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Department of Water Affairs and Forestry

Directorate: National Water Resource Planning

The Assessment of Water Availability in the Berg Catchment (WMA 19) by means of Water Resource Related Models

Report No. 4 : Land Use and Water Requirements

Volume 2 : Invasive Alien Plant Mapping

Final **May 2009**

Submitted by:
Ninham Shand (Pty) Ltd
in Association with
Umvoto Africa (Pty) Ltd

NINHAM SHAND
CONSULTING SERVICES

UMVOTO

DEPARTMENT OF
WATER AFFAIRS AND FORESTRY

THE ASSESSMENT OF WATER AVAILABILITY IN THE BERG CATCHMENT (WMA 19) BY MEANS OF WATER RESOURCE RELATED MODELS

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Department of Water Affairs and Forestry
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THE ASSESSMENT OF WATER AVAILABILITY IN THE BERG CATCHMENT (WMA 19) BY MEANS OF WATER RESOURCE RELATED MODELS

APPROVAL

TITLE :		The Assessment of Water Availability in the Berg Catchment (WMA 19) by Means of Water Resource Related Models: Land Use and Water Requirements: Invasive Alien Plant Mapping
DWAF REPORT NO.	:	P WMA19/000/00/0409
CONSULTANTS	:	Ninham Shand in association with Umvoto Africa (Pty) Ltd
AUTHORS	:	L Hayes, G English
REPORT STATUS	:	Final
DATE	:	May 2009

STUDY TEAM : Approved for Ninham Shand

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G ENGLISH

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A H M GÖRGENS

DEPARTMENT OF WATER AFFAIRS AND FORESTRY
Directorate National Water Resource Planning
Approved for Department of Water Affairs and Forestry

.....
I THOMPSON
Chief Engineer: NWRP(s)

.....
J A VAN ROOYEN
Director: NWRP

REFERENCE

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REPORT No	REPORT TITLE	VOLUME No.	VOLUME TITLE
1	Final Summary Report		
2	Rainfall Data Preparation and MAP Surface		
3	The Assessment of Flow Gauging Stations		
4	Land Use and Water Requirements	Vol 1	Data in Support of Catchment Modelling
		Vol 2	Invasive Alien Plant Mapping
		Vol 3	Water Use and Water Requirements
5	Update of Catchment Hydrology	Vol 1	Berg River
		Vol 2	Upper Breede River
		Vol 3	Peripheral Rivers
6	Water Quality	Vol 1	A Literature Review of Water Quality Related Studies in the Berg WMA, 1994 - 2006
		Vol 2	Updating of the ACRU Salinity Model for the Berg River
		Vol 3	Update Monthly FLOSAL Model to WQT
7	(Report No Not Used)		
8	System Analysis Status Report		
9	Groundwater Model	Vol 1	Overview of Methodology and Results
		Vol 2	Data Availability and Evaluation
		Vol 3	Regional Conceptual Model
		Vol 4	Regional Water Balance Model
		Vol 5	Cape Flats Aquifer Model
		Vol 6	Langebaan Road and Elandsfontein Aquifer System Model
		Vol 7	TMG Aquifer, Piketberg Model
		Vol 8	TMG Aquifer, Witzenberg – Nuy Model
		Vol 9	Breede River Alluvium Aquifer Model
10	Berg and Mhlathuze Assessment Studies (Refer to Report No.1)		
11	Applicability of the Sami Groundwater Model to the Berg WAAS Area		

THE ASSESSMENT OF WATER AVAILABILITY IN THE BERG CATCHMENT (WMA 19) BY MEANS OF WATER RESOURCE RELATED MODELS

LAND USE AND WATER REQUIREMENTS
INVASIVE ALIEN PLANT MAPPING

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ABBREVIATIONS

BRBS	Breede River Basin Study
DWAF	Department of Water Affairs and Forestry
GIS	Geographical Information System
IAP	Invasive Alien Plant
WAAS	Water Availability Assessment Study
WfW	Working for Water
WMA	Water Management Area
WRSM2000	Water Resources Simulation Model (2000)
WRYM	Water Resources Yield Model

1. INTRODUCTION

1.1 BACKGROUND

During the Inception Phase of the Berg Water Availability Assessment Study (WAAS), it was acknowledged that the mapping of invasive alien plants (IAPs) as part of this study would also support the Working for Water (WfW) prioritisation for clearing. At the time of the Inception Phase, the extent and resolution of the aerial photography had yet to be defined, and as such, the degree of species identification possible from the photography was also not known.

The aerial photography that pertains to the study was obtained from DWAF. **Figure 1.1** shows the dates on which the various areas within the Western Cape were flown. On closer inspection of the quality of the aerial photography, WfW and Ninham Shand recognised the need for a field verification exercise, in order to gain an understanding of the common IAP types, and to determine the ease with which species identification, age and density could be determined at a desktop level.

Ninham Shand in collaboration with the regional WfW office undertook a review of the available aerial photography, including ground-truthing field trips to the Cecelia Forest and to the Banhoek and Franschhoek valleys.

1.2 APPROACH

The outcome of the aforementioned activities made it clear that within the limitations of the Berg WAAS, an attempt at species identification would, at best, only be possible at a coarse level (i.e. pines, eucalyptus, acacias, black wattle, etc.). Furthermore, age classification would be based on size of tree (i.e. tall trees of a species would be considered as mature and smaller trees of the same species as young) and estimates of density would be approximate and based on canopy cover. It was also recognised that Hakea infestations cannot be distinguished from natural fynbos vegetation, and as such, no attempt would be made to digitise Hakea. It should be noted that whilst there are localised areas of Hakea infestation within the study area, WfW indicated that the spreading of Hakea has stabilized, and that the clearing of Hakea does not currently demand the same priority as other, more prominent invasive species.

