockyards and airports.
31	Mines and quarries	Areas in which mining activity has been done or is being done. Includes opencast mines and quarries as well as surface infrastructure (mine dumps etc.) associated with underground mining activities.

To provide a broad overview of the nature and extent of land-cover in a particular catchment these 31 classes were aggregated into four generalised land-cover categories: agriculture, degraded, natural and urban (Table 2).

Table 2. NLC land-cover classes aggregated into Agriculture, Degraded, Natural and Urban categories.

NLC Code	Land-cover class	Aggregated categories
7	Improved grassland	Agriculture
8	Forest plantations	
18	Cultivated: permanent - commercial irrigated	
19	Cultivated: permanent - commercial dryland	
20	Cultivated: permanent - commercial sugar cane	
21	Cultivated: temporary - commercial irrigated	
22	Cultivated: temporary - commercial dryland	
23	Cultivated: temporary - subsistence dryland	
12	Dongas & sheet erosion scars	Degraded
13	Degraded: forest and woodland	
14	Degraded: thicket & bushland (etc)	
15	Degraded: unimproved grassland	
16	Degraded: shrubland and low Fynbos	
17	Degraded: herbland	
1	Forest and Woodland	Natural
2	Forest	
3	Thicket & bushland (etc)	
4	Shrubland and low Fynbos	
5	Herbland	
6	Unimproved grassland	
9	Waterbodies	
10	Wetlands	
11	Barren rock	
24	Urban: residential	Urban
25	Urban: residential (smallholdings: forest & woodland)	
26	Urban: residential (smallholdings: bushland)	
27	Urban: residential (smallholdings: shrubland)	
28	Urban: residential (smallholdings: grassland)	
29	Urban: commercial	
30	Urban: industrial/transport	
31	Mines & Quarries	

Most of the aggregated land-cover classes are self-explanatory, however, in certain cases, some compromise was required. The class 'improved grassland', for example, includes recreational man-managed grasslands such as golf courses, but also includes agriculture-related land-cover such as grazing, and hay or turf production (Thompson, 1996). For this analysis, 'improved grassland' was placed under the category 'Agriculture'. Fairbanks *et al*. (2000) also placed 'improved grassland' under the category of 'Cultivated Lands' in their aggregation of the NLC land-cover classes.

Degraded vegetation classes (NLC classes 13-17) are typically associated with rural subsistence level farming and livestock grazing, however, they are predominantly related to severe soil erosion problems associated with overgrazing and/or excessive wood-resource removal (Thompson, 1996). Although Fairbanks *et al*. (2000) placed these classes in the 'Cultivated Lands' category, in this analysis these classes, together with 'dongas and sheet erosion scars', were placed in a separate category - Degraded. The NLC land-cover classification also distinguishes between degraded lands and subsistence cultivation (NLC class 23).

In the classes 'waterbodies' and 'wetlands', no distinction is made between natural and man-made areas. Both classes were included under the category Natural in this study. It should be noted, however, that artificial impoundments can and often do, have a major impact on the functioning of rivers and estuaries.

NATIONAL SUMMARY

The nature and extent of each generalised land-cover category was determined for some 62 estuarine catchments. These results are presented in Figure 1. Details on the catchment land-cover for each estuary are contained in the Appendix.

The catchments of estuaries in KwaZulu-Natal (Kosi Bay-Mtamvuna) had a relatively high proportion of commercial agriculture (>20%). There was also a relatively high proportion (>20%) of agriculture in the catchments of estuaries in the Transkei region of the Eastern Cape (Mtamvuna-Great Kei). This, however, primarily consisted of subsistence farming. Those systems in the Western Cape (Keurbooms-Olifants) had this highest proportion (>40%) of agriculture in their catchments and this was mainly commercial.

Estuaries situated in predominantly rural areas, particularly in the Transkei (Mtamvuna-Great Kei) and Ciskei (Tyolomnqa-Great Fish) regions of the Eastern Cape had the highest proportion of degraded land-cover in their catchments. Most catchments had over 10% degraded land-cover with many exceeding 20%. This is probably a result of poor farming practices.

Most estuaries had a relatively high proportion of natural land-cover in their catchments, usually exceeding 50%. Estuaries in the southwest region of the Eastern Cape (Great Kei-Kromme) had the highest proportion of natural land-cover, generally exceeding 70% and often as high as 80-90%. Those estuaries with very large catchments, generally above 20 000 km^2 such as the Thukela, Mzimvubu, Great Kei, Great Fish, Sundays, Gamtoos, Gourits, Olifants and Gariep also had a high proportion of natural land-cover (>70%).

A relatively high proportion of urban land-cover was associated with those estuaries located near coastal cities such as the Mgeni and Durban Bay near Durban, the Buffalo system near East London, the Swartkops estuary near Port Elizabeth, and the Diep estuary near Cape Town. Relatively high residential development was also apparent in the rural areas of the Eastern Cape (Transkei and Ciskei). This is probably a result of a relatively high population density in this region.

This analysis provides a unique, quantitative measure of land-cover in the catchments of the major estuaries along the South African coast, using remote sensing data. It serves as a valuable measure of the state of environment of these systems as well as a useful tool for planners and managers. These results can also be used as a baseline against which future changes in catchment land-use can be monitored.

