

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNT RATES

Year	Net Demand Mm ³ /a	Total annual costs (excl VAT)	Discounted Figures 6%		Discounted Figures 8%		Discounted Figures 10%	
			Demand	Costs	Demand	Costs	Demand	Costs
2008	0.00	0	0.00	0	0.00	0	0.00	0
2009	12.92	0	12.19	0	11.97	0	11.75	0
2010	13.80	2,778,977,726	12.28	2,473,280,283	11.83	2,382,525,485	11.40	2,296,675,807
2011	18.70	2,741,317,247	15.70	2,301,662,822	14.84	2,176,146,014	14.05	2,059,592,222
2012	31.70	2,021,007,130	25.11	1,600,826,941	23.30	1,485,500,573	21.65	1,380,375,063
2013	40.43	2,040,755,245	30.21	1,524,971,036	27.51	1,388,903,729	25.10	1,267,148,447
2014	53.36	178,099,893	37.62	125,553,397	33.62	112,233,143	30.12	100,532,747
2015	84.81	497,446,927	56.40	330,830,618	49.49	290,255,504	43.52	255,268,929
2016	115.92	649,423,699	72.73	407,456,463	62.63	350,863,417	54.08	302,960,948
2017	135.54	816,049,722	80.23	483,018,577	67.80	408,228,031	57.48	346,084,744
2018	147.86	920,657,578	82.56	514,090,383	68.49	426,442,595	57.01	354,953,351
2019	153.54	968,914,883	80.89	510,412,274	65.85	415,550,986	53.82	339,598,756
2020	161.42	1,035,573,464	80.22	514,648,286	64.10	411,240,471	51.43	329,965,620
2021	166.50	1,078,643,761	78.06	505,710,286	61.22	396,615,072	48.23	312,444,676
2022	175.23	1,152,639,429	77.50	509,813,531	59.66	392,428,820	46.14	303,525,987
2023	183.74	1,224,798,349	76.67	511,065,557	57.92	386,107,520	43.99	293,206,987
2024	190.54	1,282,412,317	75.00	504,816,843	55.62	374,323,931	41.47	279,090,284
2025	194.11	1,312,695,559	72.09	487,488,423	52.46	354,780,852	38.40	259,709,818
2026	194.77	1,320,491,618	68.24	462,626,040	48.74	330,451,745	35.03	237,502,025
2027	194.71	1,317,774,659	64.35	435,541,670	45.12	305,344,286	31.84	215,466,687
2028	195.00	1,320,249,720	60.80	411,660,103	41.84	283,257,211	28.99	196,246,708
2029	196.24	1,345,619,906	57.73	395,821,365	38.98	267,315,128	26.52	181,834,386
2030	197.20	1,338,920,606	54.73	371,557,293	36.27	246,281,735	24.23	164,481,005
2031	198.00	1,345,631,220	51.83	352,282,568	33.72	229,181,564	22.11	150,277,616
2032	198.00	1,345,631,220	48.90	332,342,045	31.22	212,205,152	20.10	136,616,014
2033	198.00	1,345,631,220	46.13	313,530,231	28.91	196,486,252	18.27	124,196,377
2034	198.00	1,345,631,220	43.52	295,783,237	26.77	181,931,714	16.61	112,905,797
2035	198.00	1,345,631,220	41.06	279,040,790	24.79	168,455,291	15.10	102,641,634
2036	198.00	1,345,631,220	38.73	263,246,028	22.95	155,977,121	13.73	93,310,576
2037	198.00	1,345,631,220	36.54	248,345,310	21.25	144,423,261	12.48	84,827,796
2038	198.00	1,345,631,220	34.47	234,288,028	19.68	133,725,241	11.35	77,116,179
2039	198.00	1,345,631,220	32.52	221,026,441	18.22	123,819,668	10.32	70,105,617
2040	198.00	1,345,631,220	30.68	208,515,511	16.87	114,647,841	9.38	63,732,379
2041	198.00	1,347,836,546	28.94	197,035,134	15.62	106,329,384	8.53	58,033,480
2042	198.00	1,345,631,220	27.31	185,578,062	14.46	98,292,044	7.75	52,671,388
2043	198.00	1,345,631,220	25.76	175,073,644	13.39	91,011,152	7.05	47,883,080
2044	198.00	1,360,494,498	24.30	166,988,145	12.40	85,200,392	6.41	44,010,887
2045	198.00	1,345,631,220	22.93	155,814,920	11.48	78,027,394	5.82	39,572,793
2046	198.00	1,345,631,220	21.63	146,995,207	10.63	72,247,587	5.29	35,975,266
2047	198.00	1,345,631,220	20.40	138,674,724	9.84	66,895,914	4.81	32,704,788
2048	198.00	1,345,631,220	19.25	130,825,211	9.11	61,940,661	4.37	29,731,625
2049	198.00	1,345,631,220	18.16	123,420,010	8.44	57,352,464	3.98	27,028,750
2050	198.00	1,345,631,220	17.13	116,433,972	7.81	53,104,133	3.62	24,571,591
2051	198.00	1,345,631,220	16.16	109,843,370	7.23	49,170,494	3.29	22,337,810
2052	198.00	1,345,631,220	15.25	103,625,821	6.70	45,528,235	2.99	20,307,100
2053	198.00	1,345,631,220	14.38	97,760,208	6.20	42,155,773	2.72	18,461,000
2054	198.00	1,345,631,220	13.57	92,226,612	5.74	39,033,123	2.47	16,782,727
2055	198.00	1,345,631,220	12.80	87,006,237	5.32	36,141,781	2.24	15,257,025
2056	198.00	1,345,631,220	12.08	82,081,356	4.92	33,464,612	2.04	13,870,023
2057	198.00	1,345,631,220	11.39	77,435,241	4.56	30,985,752	1.86	12,609,111
2058	198.00	1,345,631,220	10.75	73,052,115	4.22	28,690,511	1.69	11,462,829
2059	198.00	1,345,631,220	10.14	68,917,089	3.91	26,565,288	1.53	10,420,753
TOTAL	8600	66,382,843,000	2,020	20,460,039,000	1,410	15,947,786,000	1,020	13,026,087,000
URV				10.13		11.31		12.77

