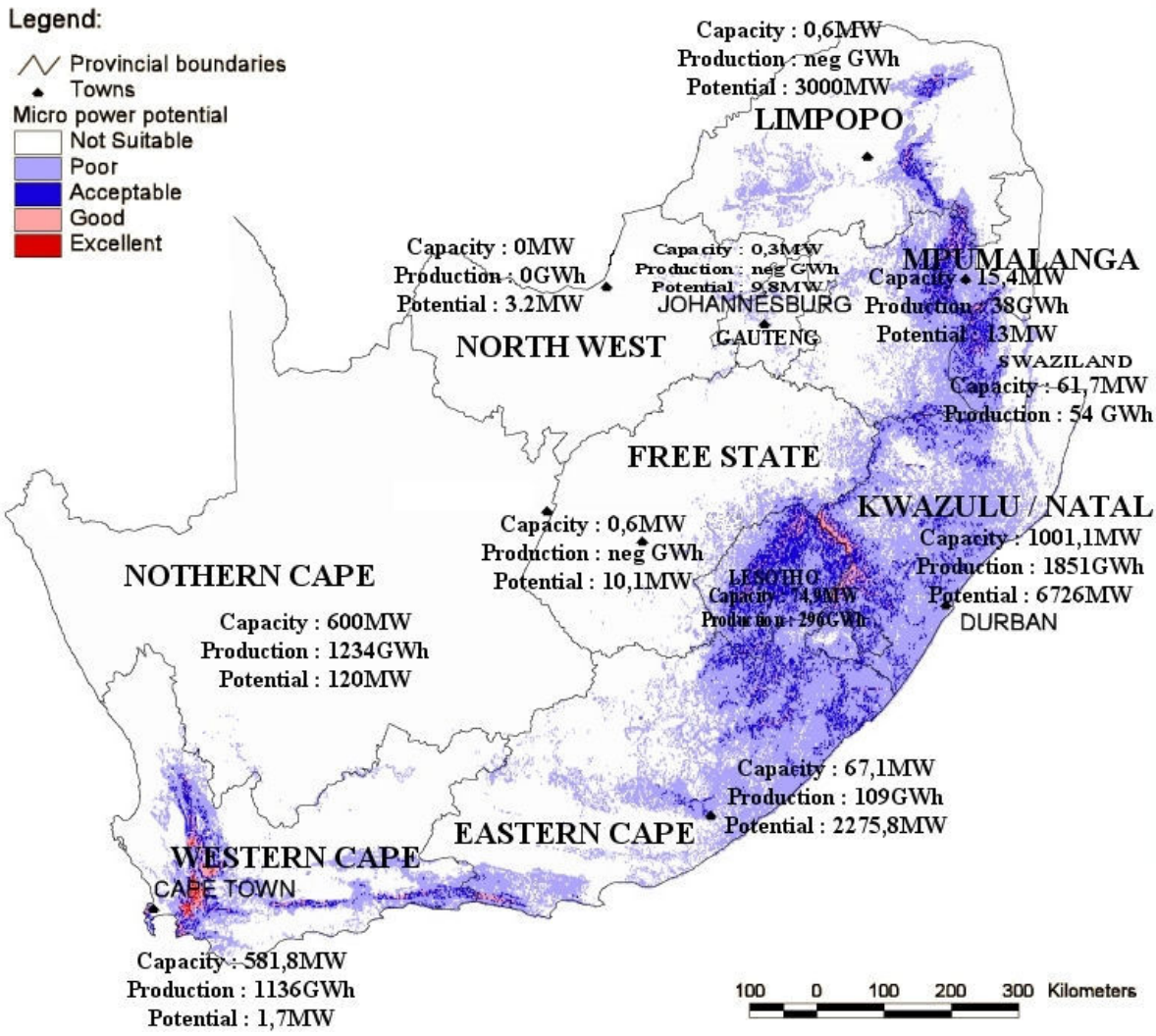
The small hydropower development will contribute in best way to the increase in implementing of renewable energy technology in South Africa, somewhat marginally in numerical representation, however, most suitable and sustainable in short to medium-term.



Note: The values for hydropower capacity, production and potential for development represent all categories of hydropower including hydro-pumping storage but excluding imported hydropower.