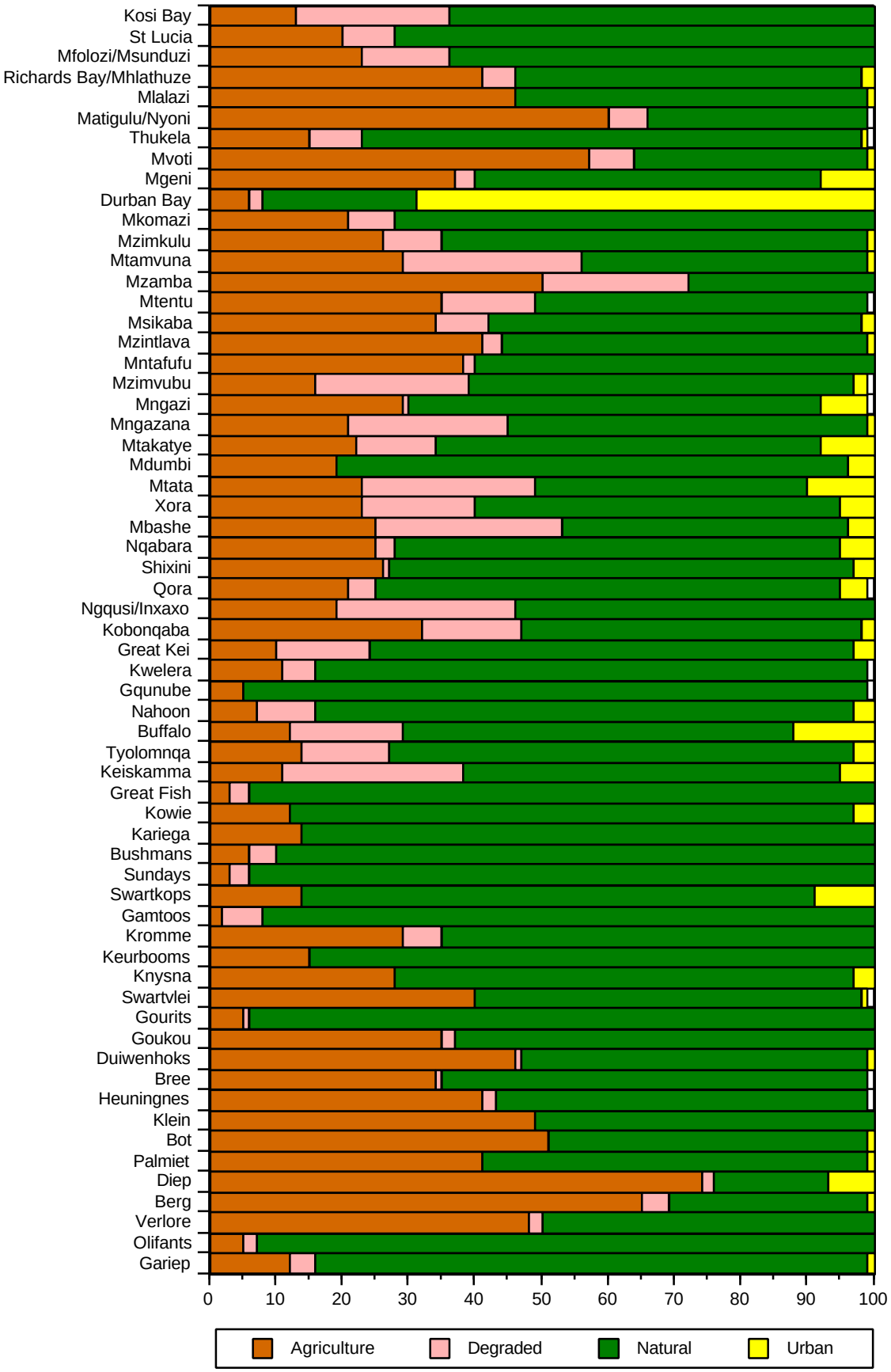

Figure 1. Percent land-cover for the catchments of 62 South African estuaries.

REFERENCES AND SUGGESTED READING

Allanson, B. R. & Baird D. 2000. *Estuaries of South Africa*. Cambridge University Press, Cambridge. 340 pp.

Begg, G. W. G. W. 1978. The estuaries of Natal. *Natal Town and Regional Planning Report*. 41: 1- 657.

Begg, G. W. 1984. The estuaries of Natal (Part II). *Natal Town and Regional Planning Report*. 55: 1- 631.

Branch, G. & Branch, M. 1992. *The Living Shores of Southern Africa*. Struik Publishers, Cape Town. 272 pp.

Day, J. H. 1981. *Estuarine Ecology with Particular Reference to Southern Africa*. A. A. Balkema, Cape Town. 411 pp.

Fairbanks, D. H. K., Thompson, M. W., Vink, D. E., Newby, T. S., van den Berg, H. M. & Everard, D. A. 2000. The South African Land-Cover Characteristics Database: a synopsis of the landscape. *South African Journal of Science*. 96: 69-82.

Harrison, T. D., Cooper, J. A. G. & Ramm, A. E. L. 2000. State of South African estuaries. Geomorphology, ichthyofauna, water quality and aesthetics. *Department of Environmental Affairs & Tourism State of the Environment Report* 2: 1-127.

Heydorn A. E. F. 1991. The conservation status of southern African estuaries. In Huntley, B. J. (Ed.) *Biotic Diversity in Southern Africa. Concepts and Conservation*. Oxford University Press, Cape Town. pp 290-297.

Heydorn, A. E. F. & Tinley, K. L. 1980. Estuaries of the Cape, Part I: Synopsis of the Cape coast. Natural features, dynamics and utilization. *CSIR Research Report* 380: 1-97.

Noble, R. G. & Hemens, J. 1978. Inland water ecosystems in South Africa – a review of research needs. *South African National Scientific Programmes Report* 34: 1-150.

Payne, A. I. L. & Crawford, R. J. M. 1989. *Oceans of Life off Southern Africa*. Vlaeberg Publishers, Cape Town. 380 pp.

Thompson, M. 1996. A standard land-cover classification scheme for remote-sensing applications in South Africa. *South African Journal of Science*. 92: 34-42.

Whitfield, A. K. 2000. Available scientific information on individual South African estuarine systems. *Water Research Commission Report*. 577/3/00.

Appendix

Catchment land-cover characteristics of selected South African estuaries

1) Kosi Bay

Kosi Bay (26° 54' S; 32° 53'E) is situated on the east (KwaZulu-Natal) coast near the Mozambique border. This system has a catchment area of approximately 304 km^2. Approximately 13% of the Kosi Bay catchment was under agriculture, mostly subsistence farming. Roughly 23 % of the catchment was degraded, comprising degraded grassland and forest while about 64% was natural, and generally consisted of grassland, waterbodies (the Kosi lakes), forest, and forest and woodland. There did not appear to be any major development in the catchment.

2) St Lucia

The St Lucia estuary (28° 23' S; 32° 25'E) is situated north of the coastal town of Richards Bay in KwaZulu-Natal. It is the largest estuarine system in the country and has a catchment area of approximately 9 542 km^2. Approximately 20 % of the catchment was under agriculture, mostly subsistence agriculture and forestry. About 8% of the St Lucia catchment was degraded, comprising degraded forest, bushland and grassland. Roughly 73% of the catchment was natural and comprised a mixture of forest and woodland, bushland, and grassland with waterbodies and wetlands associated with the St Lucia system. There was very little urban development in the St Lucia catchment (<1%) and most of this comprised mines and quarries located in the upper catchment, near the town of Vryheid, as well as some residential development.

3) Mfolozi/Msunduzi

The Mfolozi/Msunduzi estuary (28° 24' S; 32° 25'E) is located north of the coastal town of Richards Bay in KwaZulu-Natal. This system has a catchment area of approximately 11 068 km^2. Agriculture accounted for about 23% of the catchment land-cover in the Mfolozi/Msunduzi system. Most of this consisted of subsistence agriculture and commercial forestry. Approximately 13 % of the catchment was degraded, mostly comprising degraded grassland, bushland and forest while about 64% was natural. Natural land-cover generally consisted of grassland, bushland, and forest and woodland. There was very little urban development (<1%) in the Mfolozi/Msunduzi catchment. Most of the urban development comprised residential and industrial development associated with the towns of Mtubatuba in the lower catchment, Ulundi in the middle catchment and Vryheid in the upper catchment; mines and quarries were also located near the inland town of Vryheid.