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES- 30 year analysis period (2014-2044)

TOTAL	5630	46,198,375,000	1,780	18,855,927,000	1,300	15,226,482,000	975	12,694,994,000
URV				10.59		11.72		13.01

UNIT REFERENCE VALUE CALCULATIONS AT DIFFERENT DISCOUNTED RATES- 20 year analysis period (2014-2034)

TOTAL	3650	32,724,994,000	1,460	16,676,790,000	1,120	14,004,601,000	873	12,000,661,000
URV				11.42		12.51		13.74

Summary Sheet

Component		Total (R)	Upgrade to Ultimate System Capacity (R) ⁽¹⁾
Mokolo Scheme – Phase 1 ⁽²⁾			
1.1	Pump Station (Maximum duty 1,5 m ³ /s @ 263 m) - Civil Works - Mechanical & Electrical Work	64,805,000 70,770,000	N/A
1.2	Rising Main - 900mm diameter (5 700 m)	86,540,000	N/A
1.3	Gravity Mains ⁽³⁾ - 1900mm diameter (1 400 m) - 1100mm diameter (42 950 m) - 1000mm diameter (19 970 m) - 900mm diameter (11 770 m) - 800mm diameter (1 940 m)	51,243,000 692,875,000 308,070,000 152,910,000 27,544,000	N/A
1.4	Eskom Electricity to Site	76,430,000	N/A
1.5	Compensation	2,170,000	N/A
1.6	Environmental and Socio-economic	1,000,000	N/A
Sub Total – Phase 1		1,534,357,000	
Crocodile River (West) Scheme - Phase 2			
2.1	Abstraction Weir and Low-Lift Pump Station Civil Works	247,983,890	
2.2	Low-Lift Pump Station M&E Works ^{(4),(5)}	74,073,110	74,073,110
2.3	Rising Main to De-silting Works	171,573,000	171,573,000
2.4	De-silting Works	86,148,000	86,148,000
2.5	High-Lift Pump Station Balancing Reservoir ⁽⁶⁾	318,909,000	
Sub Total – River Abstraction Works		898,687,000	331,794,110
3.1	High lift pump station (Maximum duty 6,6 m ³ /s @ 255 m)	350,544,000	N/A
3.2	Rising Main ⁽⁷⁾ - 1900mm diameter (26 700 m)	1,263,545,000	N/A
3.3	Gravity Mains (not constructed under Phase 1) ⁽⁸⁾ - 2200mm diameter (62 700 m) - 2300mm diameter (28 200 m) - 800mm diameter (1940 m)	3,464,072,000 1,440,550,000 28,110,000	N/A
3.4	Break Pressure and Operational reservoir	118,964,000	N/A
3.5	Eskom electricity to Vlieëpoort site ⁽⁹⁾	156,564,000	N/A
Sub Total – Crocodile River (West) Transfer Scheme		6,822,349,000	
TOTAL COMBINED CAPITAL – MOKOLO CROCODILE RIVER (WEST) WATER AUGMENTATION PROJECT		9,255,393,000	