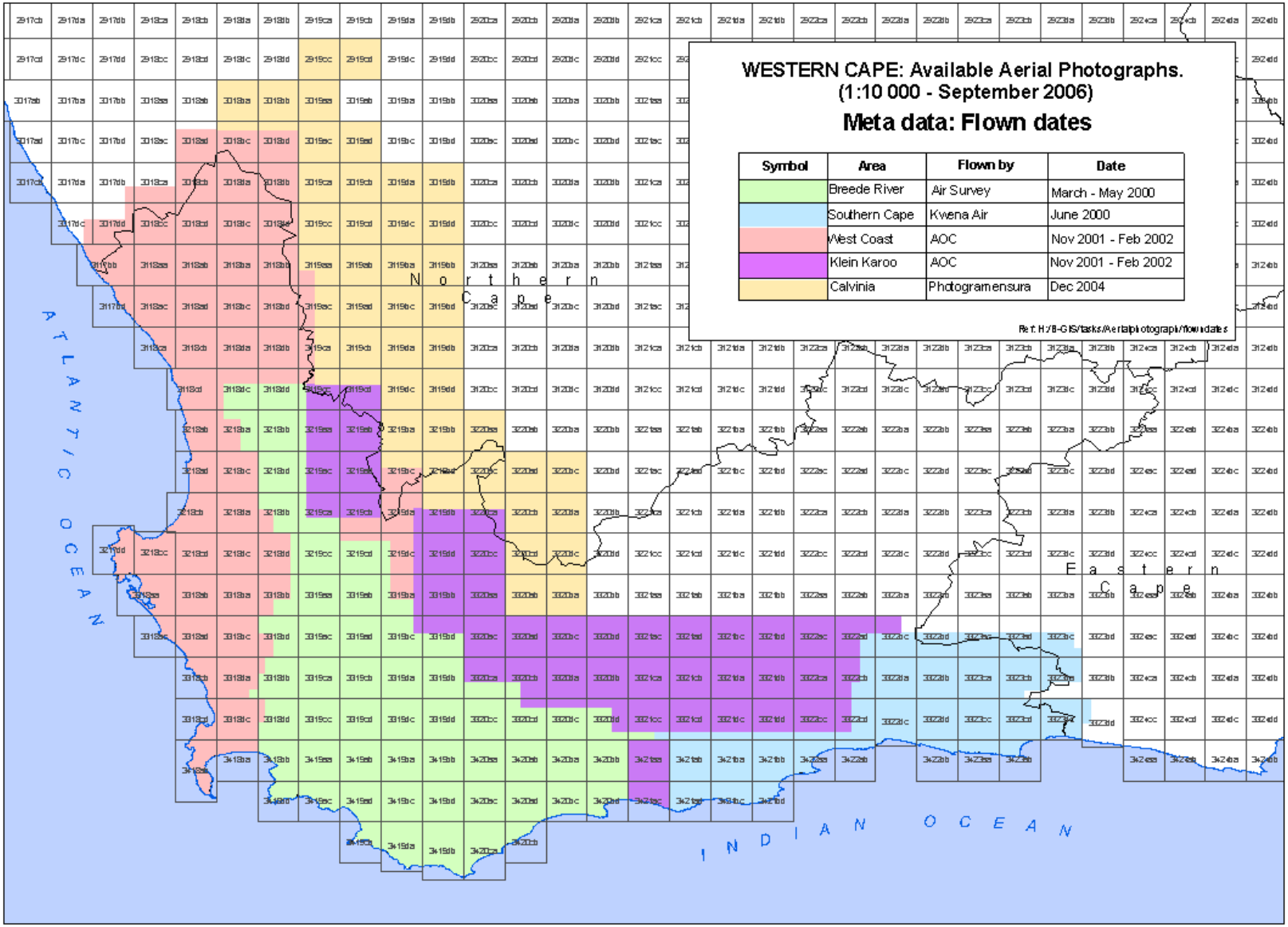

Figure 1.1 Extent of available aerial photography

2. MAPPING GUIDELINES

The following general guidelines towards the mapping of IAPs from the 1:10 000 aerial photographs were derived by the Study Team in consultation with WfW:

- in mountain catchment areas, concentrated vegetation occurring in high-lying gulleys and along steep flow paths would be considered as indigenous vegetation
- in the Berg River catchment upstream of Paarl, riparian vegetation is most likely to be Black Wattle or a mix (with Black Wattle being prominent)
- downstream of Paarl, riparian vegetation is likely to be Eucalyptus or a mix (with Eucalyptus being prominent)
- Rooikrantz, which was originally introduced in the Cape Flats areas for dune stabilisation purposes, is most common along the Cape Flats coastal area
- along the West Coast and the N7 (Diep River and Swartland), Port Jackson (an acacia) is known to be predominant. This invader is also not generally found above altitudes of 1 000 masl
- in the upper Breede River and upper Riviersonderend catchments, the Breede River Basin Study (BRBS) IAP coverage would be used. This coverage was developed based on high-resolution colour aerial photography (1999) and was verified in collaboration with WfW and Cape Nature Conservation as part of that study
- individual wind-rows would not be captured
- ground-truthing to verify IAP types would be undertaken in selected areas on an *ad hoc* basis
- previous forestry plantations that are currently not managed or have been abandoned would be classified as IAPs, with only well-maintained and functioning plantations digitised as forestry.

Typical queries that required verification are shown graphically in **Figure 2.1**, **Figure 2.2** and **Figure 2.3**. Wherever possible, these queries were resolved.