4) Richards Bay/Mhlathuze (Mhlatuze)

The Richards Bay/Mhlathuze system (28° 51' S; 32° 03'E) is situated at the coastal town of Richards Bay in KwaZulu-Natal. Prior to the construction of a deep-water harbour in the 1970's, the system comprised a large shallow, expanse of water, fed primarily by the Mhlathuze River, with a catchment area of approximately 3670 km^2. The system today consists two separate components, a harbour (Richards Bay) and a sanctuary area (Mhlathuze estuary) into which the Mhlathuze River flows. The harbour and sanctuary are

separated by a 4 km long causeway or berm and each has its own separate opening to the sea. Although the harbour and sanctuary are separate systems, the two components have been combined in this analysis. Approximately 41% of the Richards Bay/Mhlathuze catchment was under agriculture, comprising a mixture of commercial forestry, subsistence farming and sugar cane. About 5% of the catchment was degraded, mostly consisting of degraded bushland and grassland. Roughly 52 % of the catchment was natural and comprised grassland, bushland, and forest and woodland. Urban development accounted for about 2% of the catchment land-cover and this comprised mainly residential, industrial and commercial development mainly associated with Richards Bay near the coast as well as Empangeni further inland.

5) Mlalazi

The Mlalazi estuary (28° 57' S; 31° 49'E) is located just south of Richards Bay in KwaZulu-Natal. The river is approximately 54 km long with a catchment area of 492 km^2. Approximately 46% of the catchment land-cover of the Mlalazi system was agriculture and consisted mainly subsistence farming, sugar cane and commercial forestry. The catchment did not appear to be degraded and about 53% was natural. This comprised grassland, bushland and forest. About 1% of the catchment was urban comprising mainly the residential and industrial developments associated with of the coastal village of Mtunzini and the town of Eshowe further inland.

6**) Matigulu/Nyoni**

The Matigulu/Nyoni system (29° 05' S; 31° 38'E) is situated south of Richards Bay in KwaZulu-Natal. This system drains a catchment area of over 900 km^2. Approximately 60% of the catchment was under agriculture, mainly sugar cane and subsistence farming with some commercial forest. About 6% of the Matigulu/Nyoni catchment comprised degraded bushland. Roughly 33% of the catchment was natural, mostly comprising grassland, bushland and forest. Very little of the catchment was urban (<1%) and most of this was residential and commercial and industrial development associated with the inland town of Eshowe.

7**) Thukela (Tugela)**

The Thukela system (29° 13' S; 31° 30'E) is situated in KwaZulu-Natal, approximately midway between Richards Bay and the coastal city of Durban. The Thukela is the largest river system in KwaZulu-Natal. The river is approximately 405 km long with a catchment area of 29 101 km^2. About 15% of the Thukela catchment was under agriculture, comprising mainly subsistence farming, temporary commercial dryland agriculture, temporary commercial irrigated agriculture, and commercial forestry. Some sugar cane and improved grasslands were also present. Roughly 8% of the Thukela catchment comprised degraded grassland, bushland and forest with some erosion also present. A high proportion of the catchment (75%) was natural and consisted mostly of grassland and bushland with some forest.

Approximately 1% of the catchment was urban, comprising mostly residential, industrial and commercial development as well as mines and quarries. This was mainly associated with the towns of Estcourt, Ladysmith, Dundee and Newcastle situated in the upper catchment.

8) Mvoti

The Mvoti estuary (29° 24' S; 31° 20'E) is situated north of the coastal city of Durban in KwaZulu-Natal. The river is approximately 197 km long with a catchment area of 2 829 km^2. About 57% of the Mvoti catchment was under agriculture. This mainly comprised commercial forestry and sugar cane as well as commercial dryland agriculture and subsistence farming. Around 7% of the catchment consisted of degraded bushland and grassland while approximately 35% was natural. This consisted mainly of bushland and grassland with some forest. Urban development accounted for 1% of the catchment land-cover and this was largely residential development, smallholdings and commercial and industrial development mainly associated with the town of Stanger in the lower catchment and Greytown in the upper catchment.

9) Mgeni

The Mgeni estuary (29° 48' S; 31° 02'E) is situated near the coastal city of Durban in KwaZulu-Natal. The river is approximately 232 km long with a catchment area of 4 432 km^2. Approximately 37% of the Mgeni catchment was under agriculture, consisting mainly of commercial forestry, sugar cane and subsistence farming with some temporary commercial dryland agriculture, temporary commercial irrigated agriculture, and improved grassland also present. About 3% of the catchment consisted of degraded bushland and shrubland. Approximately 52% of the Mgeni catchment was natural and comprised grassland, bushland, and forest. A number of impoundments (Inanda Dam, Nagle Dam, Albert Falls Dam and Midmar Dam) also occur in the catchment. Roughly 8% of the catchment land-cover was urban, mostly residential, industrial, and commercial development associated with the cities of Durban at the coast and Pietermaritzburg inland.

10) Durban Bay

Durban Bay (29° 52' S; 31° 04'E) is located in the coastal city of Durban in KwaZulu-Natal. This important industrial harbour has a catchment area of approximately 264 km^2. About 6% of the Durban Bay catchment was under agriculture, comprising mostly subsistence farming, commercial sugar cane, commercial forest, and improved grasslands. It should be noted that the improved grasslands in this catchment were mainly associated with recreational areas. Approximately 2% of the catchment comprised degraded bushland with roughly 23% natural, consisting mostly of bushland, grassland and forest. The coastal city of Durban accounts for the high proportion of urban development (70%) in the catchment. This is mainly residential, industrial and commercial development with some smallholdings also present.

11) Mkomazi

The Mkomazi estuary (30° 12' S; 30° 48'E) lies south of the city of Durban in KwaZulu-Natal. The river is approximately 298 km long with a catchment area of 4 310 km^2. Approximately 21% of the Mkomazi catchment was under agriculture. Most of this was commercial forestry and subsistence farming with some temporary commercial irrigated agriculture, temporary commercial dryland agriculture, sugar cane, and improved grassland also present. About 7% of the catchment comprised degraded shrubland and bushland. A large proportion of the Mkomazi catchment (72%) was natural. This was mostly made up of grassland, bushland and forest. There was little urban development (<1%) in the Mkomazi catchment and most of this comprised residential development, smallholdings and industrial development associated with the towns of Umkomaas near the coast and Ixopo and Richmond further inland.

