APPENDICES

APPENDIX A

A.1 Hydrology of the Luvuvhu catchment

Quaternary catchment	Rainfall (mm)	Mean annual runoff (million m^3/annum)	
		WR90	**1990 Pre-feasibility study**
A91A	696	16.5	14.0
A91B	620	12.0	4.9
A91C	866	35.5	37.7
A91D	1287	49.8	67.9
A91E	1078	56.0	61.8
A91F	662	20.0	31.3
A91G	950	138.1	126.5
A91H	722	26.5	28.0
A91J	450	5.7	17.1
A91K	373	2.6	7.7
TOTAL/AVERAGE	**627**	**362.9**	**397.0**

A.2 Hydrology of the Mutale catchment

Quaternary catchment	Rainfall (mm)	Mean annual runoff (million m^3/annum)
		WR90
A92A	997	118.5
A92B	711	31.6
A92C	423	4.9
A92D	301	1.4
TOTAL/AVERAGE	**627**	**156.5**

APPENDIX B

B.1 Land Use in the Luvuvhu Catchment

Quaternary catchment	Irrigation (km^2)	Forestry (km^2)
A91A	3.5	40.0
A91B	5.3	4.0
A91C	21.9	26.2
A91D	7.3	20.4
A91E	6.7	12.4
A91F	4.2	0
A91G	6.1	27.5
A91H	8.8	3.3
A91J	0.0	0
A91K	0.0	0
TOTAL	**63.8**	**133.5**

Source: Luvuvhu Pre-feasibility study (Irrigation) CSIR (Forestry)

B.2 Land Use in the Mutale Catchment

Quaternary catchment	Irrigation (km^2)	Forestry (km^2)
A92A	41.4	34.8
A92B	1.6	0
A92C	0	0
A92D	0.7	0
TOTAL	**43.7**	**34.8**

Source: WRSA (Letaba/Luvuvhu) CSIR (Forestry)

APPENDIX C

DAMS IN THE LUVUVHU/MUTALE CATCHMENT

QUATERNARY CATCHMENT	DAM	USE	CAPACITY (MILLION M3)	YIELD (Million m^3/a)
A91B	ALBASINI	Irrigation/Domestic	28.27	
A91B	ELDORET	Irrigation	1.83	
A91C	APPELFONTEIN NO.3-	Irrigation	0.071	
A91C	APPELFONTEIN NO.4-	Irrigation	0.05	
A91C	APPELFONTEIN-SEMENTBOOG	Irrigation	0.056	
A91C	BEAUFORT	Irrigation	0.14	
A91C	MAMBEDI LOWER	Irrigation	0.72	
A91C	MAMBEDI MIDDLE DAM	Irrigation	0.18	
A91C	MEMBEDI MIDDLE	Irrigation	0.18	
A91C	MEMBEDI UPPER	Irrigation	0.75	
A91C	MOLODZWI	Irrigation	0.5	
A91C	TOM MITCHELL	Irrigation	0.65	
A91C	WILLIE VAN WYK	Irrigation	0.24	
A91D	TEVREDE	Irrigation	0.1	
A91E	LAATSGEVONDEN TOP	Irrigation	0.067	
A91G	FRANK REVELE DAM	Irrigation	1.1	
A91G	MVUWE DAM	Irrigation	0.28	
A91G	VONDO	Irrigation/Domestic	30.54	
A92A	MBWEDI DAM	Domestic Water Use	11	
A92A	MUKUMBANI DAM	Irrigation	3.9	

Source: T&M Dams database

APPENDIX D

Hydrology of the Letaba catchment

Quaternary catchment	Rainfall (mm)	Mean annual runoff (million m^3/annum)
B81A	1194	63.9
B81B	1163	115.6
B81C	880	17.2
B81D	832	67.3
B81E	667	29.5
B81F	544	18.8
B81G	627	16.2
B81H	510	7.1
B81J	502	5.3
B82A	721	23.2
B82B	702	18.1
B82C	712	14.2
B82D	623	16.5
B82E	656	13.6
B82F	676	27.6
B82G	524	14.3
B82H	516	10.8
B82J	540	13.6
B83A	515	12.8
B83B	596	8.6
B83C	539	5.9
B83D	552	9.5
B82E	587	4.5
TOTAL/AVERAGE	**624**	**574.4**

Hydrology of the Shingwedzi catchment

Quaternary catchment	Rainfall (mm)	Mean annual runoff (million m^3/annum)
B90A	465	6.5
B90B	470	9.4
B90C	498	9.0
B90D	471	5.3
B90E	466	5.1
B90F	539	19.5
B90G	535	15.5
B90H	538	16.2
TOTAL/AVERAGE	**502**	**86.4**

APPENDIX E

E.1 Land use in the Letaba catchment

Quaternary catchment	Irrigation (km^2)	Forestry (km^2)
B81A	0.7	113
B81B	56.2	241
B81C	11.1	6
B81D	11.1	41
B81E	30.4	13
B81F	79.4	0
B81G	0.8	3
B81H	0.8	0
B81J	0.0	0
B82A	6.1	7
B82B	18.3	8
B82C	10.9	13
B82D	0.3	15
B82E	0.2	14
B82F	0.6	8
B82G	10.1	0
B82H	2.8	0
B82J	0.0	0
B83A	0.0	0
B83B	0.0	0
B83C	0.0	0
B83D	0.0	0
B82E	0.0	0
TOTAL	**244.6**	**484**

Source: WSAM

E.2 Land use in the Shingwedzi catchment

Quaternary catchment	Irrigation (km^2)	Forestry (km^2)
B90A	0.3	0
B90B	2.7	0
B90C	0	0
B90D	0	0
B90E	0	0
B90F	0	0
B90G	0	0
B90H	0	0
TOTAL	**3.0**	**0**

Source: WSAM

APPENDIX F: DAMS IN THE LETABA CATCHMENT

QUATERNARY CATCHMENT	DAM	USE	CAPACITY (MILLION M3)	YIELD (Million m^3/a)
B81A	DAP NAUDE	Domestic Water Use	1.94	
B81A	Dummy dam	Irrigation	1.79	
B81A	EBENEZER	Domestic Water Use	70	
B81A	STANFORD LAKE	Irrigation	0.315	
B81B	DOUGLAS	Irrigation	2.3	
B81B	GILLAND	Irrigation	0.25	
B81B	HANS MERENSKY	Irrigation	1.32	
B81B	INZANA	Irrigation	0.228	
B81B	MAGOEBASKLOOF	Irrigation	4.91	
B81B	MALOLE	Irrigation	0.062	
B81B	RAMADIEPA	Irrigation	0.87	
B81B	SEEKOEI	Irrigation	1.53	
B81B	TZANEEN DAM	Irrigation	157.3	
B81B	VERGELEGEN	Irrigation	0.26	
B81B	VON BULOW	Irrigation	0.112	
B81C	Dummy dam	Irrigation	1.72	
B81C	LEDZEE DAM NO. 1	Irrigation	0.068	
B81C	LEDZEE DAM NO. 3	Irrigation	0.205	
B81C	LEDZEE NO.4-	Irrigation	0.25	
B81C	LUSHOF	Irrigation	0.06	
B81C	MANORVLEI DAM NO.1	Irrigation	0.2	
B81C	MANORVLEI DAM NO.2	Irrigation	0.09	
B81D	DAMARA	Irrigation	0.653	
B81D	Dummy dam	Irrigation	3.08	
B81D	EL MARIE	Irrigation	0.1	
B81D	FISH EAGLE	Irrigation	0.6	
B81D	NAPHUNO	Irrigation	0.23	