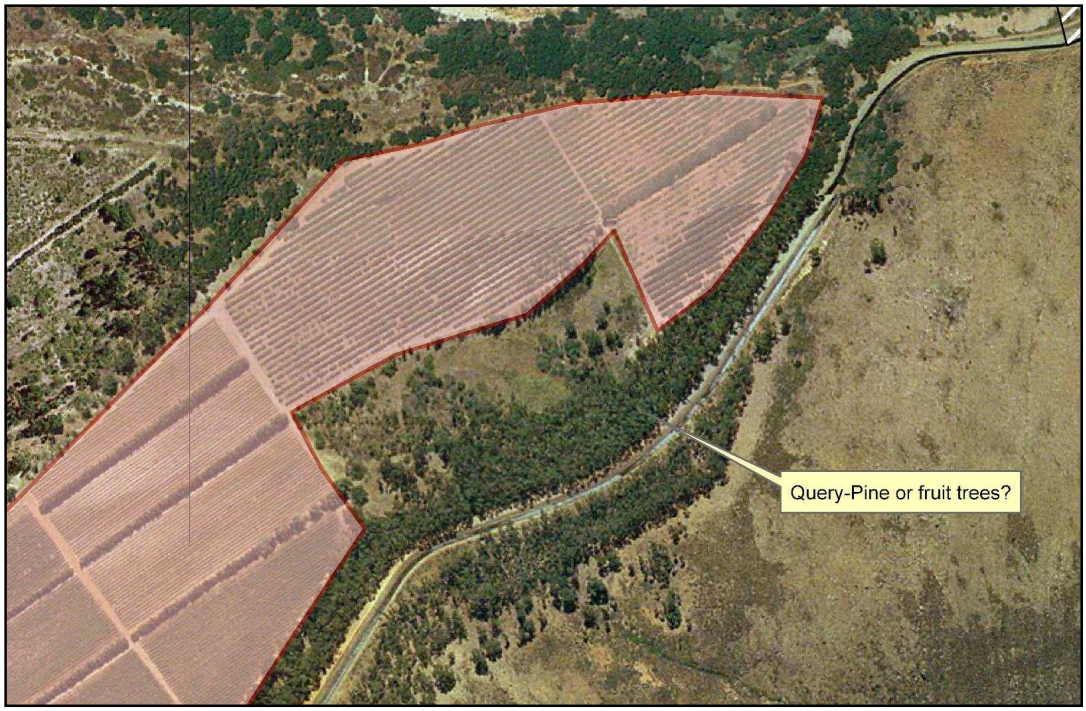

Figure 2.1 Distinguishing between pines and fruit trees

Figure 2.2 Distinguishing pines

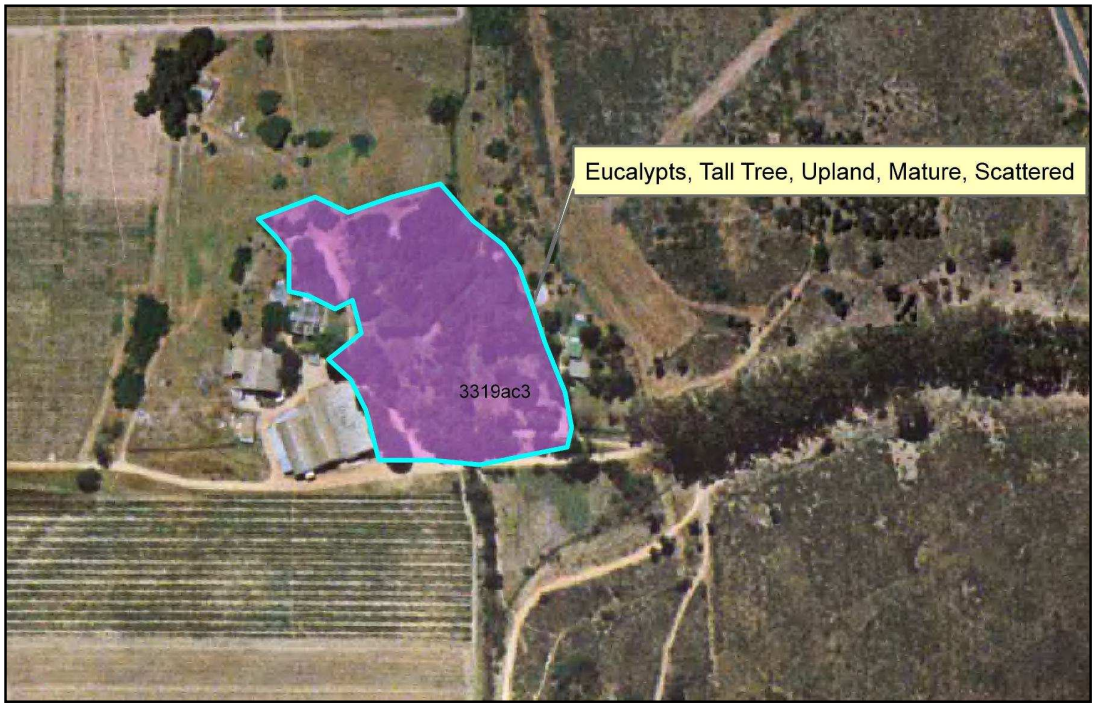

Figure 2.3 Distinguishing eucalyptus

3. CURRENT EXTENT OF INVASIVE ALIEN PLANTS

In accordance with the above guidelines, the present-day extent of IAP infestation within the study area was updated based on the 1:10 000 aerial photographs. For each polygon that was digitised, the following fields were populated:

- riparian or upland (riparian = main river channels and tributaries)
- species (black wattle, pine, acacia, eucalyptus, poplar, other (excluding Hakea))
- estimate of density in terms of canopy cover (0% - 25%: scattered; 25% - 75%: moderate; >75%: dense)
- estimate of age based on tree size (tall trees of a type = mature; other of same type = young)
- ground-truthing (where this has taken place)
- size category (tall tree, medium tree or tall shrub).

Figure 3.1 displays the present-day extent of IAPs in the Berg WAAS area.

Table 3.1 lists the current condensed areas and the interpretation IAP species per subcatchment. It is important to note that a full-ground truthing exercise has not been undertaken at species level. The species interpretation is as described previously, and should be considered as a broad indication of where certain species are dominant.

From **Table 3.1** it can be seen that the Upper Berg and Eerste River catchments, followed by the Upper Breede catchment are characterised by significant levels of invasion. Furthermore, the table shows that upland IAPs dominate in all the catchments except in the Berg where riparian infestations constitute almost 70% of the IAPs.

Appendix A shows the extent of infestation schematically at sub-catchment level.