12) Mzimkulu

The Mzimkulu estuary (30° 44' S; 30° 27'E) is situated near the coastal town of Port Shepstone in KwaZulu-Natal. The river is approximately 329 km long with a catchment area of 6 745 km^2. About 26% of the Mzimkulu catchment was under agriculture, mostly commercial forestry and subsistence farming. Some temporary commercial irrigated agriculture, sugar cane, temporary commercial dryland agriculture, and improved grassland was also present. Approximately 9% of the catchment land-cover was degraded grassland and bushland with roughly 64% being natural; this consisted mainly of grassland, bushland, and forest. About 1% of the land-cover comprised of urban development, mainly residential development and smallholdings. Major towns in the Mzimkulu catchment include Port Shepstone near the coast and Umzimkulu further inland.

13) Mtamvuna

The Mtamvuna estuary (31° 04' S; 30° 12'E) is situated just south of the coastal town of Port Edward at the KwaZulu-Natal/Eastern Cape provincial border. The river is approximately 162 km long with a catchment area of 1 553 km^2. Agriculture accounted for approximately 29% of the land-cover in the Mtamvuna catchment. Most of this was subsistence farming and commercial forestry, with some sugar cane also present. About 27% of the catchment was degraded grassland while approximately 43% was natural. Natural land-cover comprised grassland, thicket and bushland, and forest. Urban development, mainly residential and smallholdings accounted for approximately 1% of the catchment land-cover.

14) Mzamba

The Mzamba estuary (31° 06' S; 30° 10'E) is situated on the Transkei coast of the Eastern Cape, just south of Port Edward near the KwaZulu-Natal/Eastern Cape provincial border. This system drains a catchment area of approximately 505 km^2. About 50% of the Mzamba catchment was under agriculture and most of this comprised subsistence farming with some commercial forestry and sugar cane also present. Approximately 22% of the catchment consisted of degraded grassland with only 28% natural. This comprised mainly grassland

and bushland with some forest also present. Very little (<1%) of the catchment land-cover was urban and most of this was (rural) residential.

15) Mtentu

The Mtentu estuary (31° 15' S; 30° 03'E) is situated north of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 965 km^2. About 35% of the catchment was under agriculture, almost entirely comprising subsistence farming. Approximately 14% of the land-cover comprised degraded grassland while about 50% was natural grassland, bushland, and forest. Very little urban development (<1%) occurred in the catchment and almost all of this was (rural) residential.

16) Msikaba

The Msikaba system (31° 18' S; 29° 58'E) lies north of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 1 011 km^2. Agriculture accounted for about 34% of the catchment land-cover in the Msikaba system. Most of this was subsistence farming with a little commercial forestry also present. About 8% of the catchment was degraded, comprising mainly degraded grassland, forest, and bushland. Approximately 56% of the Msikaba catchment was natural, mainly grassland and bushland with some forest. Roughly 2% of the land-cover comprised residential (rural) development.

17) Mzintlava

The Mzintlava estuary (31° 32' S; 29° 41'E) is situated north of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 280 km^2. Approximately 41% of the catchment land-cover in the Mzintlava system comprised agriculture. Most of this was subsistence farming with some permanent commercial dryland agriculture and forestry. About 3% of the catchment comprised degraded bushland and grassland. Natural grassland, forest, and bushland accounted for approximately 55% of the catchment land-cover. Roughly 1% of the catchment comprised residential (rural) development.

18) Mntafufu

The Mntafufu estuary (31° 34' S; 29° 38'E) lies north of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 178 km^2. Approximately 38% of the Mntafufu catchment consisted of subsistence agriculture. A further 2% was degraded grassland while 60% was natural. The natural land-cover mainly comprised grassland, forest, and thicket and bushland. The Mntafufu catchment did not appear to be developed.

19) Mzimvubu

The Mzimvubu estuary (31° 38' S; 29° 33'E) is situated near the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 19 853 km^2. Approximately 16% of the Mzimvubu catchment was under agriculture, mainly subsistence farming. Some temporary commercial dryland agriculture, commercial forestry, temporary commercial irrigated agriculture and improved grassland were also present. About 23% of the catchment comprised degraded grassland while approximately 58% was natural. This mostly comprised grassland and bushland with some wetland and forest also present. About 2% of the Mzimvubu catchment was urban, mostly residential (rural) development.

20) Mngazi

The Mngazi estuary (31° 41' S; 29° 27'E) lies just south of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 561 km^2. Agriculture accounted for about 29% of the catchment land-cover in the Mngazi system. Most of this comprised subsistence farming, commercial forestry, and temporary commercial irrigated agriculture. Only 1% of the catchment was degraded, comprising degraded bushland and grassland. Approximately 62% of the land-cover was natural; most of this was grassland, bushland and forest. Residential (rural) development accounted for about 7% of the catchment land-cover in the Mngazi system.

21) Mngazana

The Mngazana estuary (31° 42' S; 29° 25'E) is situated south of the town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 285 km^2. Approximately 21% of the Mngazana catchment was under agriculture. Most of this comprised subsistence farming with some commercial forestry also present. About 24% of the catchment was degraded, mostly degraded grassland and bushland. Natural bushland, grassland and forest accounted for approximately 54% of the land-cover. Roughly 1% of the land-cover comprised residential (rural) development.

22) Mtakatye

The Mtakatye estuary (31° 51' S; 29° 16'E) lies south of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 493 km^2. Agriculture accounted for 22% of the catchment land-cover of the Mtakatye system. Most of this was subsistence farming and some commercial forestry. About 12% of the catchment comprised degraded grassland while 58% was natural. Natural land-cover included grassland, bushland and forest. Approximately 8% of the catchment comprised residential (rural) development.

23) Mdumbi

The Mdumbi estuary (31° 56' S; 29° 13'E) is situated south of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 2 338 km^2. Approximately 19% of the land-cover in the Mdumbi catchment was agriculture. This comprised mainly subsistence farming with some commercial forestry. Very little of the catchment was degraded (<1%) and this consisted of degraded grassland. A large proportion (77%) of the Mdumbi catchment was natural, comprising mainly grassland, bushland, and forest. About 4% of the land-cover consisted of residential (rural) development.

24) Mtata

The Mtata estuary (31° 57' S; 29° 10'E) lies south of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 2 585 km^2. Approximately 23% of the land-cover in the Mtata catchment was agriculture and comprised a mixture of commercial forestry and subsistence farming. About 26% of the catchment consisted of degraded grassland while 41% was natural. Natural land-cover comprised mostly grassland, bushland, and forest. Approximately 10% of the catchment consisted of mostly residential (rural) development; a small amount of commercial and industrial development was located at the inland city of Umtata.

25) Xora

The Xora estuary (32° 10' S; 29° 00'E) is situated south of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 438 km^2. Agriculture accounted for about 23% of the land-cover in the Xora catchment. Most of this comprised subsistence farming with some commercial forestry also present. About 17% of the catchment was degraded grassland while approximately 55% was natural. Natural land-cover mainly comprised grassland, thicket and bushland, and forest. Approximately 5% of the catchment consisted of residential (rural) development.