QUATERNARY CATCHMENT	DAM	USE	CAPACITY (MILLION M3)	YIELD (Million m^3/a)
B81D	THABINA	Domestic Water Use	0.28	
B81D	TORCHWOOD	Irrigation	0.1	
B81D	TUBB'S HILL-OPGAAR	Irrigation	0.096	
B81D	WHITE ELEPHANT	Irrigation	0.095	
B81D	ZIMBABWE	Irrigation	0.06	
B81E	BELLE OMBRE DUBBEL	Information	0.182	
B81E	BELLE OMBRE NO.1-	Irrigation	0.112	
B81E	BELLE OMBRE-GROOT	Irrigation	1.255	
B81E	BOTES	Irrigation	0.095	
B81E	DEER PARK DAM	Irrigation	0.086	
B81E	Dummy dam	Irrigation	5.2	
B81E	KAMPONG	Irrigation	0.05	
B81E	KNAPSAK-BOONSTE	Irrigation	0.05	
B81E	KNAPSAK-GROOT	Irrigation	0.15	
B81E	KROKODIL	Irrigation	0.06	
B81E	KUKA	Irrigation	0.1	
B81E	LABORIE	Irrigation	0.078	
B81E	NAGUDE VELD	Irrigation	0.1	
B81E	NAGUDE-BO	Irrigation	0.075	
B81E	PHINEAS	Irrigation	0.105	
B81E	TAGANASHOEK	Irrigation	0.07	
B81E	THE JUNCTION BIG	Irrigation	0.8	
B81E	TP-BO	Irrigation	0.1	
B81E	TP-SLOOT	Irrigation	0.15	
B81E	TP-VELD	Irrigation	0.06	
B81F	CONSTANTIA-BOONSTE	Irrigation	0.06	

QUATERNARY CATCHMENT	DAM	USE	CAPACITY (MILLION M3)	YIELD (Million m^3/a)
B81F	CONSTANTIA-GROOT	Irrigation	0.8	
B81F	GROETE	Irrigation	0.11	
B81F	JASI	Irrigation	1.096	
B81F	JASIE GROND	Irrigation	0.2	
B81F	KLEIN-CONSTANTIA	Irrigation	0.105	
B81F	LA COTTE NO.1-	Irrigation	1.28	
B81F	LA COTTE NO.2-	Irrigation	0.073	
B81F	LAPARISA	Irrigation	0.126	
B81G	MODJADJI DAM	Domestic	2	
B82A	JAN VAN DER LITH	Irrigation	0.29	
B82A	LORNA DAWN	Irrigation	11.748	
B82B	ALTENZUR	Irrigation	0.914	
B82B	CALESIO	Irrigation	1.7	
B82B	DIEPLAAGTE	Irrigation	0.71	
B82B	DONKERVAL	Irrigation	1.7	
B82B	FRY	Irrigation	4.805	
B82B	HEUNINGPLAAS	Irrigation	0.33	
B82B	JACHTPAD	Irrigation	2.5	
B82B	VAN ZYL	Irrigation	1.5	
B82B	WELGEVONDEN	Irrigation	1.74	
B82C	DUIWELSKLOOF	Domestic Water Use	0.091	
B82C	LEEUDRAAI	Irrigation	0.25	
B82D	MIDDEL LETABA	Irrigation	184.2	
B82D	MODJADJI DAM - LEBOWA	Domestic Water Use	8.16	
B82H	NSAMI DAM (HUDSON NTSANWISI)	Irrigation	29.46	

Source: T&M Dams database

APPENDIX G: WATER REQUIREMENTS - LETABA

Domestic Water Use

Town/Magisterial district	**Quaternary catchment**	**Water use in 2000 (million m^3/annum)**
Haenertsburg	B81A	0.04
Tzaneen	B81C	5.5
Politsi	B81B	0.14
Duiwelskloof	B81B	0.41
Ga-Kgapane	B82C	0.35
Letsitele	B81D	0.26
Ritavi 1	B81E	0.73
Ritavi 2	B81D	2.66
Naphuno	B81D	1.30
Bolobedu	B81G	2.56
Giyani	B82G	0.98
Namakgale		Groundwater
TOTAL		**14.93**

Industrial Water Use

Industry/Mine	**Quaternary catchment**	**Water use in 2000 (million m^3/annum)**
Sapekoe	B81B	0.3
Letaba Citrus	B81C	0.24
Koedoe Co-op	B81C	0.1
Addington Farm	B81C	0.05
TOTAL		**0.69**

Note: Requirements are for processing rather than irrigation

Irrigation Water Use

Quaternary catchment	Water use in 2000 (million m^3/annum)	Source of supply
B81A	12.9	Magoebaskloof and Hans Merensky Dam
B81B	14,1	Ebenezer Dam
B81C	32.0	Tzaneen Dam
B81D	14.8	Letsitele River
B81E	15.0	Nwanedzi River
B81F	73.1	Tzaneen Dam
B81G	0	
B82A	2.4	Run of river
B82B	10.4	Lorna Dawn and other farm dams
B82C	6.6	Groundwater and run of river
B82D	0.1	Run of river
B82E	0.1	Run of river
B82F	0.3	Run of river
B82G	6.7	Middle Letaba Dam
B82H	3.6	Middle Letaba Dam
TOTAL	**170**	

Source:

DWAF, 1998 for the Groot Letaba catchment
DWAF, 2002 for the Klein Letaba catchment

APPENDIX H: REVITALISATION OF SMALLHOLDER IRRIGATION SCHEMES IN THE WMA

1. The Revitalisation Process

The Limpopo Provincial Department of Agriculture (LDA) has embarked on a programme of revitalising irrigation schemes that have fallen into disuse. The main objective of this initiative is to eventually transfer ownership of existing government "owned" small holder irrigation schemes to emerging farmers for the purpose of food security and/or viable commercial crop production. in a sustainable manner. The LDA has committed to assist the specific communities with finance, equipment and technical know-how to revitalise these schemes before transfer takes place. In addition the LDA will assist with the following:

- Establishment of appropriate institutional (management) structures which are farmer owned and farmer led.
- Capacity building and training of farmers in scheme management, water management and crop production.
- Facilitation of appropriate commercial support services and joint ventures.
- Rehabilitation of infrastructure for ownership transfer.