Operation and Maintenance Summary Sheet

Component	Total (R)
Mokolo Scheme – Phase 1	
1.1 Pump Station	
- Civil Works	141,000
- Mechanical & Electrical	2,462,000
- Electricity	14,131,000
1.2 Rising Main	376,000
1.3 Gravity Mains	
- 1900mm diameter (1 400 m)	223,000
- 1100mm diameter (42 950 m)	3,012,000
- 1000mm diameter (19 970 m)	1,339,000
- 900mm diameter (11 770 m)	665,000
- 800mm diameter (1 940 m)	120,000
1.4 Raw Water Costs	58,571,000
Existing Exxaro Pump Station	
- Civil	6,000
- Mechanical & Electrical	223,000
Existing Exxaro Pipeline	165,000
Sub Total	81,434,000
Crocodile River (West) Scheme - Phase 2	
2.1 Abstraction Weir, Low-Lift Pump Station, De-silting Works and Balancing Dam	
- Civil	995,000
- Mechanical & Electrical	2,035,000
- Electricity	17,336,000
Sub Total – River Abstraction Works	20,366,000
3.1 High lift pump station (Maximum duty 6,6 m ³ /s @ 255 m)	
- Civil	87,000
- Mechanical & Electrical	4,797,000
- Electricity	76,866,000
3.2 Rising Main	3,018,000
3.3 Gravity Mains (not constructed under Phase 1)	
- 2200mm diameter (62 700 m)	8,304,000
- 2300mm diameter (28 200 m)	3,478,000
- 800mm diameter (1940 m)	66,000
3.4 Break pressure and Operational Reservoirs	308,000
3.5 Raw water costs	1,142,408,000
Sub Total – Crocodile River (West) Transfer Scheme	1,239,332,000
4 Annual River Management Cost	4,500,000
TOTAL COMBINED O&M – MOKOLO CROCODILE RIVER (WEST) WATER AUGMENTATION PROJECT	1,345,632,000

Summary of Discounted Present Value

Discount Rate	Capital (R)	O&M (R)	Total (R)
6%	7,726,136,000	12,733,903,000	20,460,039,000
8%	7,265,744,000	8,682,042,000	15,947,786,000
10%	6,844,128,000	6,181,959,000	13,026,087,000

Unit Reference Values

Discount Rate	Discounted Present Value of Water @ R1/m ³	Discounted Present Value (R)	Unit Reference Value (R/m ³)
6%	2,020	20,460,039,000	10.14
8%	1,410	15,947,786,000	11.35
10%	1,020	13,026,087,000	12.72

PUMP STATION, RISING MAIN AND ELECTRICITY COST CALCULATIONS

DESCRIPTION	UNIT/RATE	HL PS - BPR	LL PS - HL PS	TOTAL
Start Chainage		0	0	
End Chainage		26,735	5,000	
PUMP HEAD AND FLOW RATE				
Flow rate (duty) (Qd) 347 day average flow	m³/s	5.779	5.779	
installed capacity (Qi = Qp x (1 + Ps))	m³/s	8.24	7.42	
Required peak capacity (Qp = Q365 x Peak Refill factor)	m³/s	6.593	6.593	
Peak factor	1.20000			
Head pumped (under normal operating conditions):				
static head (Hst)	m	190.00	38.00	228.00
rising main friction loss(Hf)	m	44.77	4.84	49.61
rising main secondary losses(Hv)	m	6.68	1.25	7.93
pump station secondary losses(Hps)	m	4.00	4.00	8.00
additional pumping head	m	10.00	0.00	10.00
Total head (duty) (Hd = Hst + Hf + Hv + Hps)	m	255.45	48.09	303.54
Head pumped (under peak operating conditions):				
static head (Hst)	m	190.00	38.00	228.00
rising main friction loss(Hf)	m	58.14	6.28	64.41
rising main secondary losses(Hv)	m	6.68	1.25	7.93
pump station secondary losses(Hps)	m	4.00	4.00	8.00
additional pumping head	m	0.00	0.00	0.00
Total head (peak) (Hd = Hst + Hf + Hv + Hps)	m	258.82	49.53	308.35

All further information on this sheet is calculated for normal operating conditions

RISING MAIN				
length (L)	m	26,735	5,000	31,735
nominal diameter (ND)	mm	1,900	2,100	
outer diameter (OD)	mm	1,930	2,134	
inner diameter (ID)	mm	1,895	2,108	
minimum yield stress of steel	MPa	290.00	290.00	
minimum wall thickness (tmin = D/160)	mm	12.00	13.00	
required wall thickness (t)	mm	17.00	4.00	
chosen wall thickness (t)	mm	17.27	13.13	
number of pipes in parallel (n)	no	1.00	1.00	
flow per pipe (Qp)	m³/s	5.78	5.78	
velocity per pipe (Vp)	m/s	2.05	1.66	
secondary losses in rising main	m/km	0.25	0.25	
INPUT FOR COLEBROOK-WHITE & DARCY-WEISBACH				
friction coefficient (f)	-	0.01485	0.01458	
effective roughness (k)	mm	0.500	0.500	
Reynolds number (Re)	-	3,435,369	3,089,281	
pipe cross sectional area (A)	m²	2,8217	3,4894	
kinematic viscosity (nu)	m²/s	1.13E-06	1.13E-06	
gravity constant (g)	m/s²	9.81	9.81	
PUMP SET EFFICIENCIES				
Efficiency of pump (Ep)	%	90.0%	75.0%	
Efficiency of motor (Em)	%	97.0%	97.0%	
Average loss in efficiency between major overhauls (Eo)	%	1.5%	1.5%	
Overall efficiency (Et = Ep x Em x (1 - Eo))	%	86.0%	71.7%	
MW/MVA ratio (power factor Pf)	-	0.96	0.96	
Standby allowance (Ps)	%	25.0%	12.5%	