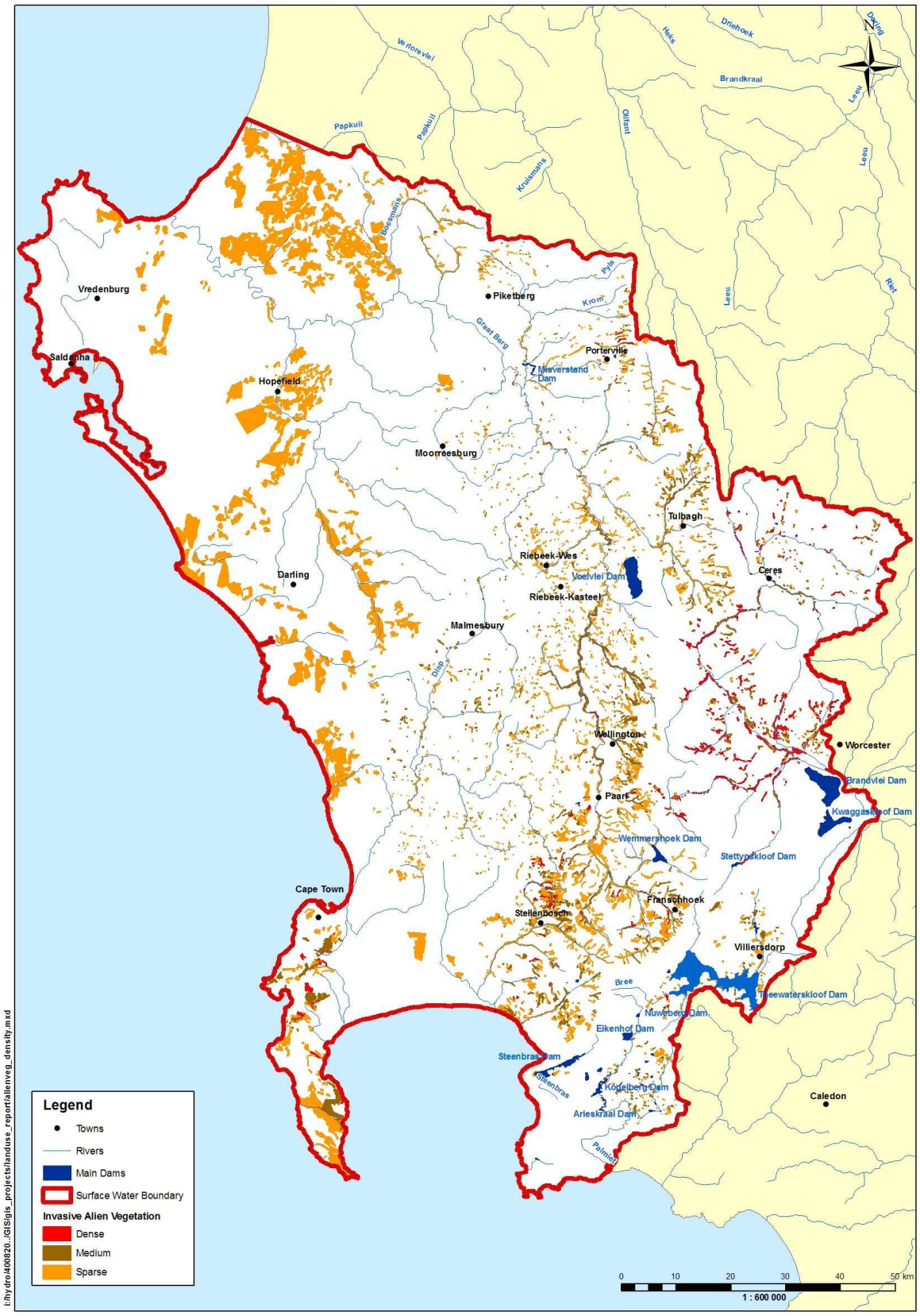

Figure 3.1 Present-day (2004) extent of Invasive Alien Plants

Table 3.1: Present-day (2004) Invasive Alien Plant condensed areas (km^2)

Type	Catchment Area (km^2) and Quaternaries											Total [2]
	Peninsula	Upper Berg	Eerste	Lourens & Sir Lowry's Pass	Diep	Sout & Matjies	Palmiet	Steenbras	Upper Rivier-sonderend	Upper Breede [1]	Lower Berg	
	G22A-D	G10A-H	G22E-H	G22J&K	G21C-F	G21A&B	G40B-D	G40A	H60A-C	H10A-L	G10K-M, G30A	
Black Wattle	2.9	11.1	2.3	1.5	0.7	0.0	0.3	0.0	0.1	No Species Data	0.6	19.4
Eucalypts	7.4	8.6	4.3	1.2	0.6	0.0	0.2	0.0	0.4		0.0	22.7
Other	0.0	0.9	0.0	0.0	0.1	0.0	0.0	0.0	0.3		0.0	1.3
Pine	0.6	6.8	1.5	0.4	0.6	0.0	0.4	0.2	1.1		0.0	11.5
Poplar	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0		0.0	0.1
Port Jackson	4.2	0.5	0.3	0.0	0.1	14.2	0.0	0.0	0.0		49.0	68.3
Rooikrans	6.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0		0.0	6.1
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.4	0.0	25.4
Total	**21.1**	**27.9**	**8.4**	**3.1**	**2.1**	**14.3**	**0.9**	**0.2**	**1.8**	**25.4**	**49.6**	**154.9 [3]**
Upland	19	9	6	2	1	14	0	0	2	11	49	114
Riparian	2	19	2	1	1		1		0	14	1	41
Upland (%)	90%	32%	76%	67%	60%	100%	7%	100%	90%	44%	99%	74%
Riparian (%)	10%	68%	24%	33%	40%	0%	93%	0%	10%	56%	1%	26%

(1): From BRBS (DWAF, 2003) ; No species information
(2): Species sub-totals, exclude Upper Breede
(3): Grand Total includes Upper Breede

Table 3.2: Age, size and density of present-day (2004) Invasive Alien Plant areas (km^2)

Characteristic	Catchment Area (km^2) and Quaternaries											Total [2]
	Peninsula	Upper Berg	Eerste	Lourens & Sir Lowry's Pass	Diep	Sout & Matjies	Palmiet	Steenbras	Upper Rivier-sonderend	Upper Breede [1]	Lower Berg	
	G22A-D	G10A-H	G22E-H	G22J&K	G21C-F	G21A&B	G40B-D	G40A	H60A-C	H10A-L	G10K-M, G30A	
AGE												
Mature	20.3	22.0	7.2	2.7	1.9	14.3	0.7	0.2	1.3		49.6	145.5
Young	0.9	5.9	1.2	0.4	0.2		0.2	0.1	0.6	25.4		9.5
Total	**21.2**	**27.9**	**8.4**	**3.1**	**2.1**	**14.3**	**0.9**	**0.2**	**1.8**	**25.4**	**49.6**	**155.0 [3]**
DENSITY												
Dense	3.4	2.4	2.0	0.2	0.0		0.1	0.2	0.2		0.0	33.8
Moderate	11.3	16.3	3.9	2.1	1.3		0.5		1.1		0.0	36.5
Scattered	6.6	9.3	2.5	0.8	0.7	14.3	0.3	0.1	0.6	25.4	49.6	84.7
Total	**21.2**	**27.9**	**8.4**	**3.1**	**2.1**	**14.3**	**0.9**	**0.2**	**1.8**	**25.4**	**49.6**	**155.0 [3]**
CLASSIFICATION												
Medium Tree	8.1	13.9	7.6	2.9	0.4		0.4	0.2	0.7		0.6	60.2
Tall Shrub	10.4	3.6	0.5	0.1	0.1	14.3	0.0	0.1	0.0		49.0	78.0
Tall Tree	2.7	10.5	0.4	0.1	1.6	0.0	0.4		1.1	25.4	0.0	16.8
Total	**21.2**	**28.0**	**8.4**	**3.1**	**2.1**	**14.3**	**0.9**	**0.2**	**1.8**	**25.4**	**49.6**	**155.0 [3]**

(1): From BRBS (DWAF, 2003) ; No species information
(2): Species sub-totals, exclude Upper Breede
(3): Grand Total includes Upper Breede

4. CONCLUSION

The key objectives of the Invasive Alien Plant Mapping task were to prepare the landuse data set from which:

- streamflow reduction allowances could be determined during the calibration of the hydrological catchment model (WRSM2000);
- present-day flow sequences could be generated from the calibrated hydrological model for input to the WRYM; and
- WfW clearing initiatives and prioritisation of areas for clearing could be supported.

These key objectives of the Invasive Alien Plant Mapping task have been successfully met.