All the smallholder irrigation schemes fall within the old "Homeland" areas. These schemes were established by "Homeland" governments outside of traditional DWAF influence. The revitalisation process now recognizes the need for DWAF approval (via the Provincial Irrigation Action Committee, IAC).

Information on smallholder irrigation schemes situated within the Luvuvhu/Letaba WMA is summarized in **Table H1**.

Table H1: Smallholder irrigation schemes within Luvuvhu/Letaba WMA

Catchment	No. of Schemes	Area Irrigated (ha)	No. of Farmers
Luvuvhu/Mutale	19	2,480	1,832
Letaba/Shingwedzi	14	4,240	3,154
TOTAL	**33**	**6,720**	**4,986**

Source: John Rutherford, 2003

Generally, the infrastructure at these schemes is in a poor state. Much of the land is actually farmed, with concomitant low levels of productivity. For those schemes that are currently in operation, inefficient irrigation methods are practiced with focus on subsistence crops.

A number of constraints facing the revitalisation programme are evident. These include:

- The schemes are isolated
- High levels of poverty
- Farmers are mostly elderly (little interest of youth)
- High illiteracy levels

- Low self-esteem
- Cultural barriers with regard to participation by women
- Small land sizes (i.e. large number of farmers per scheme)
- Low assurance of supply on many schemes
- Insecurity of land tenure
- Influence of tribal authority
- Historical role of government (handouts / loss of self-initiative)
- Poor state of infrastructure
- Poor support services
- Negative perceptions of potential markets (buyers)
- Difficulty of co-operation/coordination of many smallholder farmers with respect to water management, production inputs, marketing, etc.)

The LDA started the revitalisation programme in 1998 when it selected and implemented the revitalisation process on three pilot projects (refer to **Table H2a** for project names and more details).

April 2000 saw the launch of the next group of schemes under phase 1 of the Water Care Programme, WCP (see Table H2b), with the next phase initiated in January 2002. At this time a masterplan was formulated to expand the revitalisation programme to include all viable smallholder irrigation schemes in the Limpopo Province. This masterplan formed the foundation on which a reasonably comprehensive business plan (LDA, 2002) was developed.

The business plan outlines the revitalisation process in some detail. Each community that wishes to be part of the programme must formally apply at the LDA for assistance. The LDA then initiates a Pre-development Survey and a Technical Evaluation of resources and infrastructure. With regard to DWAF's role in these assessments the fundamental question has to be asked as to the availability of sustainable water resources for these projects. Furthermore it is necessary to ascertain whether or not these schemes had an existing water allocation/licence from a particular source in the past. The Directorate: National Water Resources Planning has started investigating these issues with a view to providing support to the LDA.

If the project is deemed viable, LDA then assists the community to establish appropriate management structures to allow them to eventually take over and manage these schemes. The rehabilitation of infrastructure only begins once these structures are in place and are functioning properly.

These structures include farmers' groups and a Water User Association (WUA) with its own Management Committee in a specific area. The farmer groups are represented on the WUA. The drafting of a constitution to establish a WUA as a legal entity in terms of the National Water Act is seen as a major milestone in this process. The WUA is then registered with DWAF, this then enables these farmers to gain access to a DWAF grant for certain irrigation infrastructure rehabilitation that may be necessary.

With the legal structures in place and rehabilitation of infrastructure underway, a gradual transfer of ownership of the scheme to the WUA is effected.

During this process farmers are trained in scheme management and administration, financial management, and farming practices to ensure that the productivity of the scheme is improved and to allow farmers to take on the maintenance and management of the scheme.

Table H2a: Pilot Smallholder Irrigation Schemes (1998 – 2001)

District	Schemes	Irrigation area (ha)	No. of farmers	Irrigation System	Crops
Mopani	Thabina	228	153	Flood	Vegetables, field crops & sub - tropical fruits
Sekhukhune*	Boschkloof	200	200	Flood	Vegetables & field crops
Vhembe	Morgan	75	24	Flood	Vegetables, field crops & sub - tropical fruits
Sub Total		**503**	**377**		

Table H2b: Water Care Programme (Phase 1) (2000 - 2003)

District	Scheme	Irrigation area (ha)	No of farmers	Irrigation System	Crops
Mopani: Naphuno sub-district near Trichardtsdal	Metz	265	148	Open canal under gravity from Metz dam to in - field furrow flood irrigation	Sub-tropical fruit (mango) , vegetables and maize
Mopani: Naphuno sub - district near Trichardtsdal	Madeira	240	108	Open canal gravity to in field furrow flood irrigation	Vegetables & maize with high potential for sub tropical fruit (mango)
Vhembe: Makhado* sub-district 25 km west of Louis Trichardt	Capes Thorn	99	77	Open canal to in-field furrow flood irrigation - partly gravity and partly booster pumped	Summer maize and winter vegetables
Bohlabelo*	Dingleydale New Forest	937 713	780 420	Lined main canal from weir on the river. Gravity fed flood irrigation	Maize, tomato and vegetables with potential for citrus and mangos
Sub Total		**2254**	**1533**		

Table H2c: Water Care Programme (Phase 2) (2002 - 2004)

District	Scheme	Irrigation area (ha)	No. of farmers	Irrigation System	Crops
Vhembe	Ndzhelele Cluster (12 schemes)	709	694	Canals with some pipes	Maize & vegetables with potential fruits
Vhembe	Matsika	102	47	Pumped sprinkler	Maize, vegetables and sub - tropical
Vhembe	Makuleke	215 (5 ha) 24 (0.12 ha)	43 200	Pumped sprinkler	Maize, vegetables and sub - tropical
Mopani	Homu	165	22	Pumped sprinkler	Banana
Sekhukhune*	Tswelopele	1020	312	Pumped to canals storage dams and sprinkler systems	Cotton , wheat, sub - tropical fruit
Sub Total	**24 schemes**	**2235**	**1318**		

Table H2d: CPC Programme

District	Scheme	Irrigation area (ba)	No. of farmers	Irrigation System	Crop
Capricon	Elandskraal	197	97	Pump and sprinkler	Maize wheat, vegetables
Sekhukhune*	Upper Arabie	426	343	Canal and flood irrigation	Maize wheat, vegetables
Sub Total	**4 schemes**	**623**	**440**		

Table H2e: All Schemes

Total	**(28 schemes)**	**5615**	**3668**		

Note: Districts marked with (*) fall outside of the Luvuvhu/Letaba WMA

2. Progress to Date

Some 28 existing smallholder irrigation schemes have been included in revitalisation process since 1998 (see Table H2.a – H2.e). This constitutes an area of 5, 615 hectares and has supported 3, 668 farmers. A full rollout plan (i.e. prioritisation over the next number of years) for the rest of the schemes has been documented in the business plan as well as subsequent planning. (Refer to **Table H3** for a list of the proposed schemes in the Luvuvhu and Mutale River Catchments). **Figure H1** shows the relative locations of these schemes.