26) Mbashe

The Mbashe estuary (32° 15' S; 28° 54'E) is situated south of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 6 030 km^2. About 25% of the land-cover in the Mbashe catchment comprised agriculture, mostly subsistence farming, commercial forestry, commercial temporary dryland agriculture and commercial temporary irrigated agriculture. Approximately 28% of the catchment was degraded grassland while 43% was natural. Natural land-cover consisted of grassland, thicket and bushland, and forest. Residential (rural) development comprised 5% of the catchment land-cover.

27) Nqabara

The Nqabara estuary (32° 20' S; 28° 47'E) lies south of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 578 km^2. Approximately 25% of the Nqabara catchment was under agriculture, mainly subsistence farming with some commercial forest also present. Degraded grassland comprised 3% of the catchment land-cover while 67% was natural. Natural land-cover was mostly grassland, bushland, and some forest. About 5% of the catchment comprised mainly residential (rural) development with quarries also present.

28) Shixini

The Shixini system (32° 24' S; 28° 43'E) lies south of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 332 km^2. Approximately 26% of the Shixini catchment was under agriculture, mainly subsistence farming with some commercial forestry. Only 1% of the catchment comprised degraded grassland while 70% was natural grassland, bushland, and forest. About 3% of the land-cover comprised residential (rural) development.

29) Qora

The Qora estuary (32° 27' S; 28° 40'E) is situated south of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a catchment area of approximately 700 km^2. Agriculture comprised 21% of the land-cover in the Qora catchment. This was mostly subsistence farming with some commercial forestry also present. About 4% of the catchment comprised degraded grassland while 70% was natural. Natural land-cover consisted mainly of grassland, bushland, and forest. Approximately 4% of the catchment comprised residential (rural) development.

30) Ngqusi/Inxaxo

The Ngqusi/Inxaxo system (32° 35' S; 28° 31'E) is situated south of the coastal town of Port St Johns on the Transkei coast of the Eastern Cape. This system drains a total catchment area of approximately 134 km^2. Approximately 19% of the Ngqusi/Inxaxo catchment comprised agriculture, mostly subsistence farming. About 27% of the land-cover comprised degraded grassland while 54% was natural. Natural land-cover consisted mainly of grassland, bushland, and forest. There did not appear to be any major development in the Ngqusi/Inxaxo catchment.

31) Kobonqaba

The Kobonqaba estuary (32° 36' S; 28° 29'E) is situated on the Transkei coast of the Eastern Cape, south of Port St Johns. This system drains a catchment area of approximately 321 km^2. Agriculture accounted for 32% of the land-cover in the Kobonqaba catchment and this mainly comprised subsistence farming with some commercial forestry and temporary commercial dryland agriculture. About 15% of the catchment was degraded grassland while

approximately 51% was natural, consisting mainly of grassland, bushland, forest and woodland, and forest. Residential (rural) development accounted for about 2% of the catchment land-cover.

32) Great Kei

The Great Kei estuary (32° 41' S; 28° 23'E) is situated north of the coastal city of East London and forms the southern border of the Transkei coast of the Eastern Cape. The river is approximately 520 km long with a catchment area of 20 566 km^2. About 10% of the Great Kei catchment was under agriculture. Most of this comprised subsistence farming, commercial forestry, temporary commercial dryland agriculture and temporary commercial irrigated agriculture. Approximately 14% of the catchment was degraded and comprised degraded grassland and bushland as well as some erosion. About 73% of the catchment land-cover was natural and consisted mainly of grassland, bushland and shrubland. Urban development accounted for about 3% of the catchment land-cover. This mainly comprised residential development as well as some smallholdings and industrial development. Major towns in the catchment include Butterworth in the lower catchment and Queenstown in the upper catchment.

33) Kwelera

The Kwelera estuary (32° 55' S; 28° 05'E) is situated north of the coastal city of East London in the Eastern Cape. The river is approximately 86 km long with a catchment area of 418 km^2. Approximately 11% of the Kwelera catchment comprised agriculture. This mainly consisted of a mixture of temporary commercial irrigated agriculture, temporary commercial dryland agriculture, subsistence farming, permanent commercial dryland agriculture, commercial forestry and some improved grasslands. Roughly 5% of the catchment was degraded, comprising mainly degraded grassland and bushland. A high proportion of the catchment was natural (83%) and comprised bushland and grassland. There was little urban development in the Kwelera catchment (<1%) and this mainly consisted of residential development.

34) Gqunube

The Gqunube estuary (32° 56' S; 28° 02'E) lies just north of the coastal city of East London in the Eastern Cape. The river is approximately 109 km long with a catchment area of 665 km^2. Only 5% of the Gqunube catchment was under agriculture and this mainly consisted of temporary commercial dryland agriculture, subsistence farming, and commercial forestry. Degraded grassland also contributed little (<1%) to the land-cover of the Gqunube catchment. Most of the land-cover was natural (94%) and this comprised mainly thicket and bushland and grassland. There was little (<1%) urban development and this primarily consisted of residential development with some industrial development, mainly associated with the coastal town of Gonubie near East London.

35) Nahoon

The Nahoon estuary (32° 59' S; 27° 57'E) is situated near the coastal city of East London in the Eastern Cape. The river is approximately 77 km long with a catchment area of 584 km^2. Agriculture, mainly subsistence farming, temporary commercial dryland agriculture and commercial forestry comprised 7% of the land-cover in the Nahoon catchment. About 9% of the catchment was degraded, comprising mainly degraded grassland and bushland. Approximately 81% of the catchment was natural and consisted mainly of thicket and bushland and grassland. Urban development accounted for 3% of the land-cover and his mainly consisted of residential and industrial development associated with the coastal city of East London.

36) Buffalo

The Buffalo estuary (33° 02' S; 27° 55'E) is situated at the coastal city of East London in the Eastern Cape. The river is approximately 133 km long with a catchment area of 1 279 km^2. About 12% of the Buffalo catchment was under agriculture, mainly subsistence farming, commercial forestry, temporary commercial dryland agriculture and temporary commercial irrigated agriculture. Approximately 17% of the catchment was degraded and consisted mainly of degraded grassland and bushland. About 59% of the Buffalo catchment was natural and comprised mostly bushland, grassland and forest. Urban development accounted for roughly 12% of the land-cover. This was mainly residential, industrial, and commercial development associated with the coastal city of East London and the inland towns of Bisho and King William's Town.