This report deals specifically with IAP mapping. The corresponding estimates of streamflow reduction (and monthly flow sequences) resulting from these areas of infestation are presented in the following Berg WAAS Reports:

- Report 4 : Volume 3 : Water Use and Water Requirements
- Report 5 : Volume 1 : Update of Catchment Hydrology : Berg River
- Report 5 : Volume 2 : Update of Catchment Hydrology : Upper Breede River
- Report 5 : Volume 3 : Update of Catchment Hydrology : Peripheral Rivers

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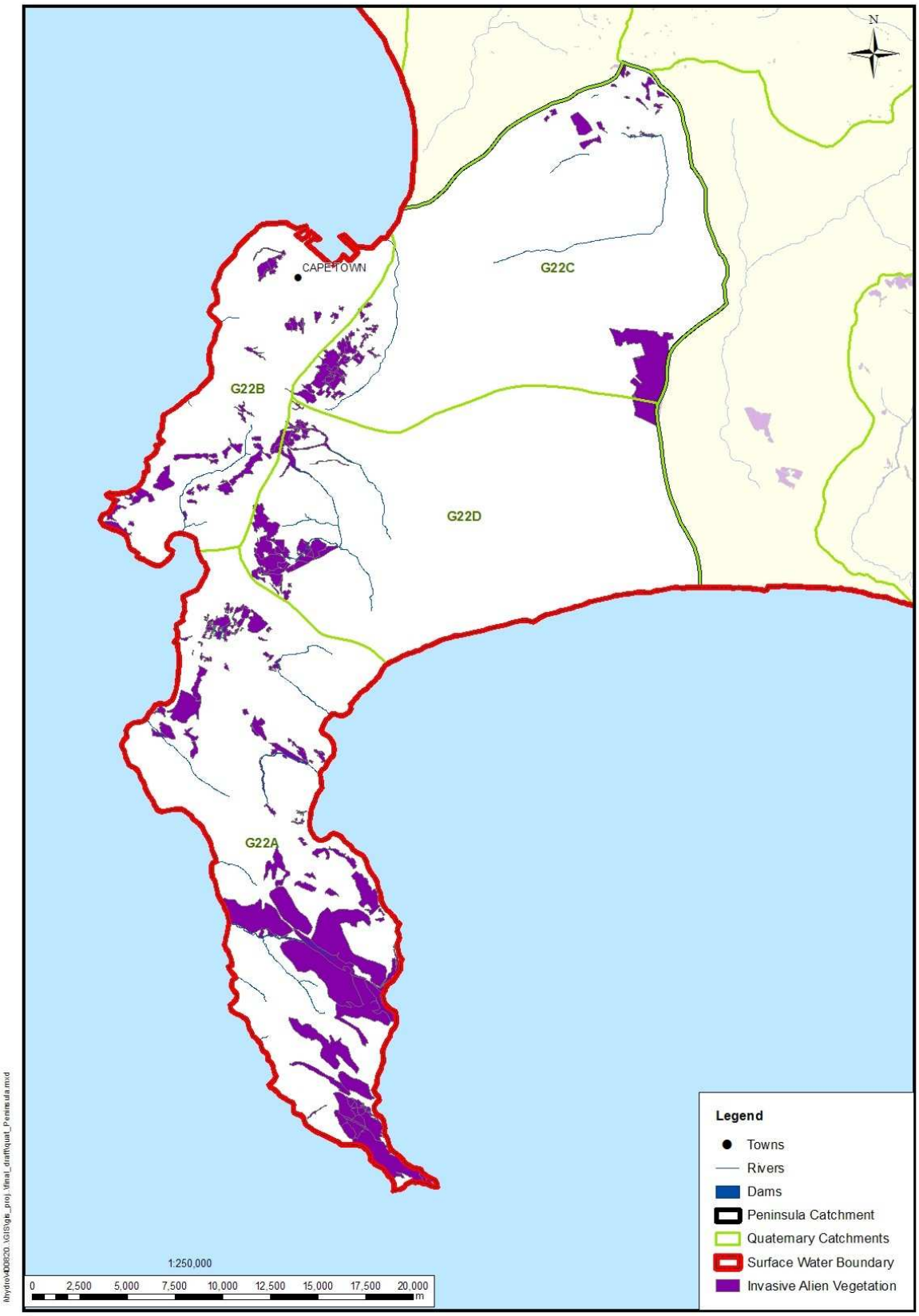
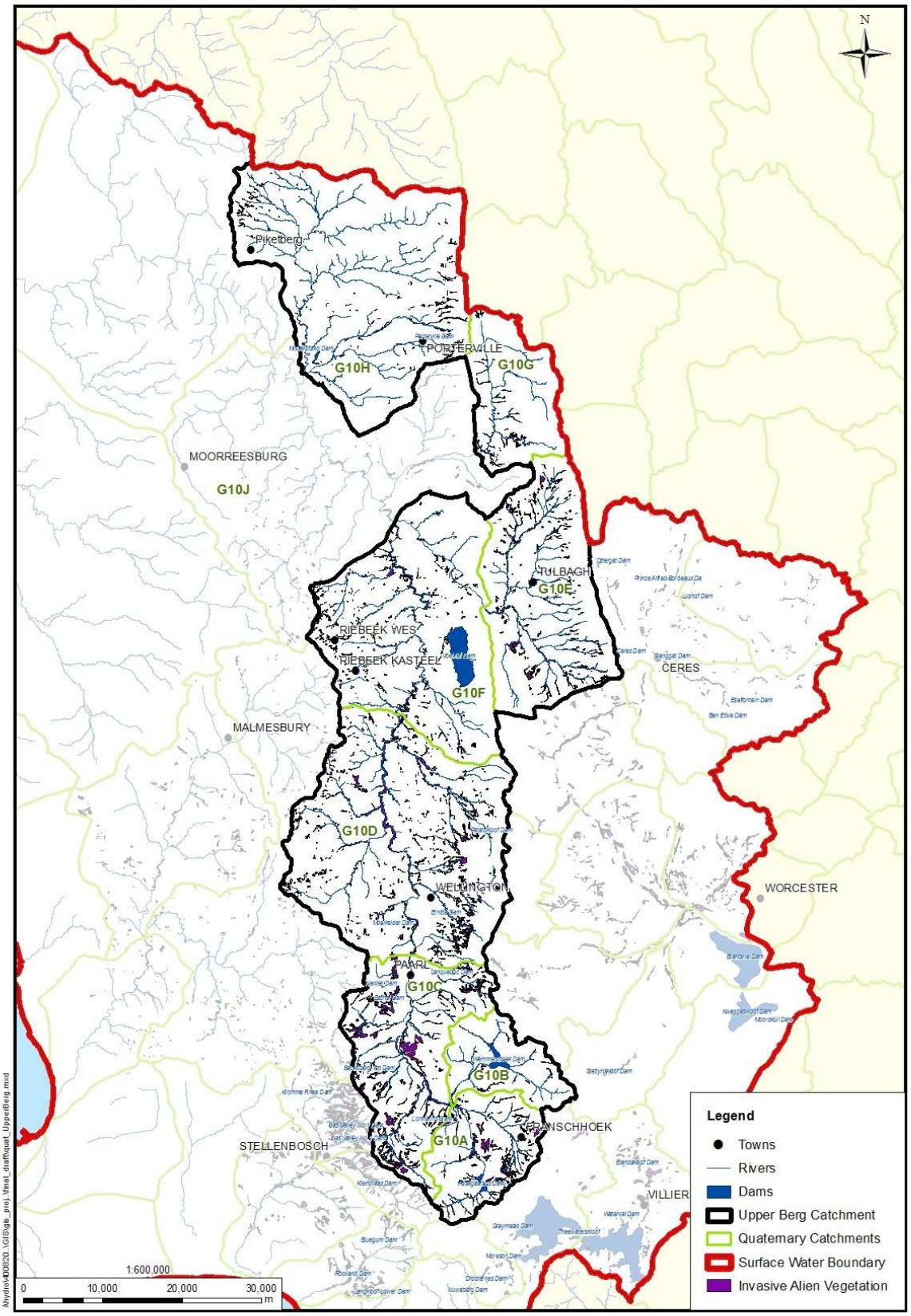
APPENDIX A – IAP MAPPING PER CATCHMENT AREA