Various shortcomings have been identified during the work that has been done on the initial 28 schemes listed in **Table H2**. These are:

- Inadequate time spent on day-to-day scheme management issues (i.e. water distribution management; financial management; and marketing).
- Inadequate follow-up support and mentorship from the LDA after formal intervention has been completed.
- Excessive delays in registration of WUAs for the schemes.
- Delays in formal handover of schemes from the LDA to beneficiaries.

FIGURE H1: RELATIVE LOCATIONS OF PROPOSED IRRIGATION SCHEMES IN THE LUVUVHU AND MUTALE RIVER CATCHMENTS

THIS FIGURE IS NOT ACCESIBLE IN ELECTRONIC FORMAT.
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Table H3: List of Irrigation Projects proposed for revitalization in Luvuvhu/Letaba WMA

Irrigation Projects Analysis

No	ProjName	ProjType	Status	Sub_Region	Size_[ha]	WaterSource	Catchment	Comments
2	Albasini	Field crops other	Active	Louistrichardt	1856		A91B	No data
123	Mununzwu	Fruit	Active	Tshitale	313	Yes	A91B	Reg: 27064033. Taking: 2.028mln/1960. Storing: 2.455mln/5 dams/1950-1967
74	La-Rochelle	Field crops other	Active	Dzanani	200		A91C	No data
6	Barotta	Fruit	Active	Vuwani	175	Yes	A91D	No data
163	Solani	Vegetables	Active	Tzaneen	96	No	A91D	No data
180	Tskhuma Packhouse		Non-active		1		A91D	No data
31	Dzindi	Vegetables	Active	Thohoyandou	136.878	Yes	A91E	No data
55	Hamutsha	Vegetables	Non-active	Vuwani	7	Yes	A91E	No data
64	Khumbe/Rebanda	Vegetables	Active	Vuwani	145.298	No	A91E	No data
122	Muledane	Fruit	Active	Thohoyandou	48		A91E	Reg: 27079152. Taking water (Dzindi): 436,500/1996. 50ha.
141	Palmaryville	Vegetables	Active	Thohoyandou	92.592	Yes	A91E	No data
179	Tsianda	Fruit	Active	Vuwani	70	Yes	A91E	No data
182	Tswinga	Fruit	Active		50		A91E	No data
32	Dzwerani	Vegetables	Non-active	Vuwani	25.92	Yes	A91F	No data
99	Mangondi	Vegetables	Active	Thohoyandou	17	Yes	A91F	No data
119	Morgan	Vegetables	Active	Malamulele	75	Yes	A91F	No data
130	Nesengani	Vegetables	Non-active	Vuwani	17	Yes	A91F	No data
131	Nesengani 1	Vegetables	Active		13.268	No	A91F	No data
132	Nesengani b2	Vegetables	Active		40.392	Yes	A91F	No data
133	Nesengani C	Vegetables	Active		31.2	No	A91F	No data
177	Tshimbupfe	Vegetables	Active	Vuwani	12	Yes	A91F	Reg: 27078055. Taking water (groundwater): 154,560/2001. 11ha
95	Malavuwe	Vegetables	Active	Thohoyandou	26	Yes	A91G	No data
104	Matsika	Vegetables	Non-active	Thohoyandou	102	Yes	A91G	No data
124	Murara	Vegetables	Active	Thohoyandou	37.294	Yes	A91G	No data
143	Phaswana	Fruit	Active	Thohoyandou	237	Yes	A91H	Reg: 27079125. Taking water (Luvuvhu). 1,895,800/1987. 170ha.
73	Lambani	Fruit	Active	Thohoyandou	44	Yes	A91H	No data
109	Mhinga - Xikundu	Fruit	Active	Malamulele	229	Yes	A91H	Reg: 27079072. Taking water (Levuvhu): 1,841,010/2002. 204ha.
175	Tshaulu	Fruit	Active	Thohoyandou	150	Yes	A91H	Reg: 27079508. Taking water (Levuvhu): 124,290/1993. 90ha.
176	Tshikonelo	Fruit	Active	Thohoyandou	107	No	A91H	Reg: 27079134. Taking water (Levuvhu): 315,150/1987. 55ha
93	Makonde	Vegetables	Non-active	Thohoyandou	200	Yes	A92A	No data
149	Rambuda	Vegetables	Active	Mutale	102	Yes	A92A	No data
178	Tshiombo	Vegetables	Active	Thohoyandou	1100	Yes	A92A	No data
12	Britz/Lubgane	Fruit	Active		70		A92B	No data
125	Mutale Estates	Ornamental plants	Active	Mutale	120	Yes	A92B	No data
66	Klein Tshipise Irrigation	Vegetables	Active	Mutale	8.835	Yes	A92C	No data
126	Mutele	Vegetables	Active	Limpopo	33		A92D	No data
153	Sanari	Vegetables	Active	Limpopo	39		A92D	No data
106	Mbulu	Vegetables	Active	Thohoyandou	?			

APPENDIX J: OVERVIEW OF GROUNDWATER RESOURCES OF THE LUVUVHU AND MUTALE CATCHMENTS

1. Groundwater Quantity

Groundwater resources are available throughout both the catchments, but in varying quantities depending upon the hydro geological characteristics of the underlying aquifer.

The western parts of the Luvuvhu catchment are heavily populated and widespread rural communities are a feature of the area. Many communities rely on groundwater although conjunctive use schemes are also widespread.

Information concerning groundwater use in the overall Luvuvhu Letaba WMA was obtained from Mr. W. du Toit, Assistant Director Geohydrology DWAF, responsible for the North Region. Estimates of groundwater use per individual catchment were not available.

Table J1 provides an overview of the use of groundwater in the Luvuvhu Letaba WMA and shows that total abstraction is of the order of 57.2Mm^3/a, 66% of which is used for rural community water supply and only 16% for irrigation.