DESCRIPTION	UNIT/RATE	HL PS - BPR	LL PS - HL PS	TOTAL
PUMP STATION POWER REQUIREMENTS				
power req'd at duty point (Pd = 9.81 x 1000 x Qd x Hd / Et)	MW	16.8	3.8	20.6
power absorbed at Qd: (Pd / Pf)	MVA	17.5	4.0	21.5
power absorbed at Qi: (Pd x Pf x (1 + Ps))	MVA	21.9	4.5	26.4
head pumped (Hd)	m	255.45	48.09	303.5
Energy consumed over 24 hours (continuous use)	24 MWh	404	91	496
power req'd at peak point (Pp = 9.81 x 1000 x Qp x Hp / Et)	MW	19.5	4.5	23.9
power absorbed at Qp: (Pp / Pf)	MVA	20.3	4.7	24.9

ADDITIONAL PUMP STATION PARAMETERS				
Access road to pump station	km	5.00	0.00	5.00

PUMP STATION COST (single stage vertical)				
mechanical: pump & motor	60% of total A1	R 48,211,578	R 0	R 48,211,578
mechanical: valves	25% of total A1	R 20,088,158	R 0	R 20,088,158
mechanical: pipework	15% of total A1	R 12,052,895	R 0	R 12,052,895
Total mechanical cost (total A1)	67% of total A1	R 80,352,630	R 0	R 80,352,630
Total electrical cost	33% of total A2	R 39,576,669	R 0	R 39,576,669
Total civil cost	0% Estimated	R 34,800,000	R 0	R 34,800,000
Subtotal: elec/mech cost (total A2)		R 119,929,299	R 0.00	R 119,929,299
access road cost	R/km	R 3,000,000	R 15,000,000	R 15,000,000
Subtotal: (total A3)		R 134,929,299	R 0	R 134,929,299
landscaping	5%	R 6,746,465	R 0	R 6,746,465
miscellaneous	10%	R 13,492,930	R 0	R 13,492,930
Subtotal: (total A)		R 155,168,694	R 0	R 155,168,694
Preliminary and General	30%	R 46,550,608	R 0	R 46,550,608
Preliminary Work		R 0	R 0	R 0
Subtotal: (total B)		R 201,719,302	R 0	R 201,719,302
Contingencies	20%	R 40,343,860	R 0	R 40,343,860
Subtotal: (total C)		R 242,063,163	R 0	R 242,063,163
Planning, design and supervision fees	15%	R 36,309,474	R 0	R 36,309,474
Total cost excluding VAT (total D)		R 278,372,637	R 0	R 278,372,637
Cost of ESKOM transmission lines to site			R 0	R 0
Connection fee		R 152,638,967	R 3,925,000	R 156,563,967
Value Added Tax	14%	R 60,341,625	R 0	R 60,341,625
Relocations and land acquisition		R 375,000	R 0	R 375,000
Total cost including VAT		R 491,728,229	R 3,925,000	R 495,653,229

ANNUAL COST OF ELECTRICITY (24 h operation @ Design Capacity)					
Network Access Charge	R/kVa/mth	R 8.40	R 1,768,387	R 399,454	R 2,167,841
Network Demand Charge	R/kVa/mth	R 9.50	R 1,035,694	R 233,949	R 1,269,643
Reactive Energy Charge	R/kVaRh	R 0.0374	R 744,119	R 168,086	R 912,205
Voltage Surcharge	%/R	11.00%	R 2,982,749	R 673,762	R 3,656,511
Annual energy Cost	R/MWh	R 173.34	R 24,311,818	R 5,491,707	R 29,803,525
Service & Admin Charge	R/day	R 131.66	R 48,056	R 0	R 48,056
Total annual cost			R 30,890,822	R 6,966,958	R 37,857,780

