APPENDICES

Appendix 1

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Appendix 2

Heritage and Wilderness Sites in the WMA

APPENDIX 2: PROTECTED NATURAL AREAS AND NATURAL HERITAGE SITES WITHIN THE OLIFANTS/DOORN WMA

Source: DANIDA IWRM Institutional Roles and Linkages Situational Assessment- WMA17 Olifants/Doorn

Existing Conservancies

- Benede Bergrivier Conservancy
- Biedou Conservancy
- Cederberg Conservancy
- Lambertsbaai/Strandveld Conservancy
- Wupperthal Conservancy

Proposed Conservancies

- Groot-Winterhoek
- Keerom
- Koue Bokkeveld
- Olifants Mountain
- Renosterveld
- Saron
- Witzenberg

Natural Heritage sites

- Boesmandskloof
- Visgat
- Gys se Kraal
- Bo-Boskloof
- Groenfontein

Marine Nature Reserves

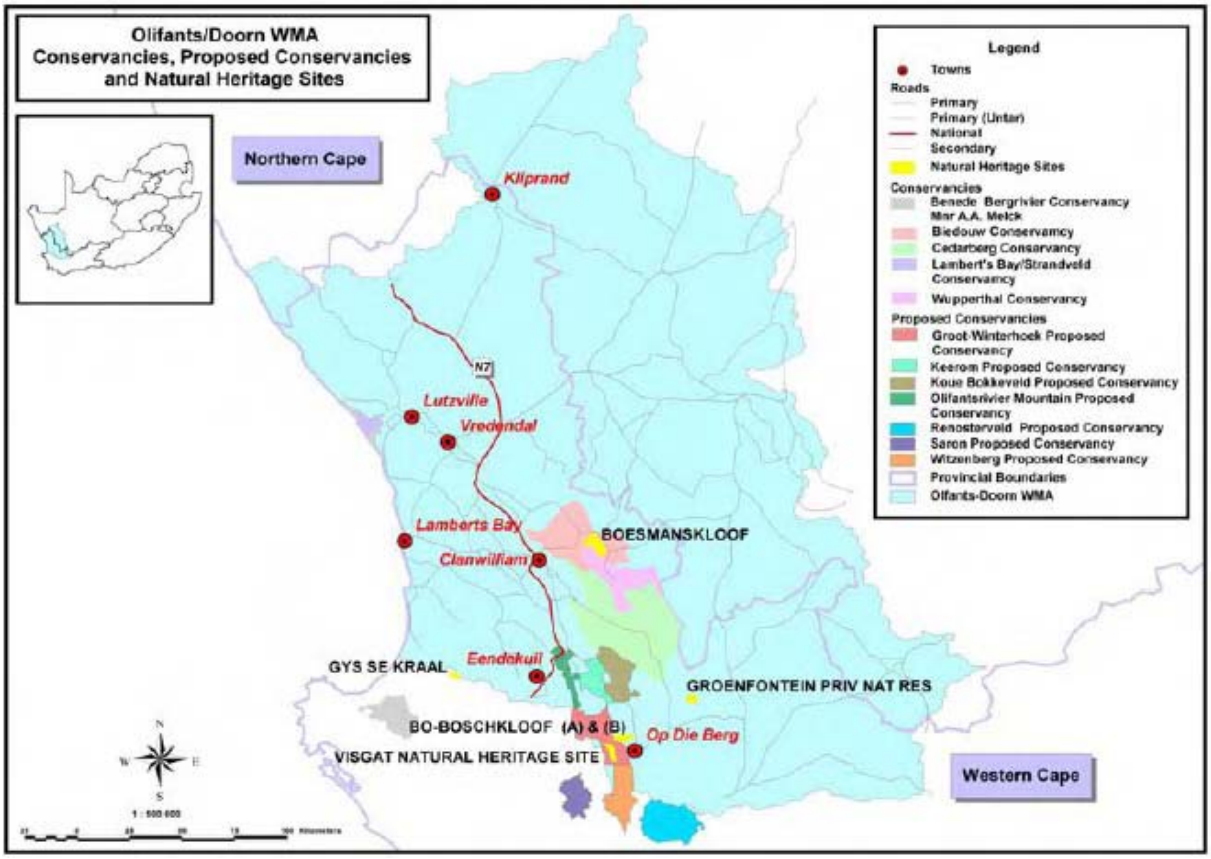
- Rocherpan Marine Nature Reserve

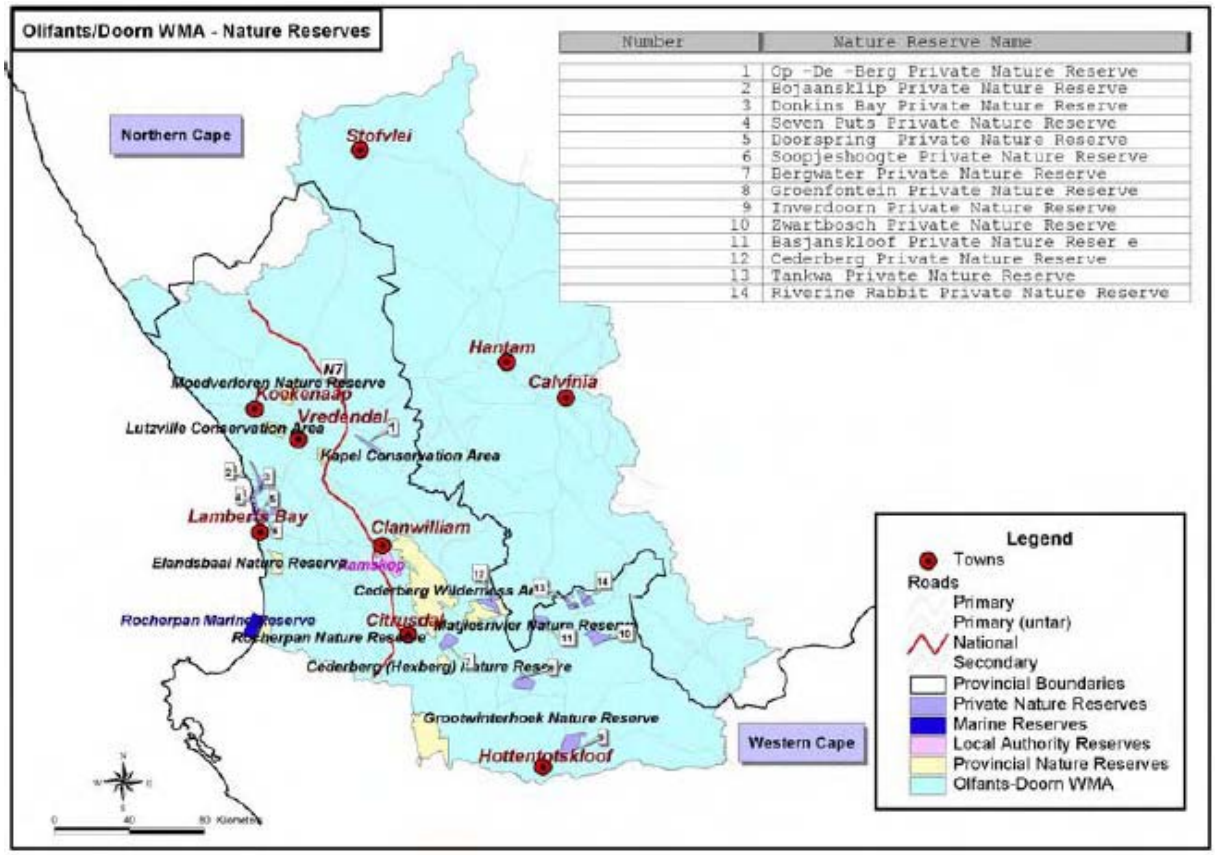
Provincial Nature Reserves

- Elandsbaai
- Lutzville Conservation Area
- Meerdeverloren
- Rocherpan
- Cederberg
- Grootwinterhoek
- Matjiesrivier
- Cederberg Wilderness Area
- Trawal Conservation Area

Municipal Nature Reserve

- Hangskop Nature Reserve (Clanwilliam)