Table J1: Groundwater Use in the Luvuvhu/Letaba WMA

Use	Million m^3 / annum	% of Total Use
Irrigation	9*	16
Livestock	0.2	<1
Rural Communities	38	66
Municipalities	8	14
Mining	2	3
Total	57.2 **	100

Notes:
* The WMA Report (DWAF, 2003a) statesthat, in total 15% of the yield from local water resources in the WMA i is from groundwater
** A figure of 43 million m^3/a is presented in the NWRS

Annual recharge is estimated to vary significantly, with recharge of over 50mm in the high lying western parts of the catchments (5% of mean annual rainfall) and <5mm in the low-lying North Eastern areas, (1 – 2% of mean annual rainfall).

Using these figures, groundwater recharge in the WMA is estimated to be approximately 125Mm^3/a, with over 75% of the recharge occurring in the higher lying western half of the WMA.

Overall the available groundwater resources within the WMA are underutilised although this clearly depends both on the groundwater occurrence and the demand. Even weaker groundwater occurrence areas can often provide more than the RDP level of 25 litres per head per day. (Note : Over-exploitation of the groundwater nevertheless occurs at some locations in the WMA, notably in the vicinity of Thohoyandou, at Gidiana and possibly downstream of Albasini Dam).

2. Groundwater Quality

2.1 Natural

Regionally the natural groundwater quality is generally good, satisfies the DWAF water quality guidelines and is suitable for domestic and agricultural use.

2.2 Pollution

Groundwater pollution is an increasing threat. Pollution of groundwater can result from:

- domestic use
- agriculture
- mining
- waste disposal

Pollution emanating from settlements, especially informal settlements, is difficult to control. Elevated nitrate levels (NO_3 >10mg/l) in groundwater are frequently found in water supply boreholes in the traditionally settled areas of the catchment. In particular the following must be considered:

- Groundwater pollution occurring as a result of high latrine density. This results in a pollution plume of increased salinity and nitrate around the settlement.
- Abstraction from boreholes for water supply located within plumes has to be terminated, i.e., water quality monitoring must be implemented to determine when and if there is an unacceptable deterioration in groundwater quality.
- Groundwater must be abstracted from outside possible impacted areas, i.e., boreholes and well fields have to be located well away from potential pollution sources.
- Education about the need for, and ways of, protecting the groundwater resources is required.
- Standards for borehole positioning, construction and protection, as specified by DWAF and SABS, must be enforced.

The impact of groundwater pollution from mining and waste disposal can be controlled and remediated according to the requirements of DWAF. Mines and waste disposal sites are required to prepare EMPRs, EIA and closure plans which identify and put preventative and remediation measures, including monitoring, in place.

Waste disposal sites offer a potentially serious hazard due to poor management and lack of operating controls. The pollution risk from waste disposal needs to be assessed and remediated.

3. Management and Monitoring Requirements

Effective groundwater management and monitoring is essential for long-term sustainability of the supply and to protect the resource. A monitoring programme needs to be implemented for each groundwater or conjunctive use scheme, involving regular measurements of:

- water levels,
- abstraction, and
- quality.

Information concerning routine monitoring undertaken by DWAF was not available and it is understood that no monitoring is currently taking place.

Underdeveloped areas, i.e., areas with unutilised groundwater resources with potential for development can be identified and earmarked for future development. Likewise areas where the available resources are overdeveloped should be identified and alternative water sources considered to alleviate abstraction stress and to augment the groundwater resource.

Groundwater development projects should be undertaken by recognised professional hydro-geologists. All contracting works should be undertaken according to a proper technical specification and bill of rates to ensure:

- correct drilling technique,
- borehole construction meets the DWAF and SABS specifications for longevity and pollution protection,
- adequate testing procedures are followed,
- water quality is determined by analysis in an accredited laboratory,
- management recommendations for the optimum long term sustainable use of the groundwater resource are prepared and implemented.

4. Poverty Eradication

Groundwater has an important positive role in poverty eradication. Development of the available resources leads to:

- an increase in water supply
- the provision of a clean water supply
- the time saved in collecting water is available for other economic activities.

The Department of Agriculture is implementing a project to encourage the development of 1 – 2 ha plots for food production as part of poverty eradication. It will be ideal for irrigation water for these schemes to be supplied from groundwater. Abstractions for these projects will need to be licensed if the anticipated water use exceeds the general authorisation. Such projects must be integrated with other water use initiatives as part of overall integrated water resources planning and management within the catchment.

5. Overview of Groundwater Throughout the Catchments

The overview of the groundwater resources and associated issues is discussed according to groups of Quaternary Catchments sharing similar lithology and morphological characteristics. The distribution of the lithologies of the region with respect to hydrogeology is illustrated on the simplified lithostratigraphical map in **Fig. J1.**

CLICK TO VIEW GRAPHIC

Groundwater occurrence is controlled by the prevailing lithology of the given area. Both the Luvuvhu and Mutale catchments are underlain by hard rocks with aquifers developed in secondary features associated with weathering pockets and structures. Structural features are important and higher borehole yields are generally associated with these features. Localised occurrences of alluvial deposits occur along the Limpopo River, which are locally exploited for irrigation.

5.1 The northern part of A92D underlain by Metamorphosed Strata of the Limpopo Mobile Belt

This is the most northerly portion of A92D bounding the Limpopo River where the easternmost extension of the NE – SW trending metamorphic rock assemblage known as the Limpopo Mobile Belt which lies across much of Limpopo province (in the Limpopo WMA) occurs. The southern boundary is faulted against the Karoo Basalt along the Bosbokpoort Fault. Much of the solid geology is covered by a thin cover of recent deposits. The topography forms flat to rolling countryside.

The area is mostly stock and game farming and is sparsely populated. Irrigation is practised along the Limpopo River on the old flood plain.

Borehole yields are <2l/s, and often <0.5l/s. Aquifers are really limited and restricted to structural features and zones of deeper weathering. Water levels vary between 20 and 30mbgl, boreholes are generally 50 – 80m deep. Impacts on groundwater quantity due to abstraction will be limited due to the restricted nature of the aquifers.

The groundwater quality is characterised by conductivities between 70 and 300 mS/m, i.e. Class I (70 – 150mS/m) or Class II (150mS/m – 300mS/m) water quality.

5.2 The Central Part of A92D and the eastern parts of A91K underlain by Karoo age Basalt

Karoo age basalt outcrops in the north of the Mutale catchment immediately south of the Bosbokpoort Fault, and forms the wide north south trending central plains and gently rolling countryside of the northern part of the Kruger National Park from Pafuri in the north south towards Shingwedzi.

The northern area in Mutale catchment is agricultural with the few scattered settlements dependant upon groundwater for domestic supply and cattle watering.

Borehole yields tend to be 0.5 - 2l/s. Aquifers within the basalt are generally of limited area extent. Yields >5l/s are locally present in major structural features, e.g. the boundary between the metamorphic rocks and the Karoo basalt in catchment A92D in the Bosbokpoort Fault area. Static water levels are between 15 and 30 mbgl, and boreholes are generally 50 – 80m deep.