Figure 8.2: Provincial representation of hydropower capacity, production and firm potential

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APPENDICES

APPENDIX A : List of essential contacts in hydropower sector

APPENDIX B : Example of IFR Modified Flows for Quarternaries T32E and T60D (WSAM/DSS data output)

APPENDIX C : Photo coverage of excursion to the Lydenburg Hydropower Plant (2 MW)

APPENDIX D : Typical rural micro/pico hydropower site and off-grid area potential in the Eastern Cape Province

APPENDIX E : Illustration of an educational aid for increasing the awareness of renewable energy and high school level

APPENDIX A

Local contacts (South Africa):

DEPARTMENT OF WATER AFFAIRS AND FORESTRY

Location of Department	Postal Address
Sedibeng Building 185 Schoeman Street 0001 PRETORIA	Private Bag X313 0001 PRETORIA

Tel: (012) 336-7500, or e-mail bda@dwaf.pwv.gov.za
Website: www.dwaf.gov.za

REGIONAL OFFICE ADDRESSES

Mpumalanga Regional Office Prorom Building, 2-6th Floor Crn. Paul Kruger and Brown Str 1200 NELSPRUIT	Private Bag X11259 1200 NELSPRUIT
Tel: (013) 755-1674-7	Fax: (013) 755-1678
Eastern Cape Regional Office Arvan Court 26 Downing Street 5600 KINGWILLIAMSTOWN	Private Bag X7485 5600 KING WILLIAMSTOWN
Tel: (043) 604-5444	Fax: (043) 642-1737
KwaZulu-Natal Regional Office Southern Life Building 9th Floor, 88 Field Street 4000 DURBAN	P O Box 1018 4000 DURBAN
Tel: (031) 336-2700	Fax: (031) 304-9546
Western Cape Regional Office De Goede Hoop Park 17 Strand Street 7532 SANLAMHOF	Private Bag X16 7535 BELLVILLE
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OTHER CONTACTS

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Water Systems Research Group
School of Civil and Environmental Engineering
University of the Witwatersrand
P Bag 3, WITS, 2050
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Mills of Southern Africa
66 – 10th Street, Parkhurst
JOHANNESBURG, 2193
Phone/Fax: (011) 880-7931
e-mail: staples@iafrica.com

International contacts:

Hangzhou International Centre on Small Hydro Power
136 Nanshan Road
P O Box 202
310002 HaNGZHOU, China
Tel: +86 571 70 70070 Fax: +86 571 70 23353
Website: www.inshp.org

International Centre for Hydropower
N-7465 TRONDHEIM, Norway
Tel: +47 73-590 780 Fax: +47 73 590 781
Website: www.ich.no

Austrian Association Promoting Small Hydropower Plants
Museumstrasse 5, District 7
A-1070 VIENNA, Austria
Tel: +43 1 523-7511, ext. 23 Fax: +43 1 526-3609
e-mail: ocvfk@aon.at

British Hydropower Association
Wimborne, Dorset BH21 1QU, U.K.
Tel: +44 121 886 622 Fax: +44 121 886 609
Website: www.brit-hydro.cwc.uk

Internationa Energy Agency
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75739 Paris Cedex 15, France
Tel: +33 1 4057 6554 Fax: +33 1 4057 6559
Website: www.ieahydro.org

Universal Electric Power Corp.
1145 Highbrook Street
AKRON, Ohio 44301, U.S.A
Tel: +1 800 766-9398

APPENDIX B

BACKGROUND TO DECISION SUPPORT SYSTEM (DSS) MODEL

The Decision Support System (DSS) model developed by Hughes and Munster, 1999, utilises the WR90 (Midgley et al, 1994) database of monthly natural time series of flow data for each quaternary catchment. The DSS model provides a low-confidence estimate of the quantity component of the ecological Reserve for the selected river at the outlet of the quaternary catchment under consideration. The Reserve results generated by the DSS model can also be scaled to the appropriate site in the catchment under consideration.

The DSS model is based on the relationships between the hydrological characteristics of the catchment under consideration, the instream flow requirements (IFRs) previously determined and used to calibrate the model for various rivers in South Africa and the selected category (A – D). The selected state can be the Present Ecological State Category (PESC) or the recommended Ecological Management Category (EMC). The PESC and EMC are based on the overall condition of the aquatic ecosystem as well as the importance of the resource. Some or all of the following parameters are used for the detemination:

- Bed modification;
- Flow modification;
- Introduced instream biota;
- Inundation;
- Riparian/bank condition;
- Water quality modification;
- Habitat integrity;
- Fish;
- Macro-invertebrates;
- Geomorphology; and
- Vegetation.

The DSS model recommend a flow regime (recommended Reserve) for any of the four ecological management categories (EMC), ranging from:

- A - unmodified, natural;
- B - largely natural;
- C - moderately modified; and
- D - Largely modified.

Provisional assessments have been carried out to determine the PESC for each quaternary catchment (Kleynhans, 1999). This formed part of the National Water Balance Model project (now the Water Resources Situation Model).

