

AVERAGE RAINFALL ON CATCHMENT OF CODE T6B

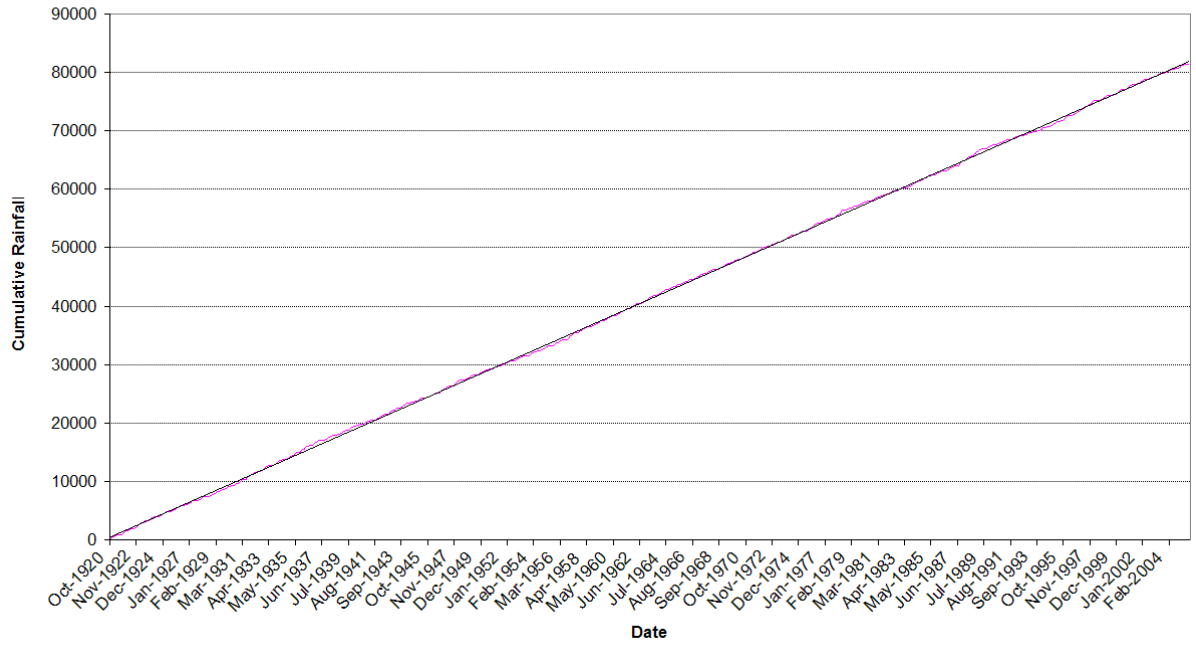
DETAILS OF RAINFALL STATIONS USED					
SECTION	POSITION	MAP(mm)	PERIOD OF RECORD	LATITUDE	LONGITUDE
129	7	1276	1923 TO 2005	31.37	29.31
153	631	1169	1916 TO 2004	31.01	29.22
153	875	932	1900 TO 1908	31.05	29.30
153	875	934	1910 TO 1911	31.05	29.30
153	875	819	1913 TO 1951	31.05	29.30
153	875	907	1956 TO 1980	31.05	29.30
153	875	857	1982 TO 1989	31.05	29.30
154	142	1008	1909 TO 1976	31.22	29.35
154	142	1541	1980 TO 1981	31.22	29.35
154	142	1195	1983 TO 1989	31.22	29.35
154	354	1441	1914 TO 2005	31.24	29.42
154	796	1181	1925 TO 1982	31.16	29.57