ELECTRICITY COSTS

Number of pumps	4 (excluding standby)	Down Time	18.0 days
Standby pumps	1	Down Time Peak	1.05
Flow per pump 347 days	1.445 m ³ /s	Refill period	90 days
Total flow 347 days	5.779 m ³ /s	Refill Peak	1.2000
Total flow 365 days	5.494 m ³ /s		
Pumps Active	347.0 days per annum		
Pumping Peak factor based on refill period	1.2000		

YEAR	HOURS PUMPED	NUMBER OF PUMPS		MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS					ENERGY ESCALATION FACTOR	TOTAL
		INSTALLED	ACTIVE		DEMAND& ACCESS	ENERGY	SERVICE	REACTIVE & SURCHARGE	TOTAL		
0	0.00			0	0	0			0	1.00	0
1	0.00			0	0	0			0	1.20	0
2	0.00			0	0	0			0	1.44	0
3	0.00			0	0	0			0	1.73	0
4	0.00			0	0	0			0	2.07	0
5	0.00			0	0	0			0	2.49	0
6	3.66	3	2	31	1,402,040	1,854,617	48,056	1,199,194	4,503,907	2.49	11,207,163
7	19.73	3	2	166	1,402,040	9,991,803	48,056	3,195,851	14,637,750	2.49	36,423,407
8	16.54	4	3	209	2,103,061	12,564,397	48,056	2,799,440	17,514,953	2.49	43,582,809
9	20.23	4	3	256	2,103,061	15,372,782	48,056	3,258,843	20,782,741	2.49	51,714,111
10	22.55	4	3	285	2,103,061	17,135,526	48,056	3,547,198	22,833,840	2.49	56,817,902
11	23.63	4	3	298	2,103,061	17,949,361	48,056	3,680,328	23,780,806	2.49	59,174,254
12	18.83	5	4	317	2,804,081	19,076,190	48,056	3,084,523	25,012,850	2.49	62,239,974
13	19.55	5	4	329	2,804,081	19,803,374	48,056	3,173,739	25,829,250	2.49	64,271,440
14	20.78	5	4	350	2,804,081	21,052,692	48,056	3,327,014	27,231,843	2.49	67,761,540
15	21.99	5	4	370	2,804,081	22,271,377	48,056	3,476,531	28,600,045	2.49	71,166,064
16	22.95	5	4	386	2,804,081	23,244,274	48,056	3,595,893	29,692,304	2.49	73,883,953
17	23.45	5	4	395	2,804,081	23,755,651	48,056	3,658,633	30,266,420	2.49	75,312,539
18	23.54	5	4	397	2,804,081	23,850,059	48,056	3,670,215	30,372,411	2.49	75,576,277
19	23.54	5	4	396	2,804,081	23,841,419	48,056	3,669,155	30,362,711	2.49	75,552,141
20	23.58	5	4	397	2,804,081	23,883,214	48,056	3,674,283	30,409,634	2.49	75,668,900
21	23.75	5	4	400	2,804,081	24,060,638	48,056	3,696,051	30,608,826	2.49	76,164,554
22	23.89	5	4	402	2,804,081	24,198,499	48,056	3,712,965	30,763,601	2.49	76,549,683
23	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
24	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
25	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
26	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
27	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
28	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
29	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
30	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
31	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
32	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
33	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
34	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
35	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
36	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
37	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
38	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
39	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
40	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
41	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
42	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
43	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
44	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
45	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
46	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
47	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
48	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
49	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
50	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
51	24.00	5	4	404	2,804,081	24,311,818	48,056	3,726,867	30,890,822	2.49	76,866,250
TOTAL					123,379,551	1,028,948,590	2,210,571	164,499,014	1,319,037,727		3,282,187,956

ELECTRICITY COSTS - LOW LIFT PUMP STATION

Number of pumps	8 (excluding standby)	Down Time	18.0 days
Standby pumps	1	Down Time Peak	1.05
Flow per pump 347 days	0.722 m ³ /s	Refill period	90 days
Total flow 347 days	5,779 m ³ /s	Refill Peak	1.2000
Total flow 365 days	5,494 m ³ /s		
Pumps Active	347.0 days per annum		
Pumping Peak factor based on refill period	1.2000		