There are over 1000 boreholes in the KNP, many of which are situated within these catchments. Almost all the boreholes are used for game watering. Most of the tourist camps are supplied by surface-water. It is planned to reduce the number of operational boreholes due to a change in management strategy towards restoring the area to it’s natural state.

The groundwater quality is primarily good which is either Class 1 or 2. Isolated occurrences of elevated NO_3 occur in settlements. The area within the KNP is pristine and is ecologically sensitive. Within the KNP impacts from activities within these catchments are unlikely.

5.3 Arenaceous Karoo Age Sediments in the northern part of A92C, part of A92D, the eastern part of A91J, and western part of A91K

This area is underlain by Karoo sandstone which forms a west – east trending outcrop across the Mutale catchment, becoming a north south trending outcrop zone along the western side of the Kruger National Park (KNP). The sandstone forms flat to hilly topography with ridges in the northern part of the KNP.

The area is agricultural with scattered communal land settlements in A92C and A92D reliant on groundwater for domestic supply and cattle watering. The area is pristine within the KNP. Impacts within the KNP area are not anticipated.

Borehole yields are variable falling mainly within the range 0.5 – 2 l/s. Water levels range from 20 – 30mbgl and boreholes average 40 – 80m in depth.

A Kumba Resources coal mine is located to the west of the KNP in catchment A92D.

Groundwater quality is generally good (Class I) to moderate (Class 2) with conductivities below 300 mS/m.

5.4 Areas Principally underlain by Arenaceous Strata of Waterberg Age forming the Soutpansberg Mountains, (parts of Quaternary Catchments A91A, D, E & F, and A91G, H & J and A92A – C

This area comprises the eastern part of the east - west trending Soutpansberg Mountains underlain by a sequence of mainly coarse-grained sandstone and conglomerate. The town of Thohoyandou is situated on the southern boundary of this lithological unit in A91E. The area is structurally complex with a NE – SW structural trend. There are numerous major faults and fracture zones and the area is characterised by rugged and mountainous terrain with steep-sided valleys.

This area mostly comprises communal lands. Quaternary catchments A91D, G & H and A92A & B are heavily settled, (Thohoyandou and Malamulele). There is widespread use of groundwater and many of the communities are supplied with conjunctive schemes using surface water together with groundwater as the source.

Groundwater resources are generally low to moderate with sustainable borehole yields between 0.5 and 2 l/s, although higher yields (>3l/s) are found along fault and fracture zones. Boreholes vary from 60 – 150m in depth and static water levels vary from <10mbgl to >40mbgl, depending upon the topographical position.

Springs are an important source of water supply for the rural communities.

The groundwater quality is mostly good; localised occurrences of elevated NO_3 are reported in the communal land areas.

The Soutpansberg Mountains are an important recharge area (as noted above recharge is estimated as up to 100mm per annum) and groundwater provides important baseflow to surface drainage.

5.5 The Southern and South Western Areas Principally underlain by Granite and Gneiss of the Basement Complex. (A91B & C and southern parts of A91A, D, E & F of the Luvuvhu Catchment)

This granitic area lies immediately south of the Soutspansberg Mountains. The western areas form the escarpment trending north from Tzaneen towards Thohoyandou. Below the escarpment the Lowveld forms a gently rolling to flat landscape. The Luvuvhu river rises in the escarpment in the west.

Forestry and natural forest occurs along the escarpment. The escarpment area is ecologically sensitive and represents an important groundwater recharge zone where uncontrolled development will have adverse impacts.

There is heavy dependence on groundwater in Elim (A91B) and in A91F south of Thohoyandou. Conjunctive use schemes supply many of the communities.

Groundwater occurrence is controlled by the presence of weathering zones and structural features. According to the published hydro geological maps (Messina 2127 and Phalaborwa 2330) borehole yields tend to be in the 2 – 5l/s range with local areas of deep weathering and good structural development supporting yields >5l/s. Recent work undertaken for the GRIP project would suggest that sustainable yields may be lower than the published 1:500 000 maps indicate, and generally 0.5 – 1 l/s.

Higher yields (>5l/s) are found on well-developed regional structures, fault and fracture zones.

Boreholes are generally 70 – 100m deep and water levels 15 – 40m below surface depending upon the topography.

Groundwater quality is generally good (Class 1) to moderate (Class 2) with conductivities between 70 and 300mS/m. Elevated NO_3 levels are reported in many of the settlements.

5.6 River Bed Sand Aquifers

The sand deposits of drainage channels are often used to obtain water, either directly from the surface flow of the river, or from sand abstraction schemes constructed in the river bed sediments.

Wellpoint offer a means of abstracting water from rivers from the subsurface flow and storage within the sand aquifers after the visible flow has ceased. Usually these schemes operate until the subsurface flow has diminished and the water level has declined to such an extent that the volume of water delivered is no longer viable for the intended use.

Wellpointing schemes and direct pumping from pits excavated in the river sand are operated along the Limpopo River in quaternary A92D to obtain water for irrigation.

Abstraction from wellpoints installed in deposits of the main river channels is also undertaken locally where the deposits are suitably developed.

It is considered that sand abstraction schemes at the Limpopo are over-utilising the available resources and licences for new schemes are not being issued at present.

5.7 Ground Water/Surface Water Linkage

Groundwater contributes to base flow throughout the catchment via sub surface seepage and springs. The Soutpansberg range and the north - south trending escarpment area are important areas for groundwater recharge and surface water base flow.

The relationship between groundwater, base flow, and river flow is reasonably well understood where hydrographs are available. However, the impact of groundwater abstraction on surface water resources is less well understood and this is an aspect that warrants study.

Recharge of the groundwater system from river flow, especially during flood events, is important.

5.8 Summary of groundwater issues

The following is a summary of groundwater issues that apply across the WMA:

- Groundwater quality could be impacted from agricultural activities, especially along the Limpopo River where irrigation is practised and the application of fertiliser is poorly managed.
- Availability of water during a drought in areas reliant on groundwater for domestic supply and stock watering is an issue. This is difficult to deal with in areas of low resources.
- Pollution of the resources from latrines and increasing population, with elevated TDS and NO_3. Implement strategy of education and training to protect borehole head areas from water spillage, damage by cattle drinking, etc. Position new boreholes well away from settlements, and pipe water to the settlement, where the groundwater resources are suitable to do this.
- Pollution of groundwater by mining effluent, acid mine drainage and agricultural activities.
- Impacts caused by mining need to be identified and remediated. Prevention measures must be put in place. EMPR's need updating, closure plans are required for mining to assess impacts of decant. Monitoring programmes should be established and/or maintained.
- Springs must be protected, particularly where these are used for water supply to rural communities.
- The impact of development on spring flows must be considered when implementing groundwater abstraction schemes.
- Groundwater quality could be impacted from agricultural activities, especially in those valley areas where irrigation is practised and fertiliser application is poorly managed.
- The escarpment area is ecologically sensitive with pristine groundwater and is an important recharge area.
- Groundwater abstraction impacts on river flow, especially during the dry season
- Are international obligations affected by the abstraction along the Limpopo?