The results of the DSS model are:

- A representative time series (modified time series) of monthly flow volumes (same length as that used to represent the natural flow regime) required for the recommended EC;

- Annual and monthly IFR values, this also include the monthly distributions of the total natural flow, separated natural base flows and the three main IFR components (maintenance low and high flows and the drought low flows); and
- An assurance table for the natural and modified flows for each month of the year. Percentage points used are 10, 20, 30, 40, 50, 70, 80, 90 and 99%.

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Midgley, D.C., Pitman, W.V. and Middleton, B.J. (1994). Surface Water Resources of South Africa, Volume II, Drainage Region C, Vaal. Water Research Commission Report No. 298/2.1/94.

Summary of Desktop (Version 2) estimate for Quaternary Catchment Area
Total Runoff : Quaternaries T32E

Annual Flows (Mill. cu. m or index values):

MAR	=	176.178
S.Dev.	=	110.309
CV	=	0.626
Q75	=	2.588
Q75/MMF	=	0.176
BFI Index	=	0.338
CV(JJA+JFM) Index	=	2.694

Ecological Category = C

Total IFR	=	36.669 (20.81 %MAR)
Maint. Lowflow	=	18.510 (10.51 %MAR)
Drought Lowflow	=	8.570 (4.86 %MAR)
Maint. Highflow	=	18.159 (10.31 %MAR)

Monthly Distributions (Mill. cu. m.)
Distribution Type : T Region

Month	Natural Flows			Modified Flows (IFR)			
				Low flows		High Flows	Total Flows
	Mean	SD	CV	Maint.	Drought	Maint.	Maint.
Oct	8.060	16.805	2.085	1.007	0.482	0.797	1.804
Nov	13.549	20.383	1.504	1.268	0.595	1.498	2.766
Dec	18.051	23.192	1.285	1.533	0.710	2.452	3.985
	21.526	23.644	1.098	1.818	0.834	2.759	4.577
Feb	32.194	34.807	1.081	2.401	1.087	1.379	3.781
Mar	35.870	39.585	1.104	2.793	1.257	7.087	9.880
Apr	16.952	19.964	1.178	2.175	0.989	1.495	3.671
May	9.214	22.224	2.412	1.590	0.735	0.000	1.590
Jun	5.849	11.106	1.899	1.177	0.556	0.000	1.177
Jul	4.461	7.324	1.642	0.974	0.467	0.000	0.974
	3.340	4.198	1.257	0.838	0.408	0.000	0.838
Sep	7.114	33.171	4.663	0.935	0.451	0.691	1.627

Summary of Desktop (Version 2) estimate for Quaternary Catchment Area
Total Runoff : Quaternaries T60D

Annual Flows (Mill. cu. m or index values)

MAR	=	245.306
S.Dev.	=	138.114
CV	=	0.563
Q75	=	5.012
Q75/MMF	=	0.245
BFI Index	=	0.407
CV(JJA+JFM) Index	=	2.612

Ecological Category = A

Total IFR	=	113.609	(46.31 %MAR)
Maint. Lowflow	=	76.757	(31.29 %MAR)
Drought Lowflow	=	13.675	(5.57 %MAR)
Maint. Highflow	=	36.852	(15.02 %MAR)

Monthly Distributions (Mill. cu. m
Distribution Type : T Reg. Coast

Month	Natural Flows			Modified Flows (IFR)			
				Low flows		High Flows	Total Flows
	Mean	SD	CV	Maint	Drought	Maint	Maint.
Oct	18.932	24.574	1.298	5.079	0.947	3.148	8.227
Nov	36.522	39.548	1.083	7.593	1.314	12.978	20.570
Dec	32.362	30.133	0.931	7.968	1.369	2.761	10.729
	22.078	17.856	0.809	7.410	1.288	3.132	10.541
	26.328	27.872	1.059	8.047	1.381	3.985	12.033
Mar	35.430	41.287	1.165	9.502	1.594	5.522	15.023
Apr	23.588	36.968	1.567	8.339	1.424	3.190	11.529
	13.629	22.692	1.665	6.200	1.111	1.132	7.332
Jun	10.553	16.943	1.605	4.824	0.910	0.000	4.824
	9.537	18.441	1.934	4.288	0.831	0.000	288
Aug	6.548	8.273	1.263	3.632	0.735	0.000	3.632
Sep	9.799	19.995	2.040	3.876	0.771	1.005	4.880

APPENDIX C

Lydenburg 2MW Hydropower Plant

River off-take above waterfall

Feeding canal headrace

Interior of 2MW Lydenburg plant