37) Tyolomnqa

The Tyolomnqa estuary (33° 14' S; 27° 35'E) lies southwest of the coastal city of East London and forms the northern border of the Ciskei coast of the Eastern Cape. The river is approximately 78 km long with a catchment area of 441 km^2. Agriculture, mostly subsistence farming, temporary commercial dryland agriculture, and commercial forestry accounted for approximately 14% of the land-cover in the Tyolomnqa catchment. About 13% of the catchment comprised degraded grassland while approximately 70% was natural. Natural land-cover consisted primarily of bushland and grassland. Urban development comprised roughly 3% of the catchment land-cover and this was mainly residential (rural) development.

38) Keiskamma

The Keiskamma estuary (33° 17' S; 27° 29'E) is found on the Ciskei coast of the Eastern Cape and is situated approximately midway between the City of East London in the north and the coastal town of Port Alfred in the south. The river is approximately 263 km long with a catchment area of 2 745 km^2. About 11% of the Keiskamma catchment was under agriculture. Most of this comprised subsistence farming and commercial forestry with some temporary commercial irrigated agriculture. Approximately 27% of the catchment was degraded, comprising mainly degraded grassland and bushland. Roughly 57% of the

Keiskamma catchment was natural and consisted primarily of bushland, grassland and forest with some shrubland also present. Urban development accounted for approximately 5% of the catchment land-cover and this comprised mainly residential development.

39) Great Fish

The Great Fish estuary (33° 30' S; 27° 08'E) is situated northeast of the coastal town of Port Alfred and forms the southern border of the Ciskei coast of the Eastern Cape. The river is approximately 730 km long with a catchment area of 30 366 km^2. About 3% of the catchment land-cover was under agriculture; most of this comprised a mixture of temporary commercial irrigated agriculture, improved grasslands, commercial forestry, temporary commercial dryland agriculture and permanent commercial irrigated agriculture. Approximately 3% of the Great Fish catchment was degraded, consisting primarily of degraded shrubland, bushland and grassland. About 94% of the catchment was natural and consisted mainly of shrubland, grassland and bushland with some forest and woodland. Urban development, mainly residential, comprised less than 1% of the catchment land-cover. Major towns in the Great Fish catchment included Peddie in the lower catchment, Fort Beaufort, Adelaide, Bedford, Somerset East, and Craddock in the middle catchment and Middleburg in the upper catchment.

40) Kowie

The Kowie estuary (33° 36' S; 26° 54'E) is located at the coastal town of Port Alfred in the Eastern Cape. The river is approximately 94 km long with a catchment area of 800 km^2. Agriculture accounted for 12% of the catchment land-cover in the Kowie system. This consisted mainly of temporary and permanent commercial dryland agriculture, temporary commercial irrigated agriculture, commercial forestry, improved grasslands, and subsistence farming. Very little of the Kowie catchment was degraded (<1%) and this comprised degraded grassland. Approximately 85% of the catchment land-cover was natural and mostly comprised bushland and grassland. About 3% of the catchment was urban, mainly residential and commercial and industrial development associated with the coastal town of Port Alfred, the inland town of Bathurst, and the city of Grahamstown in the upper catchment.

41) Kariega

The Kariega estuary (33° 41' S; 26° 44'E) is situated southwest of the coastal town of Port Alfred in the Eastern Cape. The river is approximately 138 km long with a catchment area of 685 km^2. About 14% of the Kariega catchment was under agriculture. Most of this comprised a mixture of temporary and permanent commercial dryland agriculture, improved grasslands, temporary commercial irrigated agriculture, and commercial forestry. The Kariega catchment did not appear to be degraded and a large proportion (96%) was natural, mainly comprising bushland and grassland. Very little of the catchment (<1%) was developed and this was mostly residential.

42) Bushmans

The Bushmans system (33° 42' S; 26° 40'E) is situated southwest of the coastal town of Port Alfred in the Eastern Cape. The river is approximately 293 km long with a catchment area of 2 675 km^2. Agriculture accounted for about 6% of the catchment land-cover in the Bushmans system. Most of this consisted of a mixture of temporary commercial dryland agriculture, temporary commercial irrigated agriculture, commercial forestry, permanent commercial dryland agriculture, commercial forestry, and subsistence farming. Approximately 4% of the catchment appeared to be degraded and this mainly comprised degraded bushland. A high proportion (90%) of the Bushmans catchment was natural and comprised mainly forest and woodland, shrubland, and grassland. Urban development accounted for less than 1% of the land-cover and this was mostly residential and industrial development associated with the coastal resort of Kenton-on-Sea and the towns of Patterson and Alicedale in the upper catchment.

43) Sundays

The Sundays estuary (33° 43' S; 25° 51'E) is located northeast of the coastal city of Port Elizabeth in the Eastern Cape. The river is approximately 481 km long with a catchment area of 20 990 km^2. About 3% of the catchment land-cover in the Sundays system was under agriculture, mostly temporary commercial dryland agriculture, temporary commercial irrigated agriculture, improved grassland, and commercial forestry. Approximately 3% of the catchment was degraded, comprising mainly degraded shrubland and bushland. Most of the Sundays catchment was natural (94%), consisting of shrubland, bushland and grassland. Very little of the catchment was urban (<1%) and this consisted mainly of residential development with some industry. The only major town in the Sundays catchment was Graaf Reinet in the upper catchment with smaller towns such as Kirkwood, Jansenville and Pearston occurring in the middle to upper catchment.

44) Swartkops

The Swartkops estuary (33° 52' S; 25° 38'E) is situated near the coastal city of Port Elizabeth in the Eastern Cape. The river is approximately 134 km long with a catchment area of 1 303 km^2. Agriculture accounted for approximately 14% of the land-cover in the Swartkops catchment. This consisted mainly of temporary commercial dryland agriculture, temporary commercial irrigated agriculture, commercial forestry, and improved grasslands. Less than 1% of the catchment was degraded bushland while approximately 77% was natural, mostly shrubland and bushland with some wetlands and waterbodies also present. Urban development accounted for approximately 9% of the catchment land-cover. This was mostly residential, commercial and industrial development associated with the coastal city of Port Elizabeth and the towns of Despatch and Uitenage further inland.

45) Gamtoos

The Gamtoos estuary (33° 58' S; 25° 04'E) lies to the west of the coastal city of Port Elizabeth in the Eastern Cape. The river is approximately 645 km long with a catchment area of 34 635 km^2. Agriculture accounted for about 2% of the land-cover in the Gamtoos catchment. This was mainly temporary commercial irrigated agriculture, temporary commercial dryland agriculture, permanent commercial irrigated agriculture, and commercial forestry. About 6% of the catchment was degraded shrubland while approximately 92% was natural, mostly shrubland and bushland. Urban development accounted for less than 1% of the catchment land-cover and this was mainly residential development with some mining and industrial development also present. Main towns in the Gamtoos catchment include Hankey and Patensi in the lower catchment, Steytlerville, Joubertina, Uniondale and Willowmore further inland and Murraysburg in the upper catchment.