PENINSULA CATCHMENTS



UPPER BERG CATCHMENT



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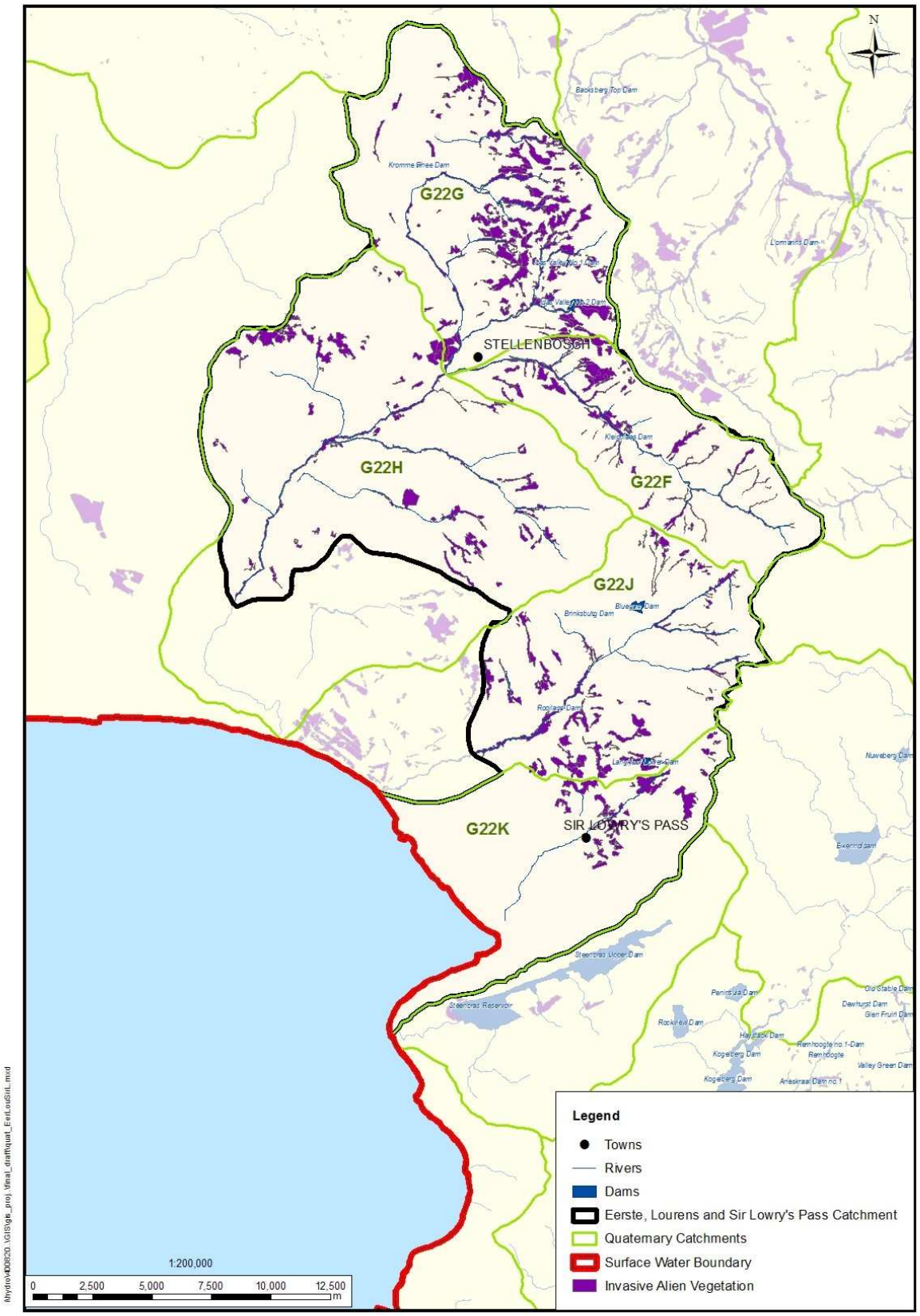