- Uncontrolled abstractions can reduce ability of river flow to maintain water quality by reducing flushing action.
- Waste management is reported to be poor and many waste disposal sites are potential sources of groundwater pollution.

APPENDIX K: OVERVIEW OF GROUNDWATER RESOURCES OF THE LETABA AND SHINGWEDZI CATCHMENTS

1. Groundwater Quantity

Groundwater resources are available throughout both catchments, but in varying quantities depending upon the hydrogeological characteristics of the underlying aquifer.

Parts of the Letaba catchment are heavily populated and widespread rural communities are a feature of the area (ex Venda and Gazankulu). Many communities rely on groundwater although conjunctive use schemes are also widespread.

Information concerning groundwater use in the Luvuvhu Letaba WMA was obtained from Mr. W. du Toit, Assistant Director Geohydrology DWAF, responsible for the North Region. Estimates of groundwater use per individual catchment were not available.

Table K1 provides an overview of the use of groundwater in the Luvuvhu Letaba WMA and shows that total abstraction is of the order of 57.2Mm^3/a, 66% of which is used for rural community supply and only 16% for irrigation.

Table K1: Groundwater Use in the Luvuvhu/Letaba WMA

Use	Million m^3 / annum	% of Total Use
Irrigation	9*	16
Livestock	0.2	<1
Rural Communities	38	66
Municipalities	8	14
Mining	2	3
Total	57.2 **	100

Notes:
* The WMA Report (DWAF, 2003a) states that, in total 15% of the yield from local water resources in the WMA is from groundwater
** A figure of 43 million m^3/a is presented in the NWRS

Overall the available groundwater resources within the catchment are under utilised although this clearly depends both on the groundwater occurrence and the demand. Even weaker groundwater occurrence areas can often provide more than the RDP level of 25 litres per head per day.

2. Groundwater Quality

2.1 Natural

Regionally the natural groundwater quality is usually good, satisfies the DWAF water quality guidelines and is suitable for domestic and agricultural supply.

2.2 Pollution

Groundwater pollution is an increasing threat. Pollution of groundwater can result from:

- domestic use
- agriculture
- mining
- waste disposal

Pollution emanating from settlements, especially informal settlements, is more difficult to control. Elevated nitrate levels (NO_3 >10mg/l) in groundwater are frequently found in water supply boreholes in the traditionally settled areas of the catchment. In particular the following must be considered:

- Groundwater pollution occurs when latrine density is high. This results in a pollution plume of increased salinity and nitrate around the settlement.
- Abstraction from boreholes for water supply located within plumes has to be terminated, i.e., water quality monitoring must be implemented to determine when and if there is an unacceptable deterioration in groundwater quality.
- Groundwater must be abstracted from outside possible impacted areas, i.e., boreholes and wellfields have to be located well away from potential pollution sources.
- Education about the need for, and ways of, protecting the groundwater resources is required.
- Standards for borehole positioning, construction and protection, as specified by DWAF and SABS, must be enforced.

The impact of groundwater pollution from mining and waste disposal can be controlled and remediated according to the requirements of DWAF. Mines and waste disposal sites must prepare EMPRs, EIA and closure plans which will identify and put preventative and remediation measures, including monitoring, in place.

Waste disposal sites offer a serious potential hazard throughout the region due to poor management and lack of operating controls. This pollution risk from the waste disposal throughout the region needs to be assessed and remediated.

3. Overview of Groundwater within the Letaba and Shingwedzi Catchments

The overview of the groundwater resources and associated issues is discussed according to groups of Quaternary Catchments sharing similar lithology and morphological characteristics. The distribution of the lithologies of the region with respect to hydrogeology is illustrated on the simplified lithostratigraphical map of **Figure K1**.

CLICK TO VIEW GRAPHIC

Groundwater occurrence is controlled by the prevailing lithology of any given area. The entire region is underlain by hard rocks with aquifers developed in secondary features associated with weathering pockets and structures. Structural features are important and higher borehole yields are generally associated with these features. An exception is the localised occurrences of alluvial deposits along the Groot Letaba River, which are locally exploited.

3.1 The eastern parts of B90A,D,& G and B90E and H in the Shingwedzi Catchment and the eastern parts of B83B, C and D and B83E of the Letaba Catchment, underlain by Karoo age Basalt and Rhyolite.

Karoo age basalt forms the wide north south trending central plains and gently rolling countryside of the northern part of the Kruger National Park from Pafuri in the north to Letaba in the south. Rhyolite forms the higher ground of the degraded Lebombo range along the Mozambique border in B83C, D & E.

Borehole yields in the basalt tend to be 0.5 - 2l/s. Aquifers within the basalt are generally of limited area extent. Yields >5l/s are locally present in major structural features and zones of extensive weathering. Static water levels are between 15 and 30 mbgl, and boreholes are generally 50 – 80m deep.

The groundwater resources of the fine grained rhynolite are marginal.

There are over 1000 boreholes in the KNP, many of which are situated within these catchments. Almost all the boreholes are used for game watering, most of the tourist camps are supplied by surface water. It is planned to reduce the number of operational boreholes due to a change in management strategy towards restoring the area to it’s natural state.

The groundwater quality is primarily good and generally Class 1. The area within the KNP is pristine and is ecologically sensitive. Since this area is within the KNP impacts from activities within these catchments are unlikely.

3.2 Arenaceous Karoo Age Sediments in the and central part of B90A in the Shingwedzi Catchment.

This area is underlain by a north south trending outcrop of Karoo sandstone along the western side of the Kruger National Park (KNP). The sandstone forms flat to hilly topography with ridges in the northern part of the KNP.

Borehole yields are variable but mainly 0.5 – 2 l/s. Water levels range from 20 – 30mbgl and boreholes average 40 – 80m in depth.

Groundwater quality is generally good to moderate with conductivities below 300 mS/m, (Class 1 or 2).

The area is pristine within the KNP. Impacts within the KNP area are not anticipated.

3.3 The western part of B90A and the northern part of B90B in the Shingwedzi Catchment) underlain by Arenaceous Strata of Waterberg Age.

This area comprises the far eastern extension of the east - west trending Soutpansberg Mountains underlain by a sequence of mainly coarse grained sandstone and conglomerate.

The area is structurally complex with a NE – SW structural trend. There are numerous major faults and fracture zones. The area is characterised by rolling countryside becoming flat to the east in the KNP.