Olifants/Doorn WMA
Conservancies, Proposed Conservancies
and Natural Heritage Sites
Northern Cape
Western Cape
Kliprand
Lutzville
Vredendal
Lamberts Bay
Clanwilliam
BOESMANSKLOOF
GYS SE KRAAL
Eendekuil
GROENFONTEIN PRIV NAT RES
BO-BOSCHKLOOF (A) & (B)
Op Die Berg
VISGAT NATURAL HERITAGE SITE
N7
Legend
Towns
Roads
Primary
Primary (Untar)
National
Secondary
Natural Heritage Sites
Conservancies
Benede Bergrivier Conservancy
Mar A.A. Melck
Biedouw Conservancy
Cedarberg Conservancy
Lambert's Bay/Strandveld Conservancy
Wupperthal Conservancy
Proposed Conservancies
Groot-Winterhoek Proposed Conservancy
Keerom Proposed Conservancy
Koue Bokkeveld Proposed Conservancy
Olifantsrivier Mountain Proposed Conservancy
Renosterveld Proposed Conservancy
Saron Proposed Conservancy
Witzenberg Proposed Conservancy
Provincial Boundaries
Olifants-Doorn WMA


Olifants/Doorn WMA - Nature Reserves
Number | Nature Reserve Name
1 Op -De -Berg Private Nature Reserve
2 Bojaansklip Private Nature Reserve
3 Donkins Bay Private Nature Reserve
4 Seven Puts Private Nature Reserve
5 Doorspring Private Nature Reserve
6 Soopjeshoogte Private Nature Reserve
7 Bergwater Private Nature Reserve
8 Groenfontein Private Nature Reserve
9 Inverdoorn Private Nature Reserve
10 Zwartbosch Private Nature Reserve
11 Basjanskloof Private Nature Reser e
12 Cederberg Private Nature Reserve
13 Tankwa Private Nature Reserve
14 Riverine Rabbit Private Nature Reserve
Northern Cape
Western Cape
Stofvlei
Hantam
Calvinia
Moedverloren Nature Reserve
Kookonaap
Vredendal
Lutzville Conservation Area
Kapel Conservation Area
Lamberts Bay
Clanwilliam
Elandsbaai Nature Reserve
Ramskop
Cederberg Wilderness Ar
Rocherpan Marine Reserve
Rocherpan Nature Reserve
Citrusd
Matjiesrivier Nature Reser
Cederberg (Hexberg) Nature Reserve
Grootwinterhoek Nature Reserve
Hottentotskloof
N7
Legend
Towns
Roads
Primary
Primary (untar)
National
Secondary
Provincial Boundaries
Private Nature Reserves
Marine Reserves
Local Authority Reserves
Provincial Nature Reserves
Olifants-Doorn WMA

AREA NAME	CATEGORY	GRID REFERENCE
Bo-Boschkloof	Natural Heritage Site	32º 58'S 19º 12'E
Bushmans Kloof	Natural Heritage Site	32º 07'S 19º 08'E
Cederberg Wilderness Area	Wilderness Area	32º 15'S 19º 15'E
Cederberg State Forest	Habitat and Wildlife	32º 35'S 19º 15'E
Elandsbaai Nature Reserve	Habitat and Wildlife	32º 20'S 18º 35'E
Elephant Rock	Habitat and Wildlife	31º 38'S 18º 07'E
Gannabos	Natural Heritage Site	31º 08'S 19º 12'E
Groot Groenfontein Private	Natural Heritage Site	32º 50'S 19º 34'E
Grootfontein	Natural Heritage Site	32º 55'S 19º 06'E
Gys se Kraal	Natural Heritage Site	32º 42'S 18º 32'E
Matroosberg State Forest	Habitat and Wildlife	33º 25'S 19º 50'E
Oorlogskloof Nature Reserve	Habitat and Wildlife	31º 27'S 19º 00'E
Penguin Island (Lamberts Bay)	Habitat and Wildlife	32º 05'S 18º 18'E
Perdefontein	Natural Heritage Site	33º 20'S 19º 20'E
Rocherpan Nature Reserve	Habitat and Wildlife	32º 35'S 18º 17'E
St Helena Bay Rock Lobster	Habitat and Wildlife	32º 45'S 18º 03'E
Tankwa Karoo National Park	National Parks and	32º 14'S 19º 50'E
Verlorevlei	RAMSAR Site	32º 22'S 18º 27'E
Visgat	Natural Heritage Site	32º 57'S 19º 12'E

(Source: WRSA, 2002)

Appendix 3

Yield and Ecological Water Requirements

YIELD AND ECOLOGICAL WATER REQUIREMENTS

3.1 Yield

A detailed description of values utilised in the yield balance provided in Chapter 3 follows.