YEAR	HOURS PUMPED	NUMBER OF PUMPS		MWh per day	ANNUAL ELECTRICITY COST FOR PUMP STATIONS					ENERGY ESCALATION FACTOR	TOTAL
		INSTALLED	ACTIVE		DEMAND & ACCESS	ENERGY	SERVICE	REACTIVE & SURCHARGE	TOTAL		
0	0.00			0	0	0			0	1.00	0
1	0.00			0	0	0			0	1.20	0
2	0.00			0	0	0			0	1.44	0
3	0.00			0	0	0			0	1.73	0
4	0.00			0	0	0			0	2.07	0
5	0.00			0	0	0			0	2.49	0
6	14.65	2	1	7	79,175	418,933	0	579,268	1,077,376	2.49	2,680,855
7	19.73	5	4	38	316,702	2,257,011	0	721,899	3,295,612	2.49	8,200,538
8	19.85	6	5	47	395,877	2,838,125	0	725,209	3,959,211	2.49	9,851,785
9	20.23	7	6	58	475,053	3,472,501	0	736,128	4,683,681	2.49	11,654,498
10	22.55	7	6	64	475,053	3,870,681	0	801,263	5,146,997	2.49	12,807,375
11	20.25	8	7	67	554,228	4,054,515	0	736,586	5,345,329	2.49	13,300,888
12	21.52	8	7	72	554,228	4,309,050	0	772,275	5,635,553	2.49	14,023,060
13	22.34	8	7	74	554,228	4,473,311	0	795,307	5,822,846	2.49	14,489,104
14	23.75	8	7	79	554,228	4,755,515	0	834,876	6,144,619	2.49	15,289,777
15	21.99	9	8	84	633,403	5,030,799	0	785,301	6,449,503	2.49	16,048,428
16	22.95	9	8	87	633,403	5,250,563	0	812,263	6,696,230	2.49	16,662,362
17	23.45	9	8	89	633,403	5,366,076	0	826,435	6,825,915	2.49	16,985,060
18	23.54	9	8	90	633,403	5,387,402	0	829,051	6,849,856	2.49	17,044,635
19	23.54	9	8	90	633,403	5,385,450	0	828,812	6,847,665	2.49	17,039,183
20	23.58	9	8	90	633,403	5,394,891	0	829,970	6,858,265	2.49	17,065,557
21	23.75	9	8	90	633,403	5,434,969	0	834,887	6,903,259	2.49	17,177,519
22	23.89	9	8	91	633,403	5,466,110	0	838,708	6,938,221	2.49	17,264,514
23	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
24	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
25	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
26	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
27	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
28	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
29	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
30	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
31	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
32	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
33	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
34	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
35	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
36	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
37	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
38	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
39	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
40	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
41	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
42	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
43	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
44	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
45	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
46	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
47	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
48	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
49	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
50	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
51	24.00	9	8	91	633,403	5,491,707	0	841,848	6,966,958	2.49	17,336,022
TOTAL					27,394,698	232,425,395	0	37,701,839	297,521,933		740,329,776

BOQ: RESERVOIR

No	PAY REF	DESCRIPTION	UNIT	RATE 1-Apr-08 (Rand)	QUANTITY	AMOUNT (Rand)
1	1.0	Clearing				
	1.1	a) Sparse	ha	5,533	0.6	3,255
	1.2	b) Bush	ha	16,598	1.2	19,527
	1.3	c) Trees	ha	27,664	4.1	113,911
3	3.0	Excavation				
	3.1	(a) Bulk				
	3.1.1	(i) all materials	m ³	40	70,600	2,824,000
	3.1.2	(ii) extra over for rock	m ³	71	21,200	1,505,200
	3.2	(b) Confined				
	3.2.1	(i) all materials	m ³	59	5,300	312,700
	3.2.2	(ii) extra over for rock	m ³	99	2,120	209,880
4	4.0	Preparation of solum				
	4.1	a) all materials	m ²	20	10,900	218,000
	4.2	b) extra over for rock	m ²	20	6,540	130,800
5	5.0	Drilling & Grouting				
	5.1	(a) Curtain grouting	m drill	443	-	-
	5.2	(b) Consolidation grouting	m drill	443	-	-
	5.3	(c) Jet grouting	m drill	4,370	-	-
6	6.0	Embankment				
	6.1	(a) Earthfill	m ³	47	64,300	3,022,100
	6.2	(b) Filters	m ³	174	3,600	626,400
	6.3	(c) Rip-rap	m ³	95	-	-
	6.4	(d) Overhaul beyond 5km	m ³ .km	4	-	-
	6.5	(e) Waterproof Membrane	m ²	200	36,300	7,260,000
7	7.0	Concrete works				
	7.1	a) Formwork				
	7.1.1	(i) Gang formed	m ²	257	200	51,400
	7.1.2	(ii) Intricate	m ²	316	50	15,800
	7.2	(b)Concrete				
	7.2.1	(i) Mass	m ³	1,156	500	578,000
	7.2.2	(ii) Structural	m ³	1,482	600	889,200
	7.3	(c) Reinforcing	t	12,350	50	617,500
		SUB-TOTAL				18,397,673