46) Kromme

The Kromme estuary (34° 09' S; 24° 51'E) lies to the west of the coastal city of Port Elizabeth in the Eastern Cape. The river is approximately 109 km long with a catchment area of 1 085 km^2. Approximately 29% of the Kromme catchment was under agriculture, mostly temporary commercial dryland agriculture. About 6% of the land-cover was degraded shrubland while roughly 65% was natural; this comprised mainly shrubland and bushland. A number of impoundments (Kromrivier Dam and Impofu Dam) also occur in the catchment and these have affected the hydrology of the system, particularly the estuary. There was very little urban development in the Kromme catchment (<1%) and most of this was residential, associated with the holiday resort of St Francis Bay near the coast.

47) Keurbooms

The Keurbooms system (34° 02' S; 23° 23'E) is located in the Western Cape province near the coastal town of Plettenberg Bay. The river is approximately 85 km long with a catchment area of 1 080 km^2. Agriculture accounted for approximately 15% of the land-cover in the Keurbooms catchment. This was mainly commercial forestry, improved grasslands, temporary commercial irrigated agriculture, and temporary commercial dryland agriculture. Very little (<1%) of the Keurbooms catchment was degraded and this mainly comprised degraded shrubland. About 85% of the catchment was natural, comprising shrubland, bushland and forest. Very little (<1%) of the catchment was developed and this comprised mainly residential development and smallholdings associated with the coastal resort town of Plettenberg Bay.

48) Knysna

The Knysna estuary (34° 05' S; 23° 04'E) is situated near the coastal town of the same name in the Western Cape. The river is approximately 60 km long with a catchment area of 525 km^2. About 28% of the Knysna catchment was under agriculture and this mainly comprised commercial forestry, improved grasslands and temporary commercial irrigated agriculture.

The catchment did not appear to be degraded with 69% being natural, mostly forest, bushland, shrubland and the Knysna estuary itself (waterbodies). About 3% of the catchment was urban and comprised mainly residential, commercial and industrial development associated with the coastal town of Knysna. Some smallholdings were also present.

49) Swartvlei

The Swartvlei system (34° 00' S; 22° 48'E) is located approximately midway between the coastal towns of Knysna and Mossel Bay in the Western Cape. The river is approximately 38 km long with a catchment area of 455 km^2. Agriculture accounted for about 40% of the land-cover in the Swartvlei catchment. Most of this comprised commercial forestry, improved grasslands and temporary commercial irrigated agriculture. The catchment did not appear to be degraded with approximately 58% being natural. Natural land-cover comprised mainly bushland, forest, shrubland, and the coastal lake of Swartvlei. Urban development accounted for about 1% of the land-cover and this was mostly residential development associated with the coastal settlement of Sedgefield.

50) Gourits

The Gourits estuary (34° 21' S; 22° 33'E) lies southwest of the coastal town of Mossel Bay in the Western Cape. The river is approximately 416 km long with a catchment area of 45 715 km^2. About 5% of the land-cover in the Gourits catchment was agriculture, comprising mainly temporary commercial dryland agriculture, temporary commercial irrigated agriculture, improved grassland, permanent commercial irrigated agriculture and some commercial forestry. Approximately 1% of the catchment comprised degraded shrubland while roughly 94% was natural, consisting mostly of shrubland and bushland. Very little of the catchment (<1%) was urban and this consisted mainly of residential development and some smallholdings. Major towns in the Gourits catchment include Albertina in the lower catchment, Oudtshoorn, Calitzdorp, Ladismith and Laingsburg in the middle of the catchment and Beaufort West and Touwsrivier in the upper catchment.

51) Goukou (Kafferkuils)

The Goukou system (34° 23' S; 21° 25'E) lies west of the coastal town of Mossel Bay in the Western Cape. The river is approximately 67 km long with a catchment area of 1 550 km^2. Agriculture accounted for about 35% of the land-cover of the Goukou catchment. This comprised a mixture of temporary commercial dryland agriculture, commercial forestry, temporary commercial irrigated agriculture, and improved grassland. About 2% of the catchment was degraded shrubland while approximately 63% was natural. Natural land-cover consisted of shrubland, grassland and grassland with some waterbodies and wetlands. Urban development accounted for about 1% of the land-cover and comprised mainly residential and industrial development associated with the coastal settlement of Still Bay and the town of Riversdale inland.

52) Duiwenhoks

The Duiwenhoks estuary (34° 22' S; 21° 00'E) is situated west of the coastal town of Mossel Bay in the Western Cape. The river is approximately 83 km long with a catchment area of 1 340 km^2. About 46% of the land-cover in the Duiwenhoks catchment was agriculture, mainly temporary commercial dryland agriculture, improved grassland, and some temporary commercial irrigated agriculture. Approximately 1% of the catchment comprised degraded shrubland while about 52% was natural shrubland, bushland and grassland. Urban development, mainly residential development associated with the inland town of Heidelberg, accounted for about 1% of the land-cover in the Duiwenhoks catchment.

53) Breë

The Breë estuary (34° 24' S; 20° 51'E) lies west of the coastal town of Mossel Bay in the Western Cape, near Cape Infanta. The river is approximately 337 km long with a catchment area of 12 384 km^2. Agriculture comprised 34% of the catchment land-cover in the Breë catchment. Most of this was temporary commercial dryland agriculture, permanent commercial irrigated agriculture, commercial forestry, and temporary commercial irrigated agriculture. About 1% of the catchment was degraded shrubland while approximately 64% was natural, comprising mainly shrubland, bushland, grassland and waterbodies. Major impoundments in the catchment include the Tweewaterskloof Dam and the Brandvlei Dam. Urban development accounted for less than 1% of the catchment land-cover. Most of this was residential, industrial and commercial development. Major towns in the Breë catchment include Swellendam in the middle to lower catchment, Montagu and Robertson in the middle catchment and Worcester in the upper catchment.

54) Heuningnes

The Heuningnes system (34° 43' S; 20° 07'E) is the southernmost estuary in South Africa, situated near Cape Agulhas. The catchment area that feeds this system is approximately 1 400 km^2. About 41% of the Heuningnes catchment was under agriculture. Most of this was temporary commercial dryland agriculture, improved grassland and some commercial forestry. About 2% of the catchment was degraded, mostly degraded shrubland. Approximately 56% of the Heuningnes catchment was natural, mostly shrubland, grassland, bushland, and wetlands and waterbodies (Zoetendalsvlei). There was little (<1%) urban development in the Heuningnes catchment and most of this comprised residential and industrial development. Major towns in the catchment include Bredasdorp, Napier and Elim.