The ecological water requirements (EWRs) shown in Table 4.2 for the Doring, Koue Bokkeveld, Knersvlakte and Sandveld sub-areas are given as per the NWRS. The hydrology for the NWRS Olifants sub-area needed to be evaluated in greater detail than in the NWRS, because the sub-area was divided into the Upper Olifants and Lower Olifants sub-areas for the ISP evaluation, with the split being below Clanwilliam Dam.

More updated hydrology than was available for the NWRS, which was undertaken for the *Olifants/Doring River Basin Study Phase 2, Possible Raising of Clanwilliam Dam* (2003) investigation, became available for the Clanwilliam Dam/Bulshoek Weir system in 2003. Where possible, these updated hydrological values have been used in the hydrological calculations for the Upper and Lower Olifants sub-areas, as it contains the latest information with regards to hydrology, land use and demand distribution (including the EWR).

Unfortunately, not all required information could be extracted from the abovementioned study results, such as e.g. the incremental yield of the Bulshoek Weir and the impact of the Reserve on this incremental yield. It was therefore necessary to undertake additional modelling for the Upper and Lower Olifants sub-areas respectively, using the latest WRYM model setup from the 2003 study, to provide the required values. This involved running the model with and without the ecological Reserve and comparing the difference in yield.

In the *Olifants/Doring River Basin Study Phase 2 (2003)* investigation, the concept of a "*distributed*" Reserve for the Upper Olifants River was introduced, in order to try and obtain a more pragmatic approach towards meeting the Reserve requirement at an EWR site just downstream of Clanwilliam Dam, which was determined during Phase 1 of the Basin Study. The ecological Reserve was therefore calculated for a number of points on the river upstream of the dam. Users will be required to ensure that there is adequate runoff to meet the Reserve. This is viewed as a more equitable result, with all users contributing to the Reserve by means of reduced abstractions. This would be difficult to control in practice but is in line with the intention of the National Water Act. The requirements for the "*distributed*" Reserve for the Upper Olifants as shown in **Table 4.2**, in practice requires that water use from upstream farm dams or direct abstraction from the river be limited.

Incremental ecological Reserve requirements for the Upper and Lower Olifants sub-areas were thus derived from the additional modelling undertaken for this study, according to the latest available model set-up, hydrology, land use and demands.

The NWRS values for surface water resources, which used a combined 1:50 year yield of 154 million m^3/a for the Clanwilliam Dam/Bulshoek Weir system, refer to yields under "*undeveloped*" conditions (i.e. a dam placed in a natural environment). The 1:50 year yield of

Clanwilliam Dam, according to the *Olifants/Doring River Basin Study Phase 2 (2003)* hydrology, as discussed in detail in **Appendix 3.2**, is 115 million m^3/a, and the developed 1:50 year incremental yield of Bulshoek Weir was modelled as 18 million m^3/a. These values can however not summarily be used in the ISP as they are yields modelled under "*developed*" conditions. An attempt could be made to derive the undeveloped dam yield from the developed yield by adding impact values, but this would be of low confidence. It was therefore decided to retain the combined dam yield of 154 million m^3/a from the NWRS and to proportionally increase the "*developed*" yields to sum to the NWRS combined value. The 1:50 year yield used for Clanwilliam Dam is thus 133 million m^3/a and for Bulshoek Weir is 21 million m^3/a.

It has been assumed that the reduction in yield of the Upper Olifants farm dams due to the requirements of a "distributed" Reserve would be offset by an increased yield from Clanwilliam Dam. The Clanwilliam Dam yield of 159 million m^3/a shown in the following **Table 4.3** is therefore a combination of the 1:50 year yield of 133 million m^3/a (when no EWRs are applied) and an increase of 26 million m^3/a to 159 million m^3/a, due to the effect of limiting use from upstream farm dams (to meet the Reserve). The 1:50 year yield from *minor dams and run of river* of 55 million m^3/a when no EWRs are applied will in turn reduce by 26 million m^3/a to 29 million m^3/a, due to the effect of limiting use from upstream farm dams to meet the Reserve. The adjustment of both these components of the surface water yield by 26 million m^3/a in **Table 4.3** does not change the overall surface water yield of the Upper Olifants sub-area.