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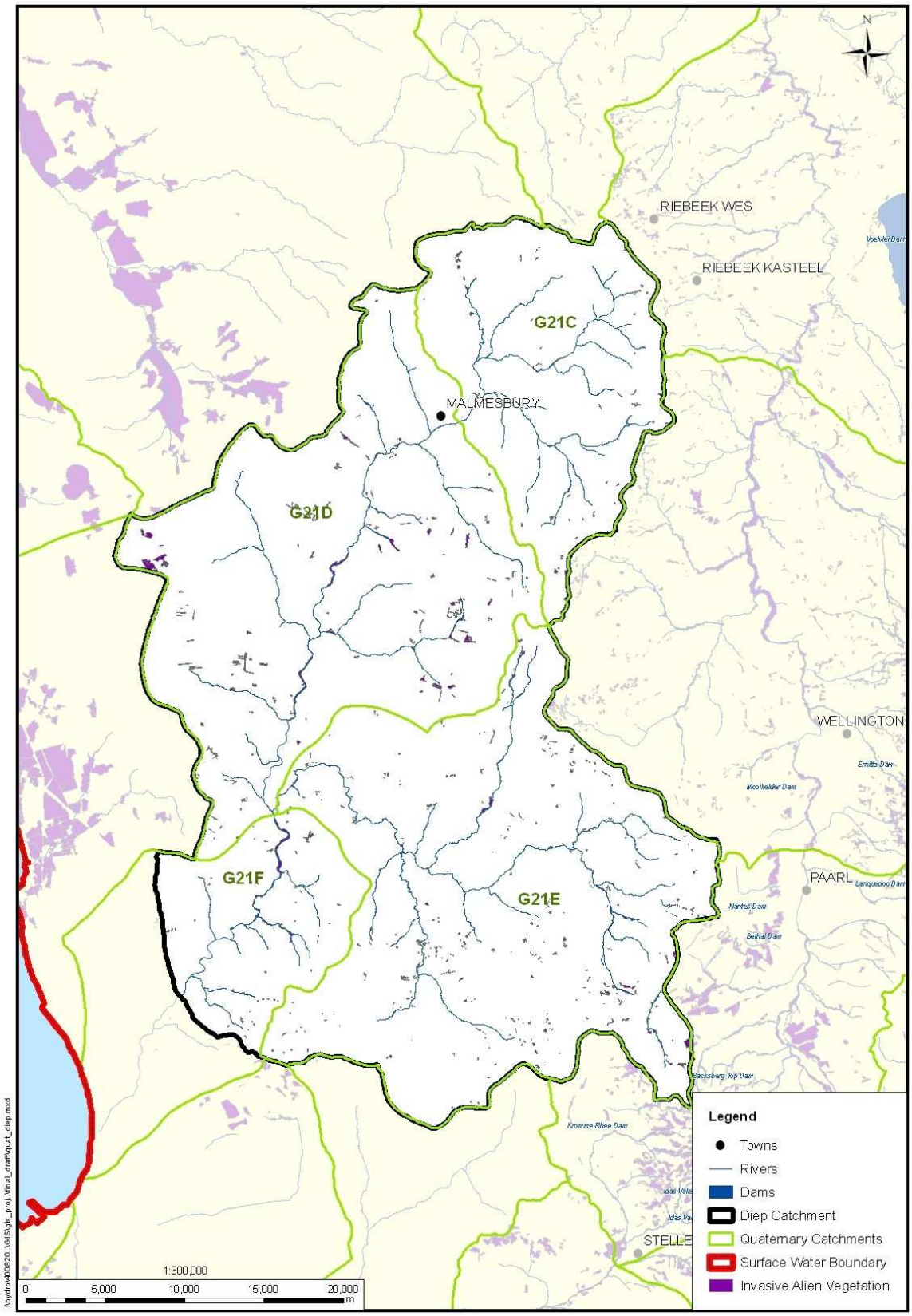
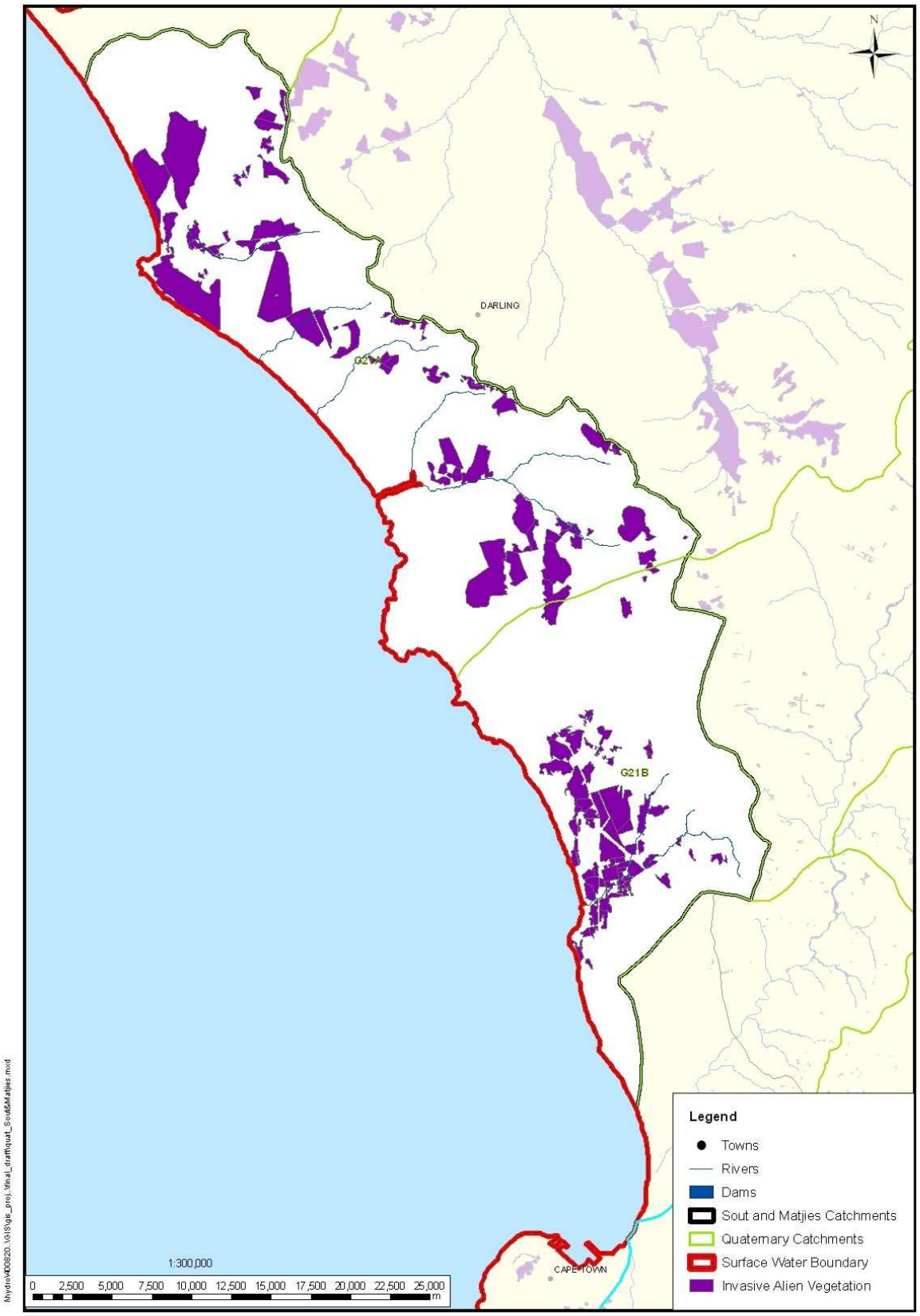
DIEP RIVER CATCHMENT