BOQ: RESERVOIR

8	8.0	Mechanical Items				
	8.1	(a) Pipes, Valves & Screens	Sum	8,850,000	1	8,850,000
	8.2	(b) Cranes & hoists	Sum	600,000	1	600,000
	8.3	(c) Structural steelwork	Sum	150,000	1	150,000
9	9.0	Fencing	km	27,664	0.5	13,724
10	10.0	Landscaping (% of 1-9)	%	5		919,884
11	11.0	Miscellaneous (% of 1-9)	%	10		1,839,767
		SUB TOTAL A				30,771,048
12	12.0	Preliminary & General (% of sub-total A)	%	30		9,231,314
13	13.0	Preliminary works				
	13.1	(a) Access road	km	350,000	5.0	1,750,000
	13.2	(b) Electricity to site	Sum	250,000	1	250,000
	13.3	(c) Water to site-construction (not potable)	Sum	150,000	1	150,000
	13.4	(d) Railhead & materials handling	Sum	275,965	1	275,965
14	14.0	Accomodation	Sum	461,566	1	461,566
		SUB TOTAL B				42,889,893
15	15.0	Contingencies (% of sub total B)	%	20		8,577,979
		SUB TOTAL C (Civils Total)				51,467,872
16	16.0	Planning design & supervision (% of sub-total C)	%	15		7,720,181
		SUB TOTAL D				59,188,053
17	17.0	VAT (% of sub-total D)	%	14		8,286,327
		NETT PROJECT COST				67,474,380
18	18.0	Cost of relocations	Sum	-		-
19	19.0	Cost of land acquisition	Sum	294,120	1	294,120
		TOTAL PROJECT COST				67,768,500
		TOTAL PROJECT COST (excl vat)				59,482,173

BOQ: HIGH LIFT PUMP STATION

No	PAY REF	DESCRIPTION	UNIT	RATE 2008 RAND	QUANTITY	AMOUNT	AMOUNT
1.		Mechanical and Electrical	Sum			119,929,299	119,929,299
2.		Civils	Sum			34,800,000	34,800,000
		(a) Estimated Civil Component					
		(c) Permanent access road	km	3,000,000	5.00	15,000,000	15,000,000
SUB-TOTAL A						169,729,299	169,729,299
3.	11.0	Landscaping (% of Sub-total A)	%	5		8,486,465	8,486,465
4.	12.0	Miscellaneous (% of Sub-total A)	%	10		16,972,930	16,972,930
SUB TOTAL B						195,188,694	195,188,694
5.	13.0	Preliminary & General (% of sub-total B)	%	30		58,556,608	58,556,608
SUB TOTAL C						253,745,302	253,745,302
6.	17.0	Contingencies (% of sub total C)	%	20		50,749,060	50,749,060
SUB TOTAL D						304,494,363	304,494,363
7.	16.0	Planning design & supervision fees, time cost & transport (% of sub total D)	%	15		45,674,154	45,674,154
SUB TOTAL E						350,168,517	350,168,517
8.	18.0	VAT (% of sub total E)	%	14		49,023,592	49,023,592
NETT PUMP STATION COST						399,192,110	399,192,110
10.	20.0	Cost of land acquisition	Sum			375,000	375,000
11.	21.0	Cost of ESKOM transmission lines to site + Connection fee	Sum			178,482,923	178,482,923
TOTAL PUMP STATION COST						578,050,032	578,050,032
TOTAL PUMP STATION COST (EXCL VAT)						507,107,485	507,107,485