55) Klein

The Klein estuary (34° 25' S; 19° 18'E) is located near the coastal town of Hermanus in the Western Cape. The river is approximately 66 km long with a catchment area of 906 km^2. About 49% of the Klein catchment was under agriculture, mostly temporary commercial dryland agriculture with some improved grassland, permanent commercial irrigated agriculture, commercial forestry, and temporary commercial irrigated agriculture. Less than

1% of the catchment was degraded, comprising degraded shrubland and herbland. Approximately 51% of the Klein catchment was natural, comprising mainly shrubland, bushland, grassland and the waterbody of the Klein estuary. Urban development accounted for less than 1% of the land-cover and comprised mainly residential development associated with the towns of Hermanus near the coast and Stanford further inland.

56) Bot

The Bot system (34° 21' S; 19° 05'E) is situated just northwest of the coastal town of Hermanus in the Western Cape. The river is approximately 54 km long with a catchment area of 920 km^2. Agriculture accounted for approximately 51% of the land-cover in the Bot catchment. This mainly comprised temporary commercial dryland agriculture, commercial forestry, permanent commercial irrigated agriculture, and improved grassland. Less than 1% of the Bot catchment was degraded, mainly comprising degraded shrubland and erosion scars. About 48% of the catchment was natural, mainly shrubland, bushland, grassland, and the waterbody of the Bot estuary. Urban development, mainly residential development and smallholdings accounted for approximately 1% of the catchment land-cover. This was mainly associated with the towns of Hawston near the coast, Botrivier in the middle catchment and Caledon in the upper catchment.

57) Palmiet

The Palmiet estuary (34° 21' S; 19° 00'E) is located west of the coastal town of Hermanus in the Western Cape. The river is approximately 73 km long with a catchment area of 535 km^2. Approximately 41% of the Palmiet catchment was under agriculture. This mainly comprised permanent commercial irrigated lands and commercial forestry. Less than 1% of the catchment comprised degraded shrubland while about 58% was natural, mainly shrubland, bushland and waterbodies. There are a number of impoundments in the Palmiet catchment; major dams include the Kogelberg Dam, Rockview Dam, Eikenhof Dam, and the Nuweberg Dam. About 1% of the catchment was urban, comprising mainly residential and industrial development associated with the inland towns of Grabouw and Elgin.

58) Diep

The Diep estuary (33° 53' S; 18° 28'E) drains into the Atlantic Ocean and is situated near the coastal city of Cape Town in the Western Cape. The river is approximately 87 km long with a catchment area of 1 495 km^2. Agriculture, mainly temporary commercial dryland agriculture, permanent commercial irrigated agriculture, and commercial forestry accounted for about 74% of the catchment land-cover of the Diep system. About 2% comprised degraded shrubland and bushland while 17% was natural, consisting of shrubland, bushland, grassland, and waterbodies and wetlands (Rietvlei). Urban development accounted for about 7% of the land-cover and was mainly residential, industrial and commercial development mostly associated with the coastal city of Cape Town. The town of Malmesbury is situated in the upper catchment of the Diep system.

59) Berg

The Berg estuary (32° 46' S; 18° 09'E) is located in the Western Cape and is found on the west coast, north of the coastal city of Cape Town. The river is approximately 294 km long with a catchment area of 7 715 km^2. About 65% of the Berg catchment was under agriculture, mostly temporary commercial dryland agriculture, permanent commercial irrigated agriculture, and commercial forestry. Approximately 4% of the catchment was degraded, comprising mainly degraded shrubland and bushland. Roughly 30% of the Berg catchment was natural, mainly shrubland, bushland, grassland, and waterbodies and wetlands. Urban development accounted for about 1% of the catchment land-cover. This was mainly residential, commercial and industrial development. Major towns in the Berg catchment included Velddrift and Laaiplek near the coast, Piketberg, Hopefield, Mooreesburg and Darling further inland, and Wellington and Paarl in the upper catchment.

60) Verlore

The Verlore system (32° 19' S; 18° 20'E) is located in the Western Cape and is found on the west coast, north of the coastal city of Cape Town. The river is approximately 101 km long with a catchment area of 1 895 km^2. About 48% of the Verlore catchment was under agriculture. Most of this was temporary commercial dryland agriculture, temporary commercial irrigated agriculture, and permanent commercial irrigated agriculture. Approximately 2% of the catchment was degraded, comprising mainly degraded shrubland and bushland as well as dongas and sheet erosion. Roughly 50% of the Verlore catchment was natural, consisting mainly of shrubland, bushland, and wetlands and waterbodies (Verlorenvlei). There was very little urban development in the Verlore catchment (<1%) and most of this was residential development.

61) Olifants

The Olifants estuary (31° 42' S; 18° 11'E) is located in the Western Cape and is found on the west coast, north of the coastal city of Cape Town. The river is approximately 285 km long with a catchment area of 46 220 km^2. Agriculture comprised approximately 5% of the catchment land-cover of the Olifants system. Most of this was temporary commercial dryland agriculture, temporary commercial irrigated agriculture, and permanent commercial irrigated agriculture. About 2% of the catchment was degraded and mainly comprised dongas and sheet erosion, and degraded shrubland. Approximately 93% of the Olifants catchment was natural, mainly shrubland, bushland and grassland. Urban development accounted for less than 1% of the land-cover in the Olifants catchment. Most of this was residential development and mines and quarries. Major towns in the Olifants catchment include Lutzville, Vredendal and Vanrhynsdorp situated in the lower catchment, Nieuwoudtville in the middle of the catchment and Clavinia and Loeriefontein in the upper catchment.

62) Gariep (Orange)

The Gariep (Orange) system (28° 38' S; 16° 27'E) is situated just north of the coastal town of Port Nolloth in the Northern Cape and forms the border between South Africa and Namibia. The Gariep (Orange) River is the largest in southern Africa and drains most of the western part of southern Africa including parts of Namibia and Lesotho. The river is approximately 2 173 km with a catchment area of about 549 700 km^2. This excludes that part of the catchment that lies in Namibia. About 12% of the Gariep catchment was under agriculture. Most of this was temporary commercial dryland agriculture, subsistence farming and some temporary commercial irrigated agriculture. Approximately 4% of the catchment was degraded, mostly bushland, grassland, and shrubland. Some dongas and sheet erosion was also present. Roughly 83% of the Gariep catchment was natural. This comprised shrubland, grassland, and bushland, with some waterbodies (impoundments). Urban development accounted for about 1% of the Gariep catchment land-cover. This comprised residential development, mines and quarries, smallholdings, and commercial and industrial development. Covering most of South Africa and all of Lesotho, the Gariep catchment includes the major cities of Bloemfontein, Johannesburg, Kimberly, Klerksdorp, Maseru, Potchefstroom, Vereeniging, and Welkom.