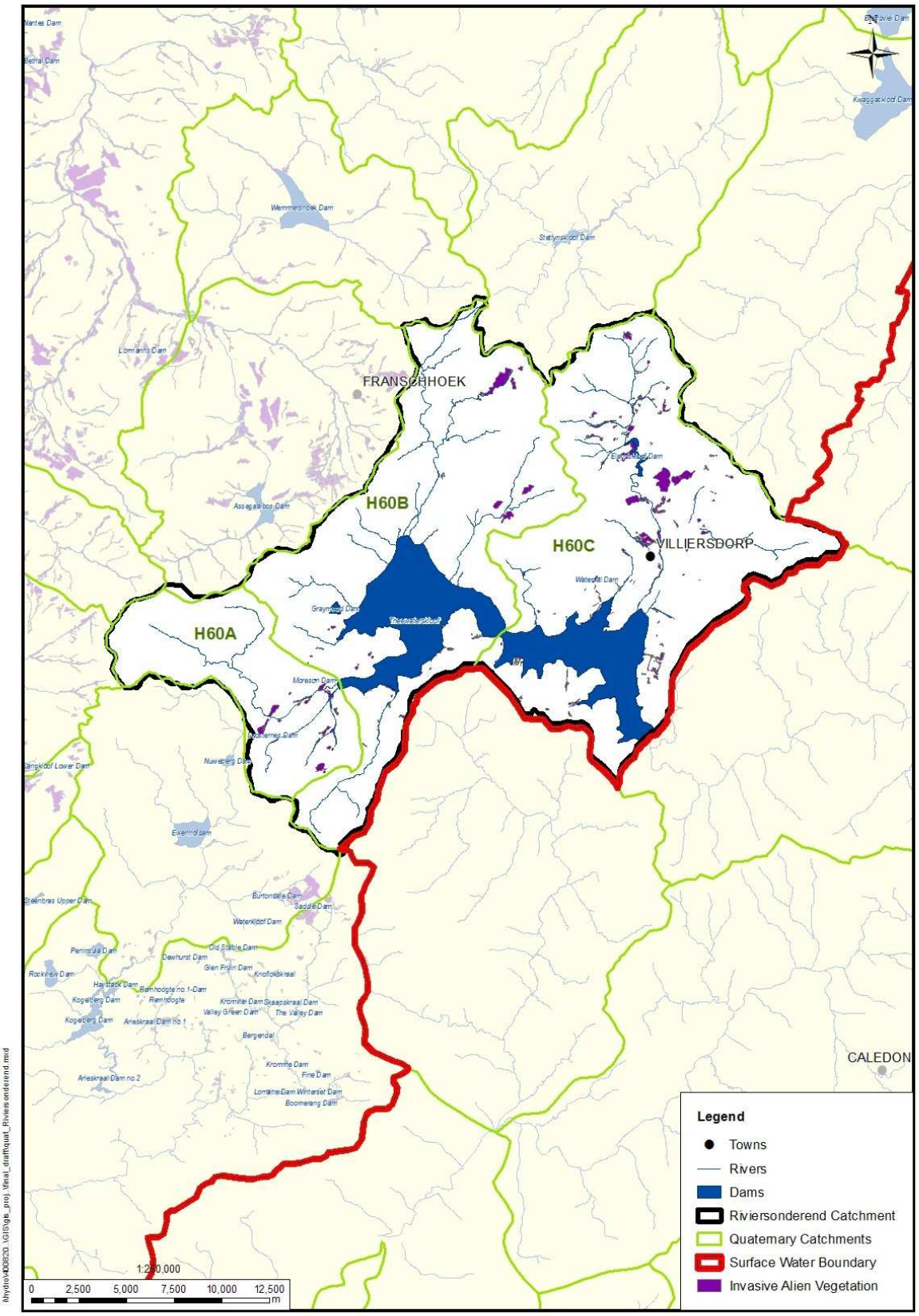


SOUT AND MATJIES RIVER CATCHMENTS

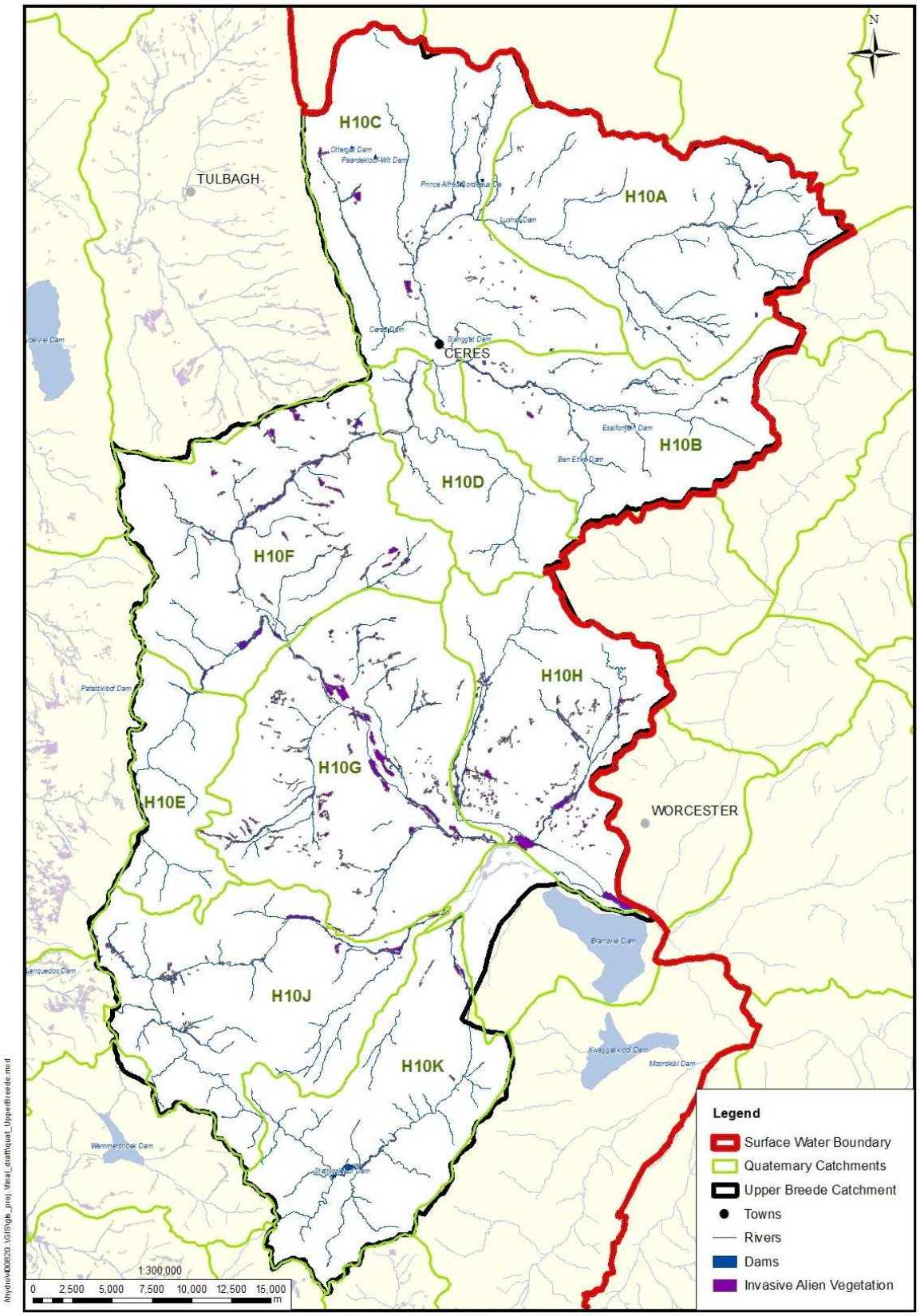


PALMIET AND STEENBRAS RIVER CATCHMENTS

UPPER RIVIERSONDEREND CATCHMENT



UPPER BREEDE RIVER CATCHMENT



LOWER BERG RIVER CATCHMENT