The western part of the area comprises communal lands dependent upon groundwater for domestic supplies and stock watering. The eastern parts are within the KNP.

Groundwater resources are generally low to moderate with sustainable borehole yields between 0.5 and 2 l/s, although higher yields (>3l/s) are found along fault and fracture zones. Boreholes vary from 60 – 150m in depth and static water levels vary from <10mbgl to >40mbgl, depending upon the topographical position.

The groundwater quality is mostly good; localised occurrences of elevated NO_3 are reported in the communal land areas.

3.4 The Central and Southern Areas Principally underlain by Granite and Gneiss of the Basement Complex. (western part of B90G in the Shingwedzi Catchment and B81A – J, B82A – J and B83A and B83B of the Letaba Catchment).

This granitic area underlies approximately 90% of the Letaba catchment and 70% of the Shingwidzi catchment. The western areas form the escarpment trending north from Tzaneen towards Thohoyandou. Below the escarpment the Lowveld forms a gently rolling to flat landscape. The Letaba and Shingwidzi rivers rise in the escarpment in the west.

Forestry and natural forest occurs along the escarpment. The escarpment area is ecologically sensitive and represents an important groundwater recharge zone where uncontrolled development will have adverse impacts.

Extensive sub-tropical agriculture is practised in the south of the Lowveld plain east of Tzaneen, especially along the Letaba river. Groundwater is reported to be used for supplementary irrigation along the Letaba river. Adverse impacts are anticipated to be limited and restricted to groundwater quality problems.

Elsewhere, much of the Lowveld area comprises communal lands. There is heavy dependence on groundwater in Malemulele (western parts of B90B, C & F), Giyani (B81H & J, B82F, G, H, & J), Sekgosese (B82D) Bolebedu (B81E, F & G), Letsitele (B81D) and NW of Phalaborwa (B81F & J). Conjunctive use schemes supply many of the communities, particularly in the Giyani area.

Groundwater occurrence is controlled by the presence of weathering zones and structural features. According to the published hydrogeological maps (Messina 2127 and Phalaborwa 2330), borehole yields in the northern granite areas tend to be in the 2 – 5l/s range with local areas of deep weathering and good structural development supporting yields >5l/s. Further south and east the groundwater resources are less well developed and yields tend to be between 0.5 and 2 l/s. Locally weathering is shallow and structural features limited and yields are <0.5l/s. Recent work undertaken for the GRIP project would suggest that sustainable yields may be lower than the published 1:500 000 maps indicate, and generally 0.5 – 1 l/s.

Higher yields (>5l/s) are found on well developed regional structures, particularly those in the west of the area where the SW – NE trending drainage sub – parallels the fracture zones, (B82A – D). Boreholes are generally 70 – 100m deep and water levels 15 – 40m below surface depending upon the topography.

Groundwater quality is generally moderate to good with conductivities between 70 and 300mS/m, Class 1 or 2. Elevated NO_3 levels are reported in many of the settlements.

3.5 Areas Underlain by Intercalated metamorphosed sedimentary rocks and basic and ultrabasic mafic intrusives (Central parts of B90F, B82H, B82G, B81H, Southern part of B81D, E & J).

These lithologies form a SW – NE trending outcrop in the central part of the Letaba and Shingwidzi catchments between the Molototsi river in the south and Shingwidzi in the north, and a southern outcrop sub-paralleling the boundary with the Olifants catchment. These areas form a hilly landscape and are characterised by numerous gold, silver, copper, nickel and zinc deposits and small abandoned mines.

Much of the central area around Giyani and the area around Letsitele in the south comprises communal lands. These areas rely on groundwater for domestic supplies and stock watering.

Groundwater occurrence is controlled by the presence of weathering zones and structural features and tends to be favourably developed especially within the mafic and ultramafic units. Borehole yields in the central area average 2 – 5l/s with local areas of deep weathering and good structural development supporting yields >5l/s. The groundwater resources are less well developed in the southern areas and yields tend to be between 0.5 and 2 l/s. Boreholes are generally 70 – 100m deep and water levels 15 – 30m below surface depending upon the topography.

Groundwater quality is generally moderate to good with conductivities between 70 and 300mS/m. Elevated NO_3 levels are reported in many of the settlements.

3.6 River Bed Sand Aquifers.

The sand deposits of drainage channels are often used to obtain water, either directly from the surface flow of the river, or from sand abstraction schemes constructed in the river bed sediments.

Wellpoints offer a means of abstracting water from rivers from the subsurface flow and storage within the sand aquifers after the visible flow has ceased. Usually these schemes operate until the subsurface flow has diminished and the water level has declined to such an extent that the volume of water delivered is no longer viable for the intended use.

Abstraction from wellpoints installed in deposits of the main river channels is also undertaken locally where the deposits are suitably developed. It is considered that sand abstraction schemes are over utilising the available resources and licences for new schemes are not being issued at present.

3.7 Ground Water/Surface Water Linkage

Groundwater contributes to base flow throughout the catchment via sub surface seepage and springs. The Soutpansberg range and the north - south trending escarpment area are important areas for groundwater recharge and surface water base flow.

The relationship between groundwater, base flow, and river flow is reasonably well understood where hydrographs are available. However, the impact of groundwater abstraction on surface water resources is less well understood and this is an aspect that warrants study.

Recharge of the groundwater system from river flow, especially during flood events, is important.

3.8 Summary of groundwater issues

The following is a summary of groundwater issues that apply across the catchment:

- Groundwater quality could be impacted from agricultural activities, especially in areas where irrigation is practised and the application of fertiliser is poorly managed.
- Availability of water during a drought in areas reliant on groundwater for domestic supply and stock watering is an issue. This is difficult to deal with in areas of low resources.
- Pollution of the resources from latrines and increasing population, with elevated TDS and NO_3. Implement strategy of education and training to protect borehole head areas from water spillage, damage by cattle drinking, etc. Position new boreholes well away from settlements, and pipe water to the settlement, where the groundwater resources are suitable to do this.
- Springs must be protected, particularly where these are used for water supply to rural communities.
- The impact of development on spring flows must be considered when implementing groundwater abstraction schemes.
- Waste management is reported to be poor and many waste disposal sites are potential sources of groundwater pollution.
- The escarpment area is ecologically sensitive with pristine groundwater and is an important recharge area. Development (removal of forests, planting of exotic plantation species, etc.) must be strictly controlled and a formal protection plan established.
- Pollution of groundwater by mining effluent and acid mine drainage. The possibility of decant from old abandoned mines must be considered and any impacts identified and remediated. Prevention and remediation measures may be needed. Monitoring programmes to be established/maintained.
- Census of operational and abandoned mines is required to assess potential groundwater pollution threat and determine need for remediation.