Mokolo and Crocodile (West) Water Augmentation Project Feasibility Study

MCWAP Combined URV

YEAR	TOTAL ANNUAL COST CROCODILE TRANSFER SYSTEM		TOTAL ANNUAL COST MOKOLO TRANSFER SYSTEM		TOTAL ANNUAL COST COMBINED SCHEME		NET PRESENT COST (2008) AT 6%		NET PRESENT COST (2008) AT 8%		NET PRESENT COST (2008) AT 10%	
	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION	CAPITAL	MAINTENANCE & OPERATION
							6.00%		8.00%			10.00%
2008	0	0	0	0	0	0	0	0	0	0	0	0
2009	0	0	0	0	0	0	0	0	0	0	0	0
2010	1,935,714.316	74,500.000	768,763.410	0	2,704,477.726	74,500.000	2,406,975.548	66,304.735	2,318,653.743	63,871.742	2,235,105.659	61,570.248
2011	1,930,258.861	4,500.000	806,558.386	0	2,736,817.247	4,500.000	2,297,884.533	3,778.267	2,172,573.769	3,572.245	2,056,211.309	3,380.917
2012	1,930,258.861	4,500.000	0	0	86,246,208	1,930,258.861	80,746,288	1,528,945.815	71,861,128	1,416,797.897	96,702,688	61,382,286
2013	1,930,258.861	4,500.000	0	0	105,996.384	1,930,258.861	110,496.384	1,442,401.710	82,669.209	1,313,701.747	75,201.965	1,198,638.866
2014	0	72,103.509	0	0	105,996.384	0	178,099.893	0	125,563.397	0	112,233.143	0
2015	0	351,901.981	64,110.684	81,434.363	64,110.684	433,336.243	42,637.266	288,193.351	37,407.966	252,647.534	32,898.918	222,370.011
2016	0	587,989.336	0	81,434.363	0	549,423.899	0	407,456.463	0	359,893.417	0	302,969.948
2017	0	734,615.360	0	81,434.363	0	816,049.722	0	483,018.577	0	408,228.031	0	346,084.744
2018	0	639,223.215	0	81,434.363	0	920,657.578	0	514,080.383	0	426,442.599	0	354,953.351
2019	0	887,480.521	0	81,434.363	0	968,914.883	0	510,412.274	0	415,550.986	0	338,588.756
2020	0	954,139.102	0	81,434.363	0	1,035,573.464	0	514,648.286	0	411,240.471	0	329,965.620
2021	0	997,209.398	0	81,434.363	0	1,078,643.761	0	505,710.286	0	396,615.072	0	312,444.674
2022	0	1,071,205.066	0	81,434.363	0	1,152,639.428	0	509,813.631	0	392,428.825	0	303,525.987
2023	0	1,143,363.986	0	81,434.363	0	1,224,798.349	0	511,065.557	0	386,107.520	0	293,206.987
2024	0	1,200,977.954	0	81,434.363	0	1,282,412.317	0	504,816.843	0	374,323.933	0	279,090.284
2025	0	1,231,281.194	0	81,434.363	0	1,312,695.559	0	497,468.423	0	354,760.852	0	259,709.818
2026	0	1,236,851.930	2,205.326	81,434.363	2,205.326	1,318,286.293	772.622	461,853.418	551.881	329,899.866	396.647	237,105.377
2027	0	1,236,340.297	0	81,434.363	0	1,317,774.659	0	435,541.670	0	305,344.286	0	215,466.687
2028	0	1,238,815.357	0	81,434.363	0	1,320,249.720	0	411,660.103	0	283,257.211	0	196,246.708
2029	14,863.278	1,249,322.265	0	81,434.363	14,863.278	1,330,756.629	4,372.114	391,449.252	2,962.676	264,362.453	2,008.483	179,825.903
2030	0	1,257,486.244	0	81,434.363	0	1,338,920.606	0	371,567.293	0	246,281.739	0	164,481.003
2031	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	352,262.588	0	229,181.564	0	150,277.616
2032	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	332,342.045	0	212,205.152	0	136,616.014
2033	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	313,630.231	0	196,486.252	0	124,198.377
2034	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	295,763.237	0	181,631.714	0	112,925.759
2035	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	279,040.793	0	168,455.291	0	102,841.634
2036	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	263,246.028	0	155,977.121	0	93,310.578
2037	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	248,345.310	0	144,423.261	0	84,827.796
2038	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	234,288.028	0	133,725.241	0	77,116.178
2039	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	221,026.441	0	123,819.668	0	70,105.817
2040	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	208,515.211	0	114,647.84	0	63,732.379
2041	0	1,264,196.858	2,205.326	81,434.363	2,205.326	1,345,631.220	322.386	198,712.746	173.976	106,155.408	94.954	57,938.603
2042	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	185,578.062	0	98,292.044	0	52,671.388
2043	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	175,073.844	0	91,011.152	0	47,883.083
2044	14,863.278	1,264,196.858	0	81,434.363	14,863.278	1,345,631.220	1,824.330	165,163.812	930.906	84,269.585	480.815	43,530.072
2045	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	155,814.920	0	78,027.394	0	39,572.703
2046	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	146,995.207	0	72,247.587	0	35,975.269
2047	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	138,674.704	0	66,995.914	0	32,734.788
2048	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	130,825.211	0	61,840.661	0	29,731.625
2049	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	123,420.010	0	57,382.464	0	27,028.759
2050	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	116,633.972	0	53,104.133	0	24,571.561
2051	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	109,843.370	0	49,170.494	0	22,337.810
2052	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	103,625.821	0	45,528.235	0	20,307.103
2053	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	97,760.208	0	42,155.773	0	18,461.003
2054	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	92,226.612	0	39,033.123	0	16,782.727
2055	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	87,006.237	0	36,141.781	0	15,257.023
2056	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	82,001.366	0	33,464.612	0	13,870.023
2057	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	77,355.241	0	30,985.752	0	12,609.111
2058	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	73,052.115	0	28,690.511	0	11,462.828
2059	0	1,264,196.858	0	81,434.363	0	1,345,631.220	0	68,917.089	0	26,665.288	0	10,420.753
TOTAL	7,796,217.456	83,919,995.491	1,643,843.131	3,962,787.351	9,400,060.581	56,882,762.843	7,726,136.326	12,733,903.131	7,265,744.451	6,682,041.694	6,844,128.341	6,181,968.664