It should be noted in **Table 4.4** that the yields of Clanwilliam Dam and Bulshoek Weir are based on the "developed" yield modelling using the system configuration as set up during the *Olifants/Doring River Basin Study Phase 2 (2003)* as discussed in detail above and in **Appendix 3.2**, and which have been proportionally increased to the combined dam yield of the NWRS. The Clanwilliam Dam yield dropped from 141 million m^3/a to 133 million m^3/a, whilst the Bulshoek Weir yield increased from 13 million m^3/a to 21 million m^3/a. There is however some uncertainty about the accuracy of these changes. There is also some uncertainty about the Bulshoek Weir yield because the effect of sedimentation[7] (which has significantly reduced the storage volume) has not been incorporated in the yield analyses.

Table 4.3: The 1:50 year yield from *minor dams and run of river* was estimated at 60 million m^3/a in the NWRS for the Olifants catchment. This was split into 55 million m^3/a in the Upper Olifants and 5 million m^3/a in the Lower Olifants for the ISP sub-areas. These figures were then reduced to 29 million m^3/a for the Upper Olifants sub-area to reflect the impact of the Reserve (55 -26), while the value for the Lower Olifants sub-area remained 5 million m^3/a, thus a comparative total of 34 million m^3/a.

Although it is currently considered to be unlikely that additional releases, to those made from Clanwilliam Dam for the ecology, will be made from Bulshoek Weir, the reduction in yield of 8 million m^3/a, to meet the Reserve for the Lower Olifants sub-area, has been retained in these

[7] In the 1994 survey, sedimentation was noted as 17% however it is believed that this is underestimated (Pers Comm 2003 F van Heerden-DWAF Clanwilliam)

calculations for consistency. A total impact of the Reserve on the combined Upper and Lower Olifants is thus 22 million m^3/a, compared to the 12 million m^3/a of the NWRS.

3.2 Determination of the impact of the preliminary ecological Reserve for the Clanwilliam Dam

The Olifants Doring River Basin Study Phase 2 included a report called the *Clanwilliam Dam Raising Reconnaissance Study* (Van Veelen and Jonck, 2003) which determined the historical firm yield of Clanwilliam Dam as 148,9 million m^3/a (Table 4.1 of that report). This is when the ecological water requirement (EWR) is not taken into account. The firm yield was determined as 97,2 million m^3/a if the preliminary Reserve is released from the dam only, and 130,9 if the preliminary Reserve requirement is applied both upstream and downstream of the dam (so-called distributed EWR). Historical impacts of the EWRs above Clanwilliam Dam are therefore calculated as follows:

EWR applied at Clanwilliam Dam only: 51,7 million m^3/a (= 148.9 – 97.2).
Distributed EWR: 18,0 million m^3/a (= 148.9 – 130.9).

Stochastic analysis in the study was however done only for the distributed EWR scenario during the study, and not for the other options. The impact of the EWR on the 1:50 year yield is therefore not known in all cases. The 1:50 year yield at Clanwilliam Dam for the distributed EWR scenario was determined as 101 million m^3/a. The ratio of the 1:50 year to historical yield is therefore 0.772 (101/130,9) and is used to estimate the yields for the other two scenarios as follows:

Scenario	Historical yields	1:50 year	Factor
No EWR	148.9	115 (2)	0.772
Distributed EWR	130.9	101 (1)	0.772
EWR supplied from Clanwilliam Dam only	97.2	75 (2)	0.772

(1) From the *Clanwilliam Dam Raising Reconnaissance Study*.
(2) Estimated by application of the ratio.

From the above, the 1:50 year impact of the EWR is as follows:

Scenario	Impact of EWR
Distributed EWR	14
EWR supplied from Clanwilliam Dam only	40

The incremental yield of the Bulshoek Weir and the impact of the Reserve on this incremental yield could however not be derived from previous reports. Another set of historical yield analyses, using the WRYM setup and supporting data from the *Clanwilliam Dam Raising*

Reconnaissance Study, were therefore done as part of this ISP, to determine the incremental yield of the Bulshoek Weir. The historical incremental yield was found to be 23 million m^3/a and the impact of the EWR on this was estimated to be 11 million m^3/a. The calculated 1:50 year yields and impacts are thus, applying the factor of 0,772:

Incremental 1:50 year yield: 18 million m^3/a.
Incremental impact of the IFR: 8 million m^3/a.