AVERAGE RAINFALL ON CATCHMENT OF CODE T6B														
RAINFALL INPUT AS PERCENT M.A.P.														
YEAR	STNS.	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	YEAR
1920	4	6.54	13.28	14.39	11.78	10.49	12.72	8.37	1.01	0.08	0.41	0.34	8.73	88.15
1921	4	10.03	18.77	20.74	10.72	8.37	3.51	3.36	15.77	7.60	0.12	7.72	6.40	113.11
1922	4	17.22	18.76	8.19	27.29	21.60	13.23	1.85	2.11	0.84	21.93	0.38	2.63	136.02
1923	5	6.08	9.13	11.79	19.62	12.81	3.55	3.78	4.37	1.40	0.30	4.65	7.04	84.53
1924	5	8.00	11.68	15.58	10.31	13.50	17.67	6.61	2.35	0.65	2.15	1.00	9.26	98.76
1925	6	6.26	11.32	10.50	14.56	12.87	20.61	3.19	3.35	7.26	0.20	1.62	8.63	100.38
1926	6	11.44	13.08	14.09	9.62	8.51	30.32	0.38	1.71	0.03	0.67	2.53	6.10	98.48
1927	6	11.54	3.44	14.90	14.84	12.95	8.64	2.01	4.16	1.14	0.56	7.38	2.68	84.23
1928	6	8.43	11.65	10.14	12.30	7.84	16.02	1.27	4.93	15.80	6.85	4.71	14.02	113.97
1929	6	15.74	14.81	8.92	10.15	5.83	12.27	6.18	2.53	8.12	2.51	7.72	11.56	106.35
1930	6	6.01	7.60	11.26	23.93	15.44	19.28	4.22	0.79	0.37	38.15	2.04	3.00	132.10
1931	6	10.41	7.36	9.95	7.18	18.16	9.36	1.80	6.82	2.89	4.84	2.28	15.15	96.20
1932	6	10.30	26.10	20.36	3.96	12.35	10.77	3.49	3.23	0.63	1.58	1.22	3.69	97.66
1933	6	4.13	19.39	17.47	16.29	7.86	12.73	4.41	2.65	0.79	10.46	0.45	1.58	98.22
1934	6	6.25	14.85	17.69	9.95	6.37	12.60	14.49	12.89	12.74	1.28	8.61	3.47	121.20
1935	6	7.32	9.82	2.12	11.90	25.31	16.91	1.98	13.67	2.63	2.38	0.19	7.14	101.38
1936	6	13.70	31.75	7.18	9.52	20.18	12.93	3.53	0.99	1.18	3.82	3.06	4.59	112.44
1937	6	7.48	8.42	17.09	12.03	9.88	4.80	14.22	2.19	4.62	3.65	2.36	1.86	88.61
1938	6	7.32	13.66	14.21	14.29	20.97	9.81	4.52	6.66	1.02	6.97	3.32	18.05	120.81
1939	6	9.72	8.09	13.84	6.59	13.10	10.33	3.79	11.10	1.30	0.74	1.90	5.86	86.35
1940	6	4.60	16.85	10.04	8.96	4.03	9.36	5.24	0.88	2.81	1.71	2.68	3.81	70.96
1941	6	8.83	11.14	6.17	22.47	8.36	12.55	5.24	7.81	0.02	0.28	4.93	6.12	93.91
1942	6	9.14	28.66	17.04	11.42	6.95	14.52	13.35	4.24	4.29	1.57	12.86	4.62	128.68
1943	6	10.87	15.62	13.64	9.10	14.20	10.93	4.43	1.28	3.46	2.64	1.04	20.71	107.91
1944	6	8.59	6.11	4.78	16.12	14.97	12.04	2.56	3.37	0.95	1.46	0.80	7.37	79.12
1945	6	20.85	2.25	8.64	9.39	13.15	14.82	6.12	1.70	1.50	1.47	0.73	5.06	85.68
1946	6	7.37	14.48	9.88	12.09	10.97	17.09	12.05	3.54	10.64	2.27	1.19	6.66	108.22
1947	6	6.01	32.03	13.43	9.43	16.27	13.63	7.60	0.46	0.25	0.22	1.28	2.47	103.06
1948	6	17.40	8.37	11.03	9.13	19.99	11.67	7.99	1.13	0.04	1.39	2.66	6.48	97.29
1949	6	8.98	17.35	9.43	15.32	13.56	10.87	7.58	8.42	0.36	4.43	7.88	3.54	107.72
1950	6	10.37	4.71	21.38	11.97	7.68	10.57	3.30	2.05	1.59	1.03	5.15	8.23	88.01
1951	6	14.95	1.91	18.35	16.26	10.14	13.26	7.97	3.57	1.05	1.42	0.35	9.76	99.00
1952	5	4.89	10.26	9.97	8.59	9.99	7.88	6.44	1.43	1.49	0.37	4.38	11.36	77.05
1953	5	11.35	18.60	13.99	8.87	6.50	14.03	2.31	7.63	5.32	2.11	1.16	8.85	100.71
1954	5	23.65	7.62	7.53	18.93	17.43	11.36	3.51	2.72	2.73	0.03	0.28	10.87	106.68
1955	5	8.37	10.63	3.36	3.58	15.12	21.61	8.52	3.43	4.99	0.98	2.48	8.12	91.20
1956	6	12.03	21.63	25.39	13.50	11.47	16.22	13.17	2.14	3.70	0.90	4.12	9.85	134.12
1957	6	8.71	10.79	12.43	14.95	16.52	9.89	12.84	0.21	0.04	3.95	1.78	5.06	97.17
1958	6	6.13	16.71	11.62	7.55	10.04	9.37	6.59	19.58	0.11	6.82	7.07	6.51	108.09
1959	6	8.19	10.11	11.14	11.51	7.74	12.58	8.91	5.55	0.08	1.91	4.94	8.14	90.78
1960	6	6.57	13.22	17.47	15.99	11.02	11.53	20.81	4.56	0.91	4.65	1.86	4.78	113.36
1961	6	5.96	15.86	11.65	10.27	11.74	14.49	3.41	3.65	0.09	0.14	6.39	3.64	87.30
1962	6	13.11	14.73	10.33	20.16	7.16	31.15	4.99	3.79	1.38	15.49	0.86	2.10	125.26
1963	6	13.53	12.97	10.98	19.84	12.86	12.53	10.73	1.60	20.24	1.08	1.54	6.11	124.02
1964	6	14.14	4.65	8.09	11.05	8.27	2.78	3.44	6.48	17.62	4.79	6.70	7.52	95.53
1965	6	19.38	13.89	8.33	12.07	8.00	2.40	4.49	19.43	1.37	0.48	3.46	6.91	100.21
1966	6	5.20	7.64	11.94	15.32	9.44	24.22	12.60	1.28	4.79	7.74	1.83	1.63	103.63
1967	6	6.35	13.09	7.95	10.09	9.91	8.09	5.86	0.27	0.90	1.03	7.07	10.57	81.17
1968	6	8.62	12.59	9.95	5.84	17.83	17.22	5.08	13.62	1.09	1.74	2.66	4.10	100.36
1969	6	9.57	13.64	10.31	6.77	12.53	3.51	4.57	3.97	6.48	0.31	18.34	6.64	96.64
1970	6	20.03	12.11	9.83	11.18	12.09	8.10	8.75	13.55	0.44	8.41	11.46	4.63	120.58
1971	6	16.26	9.63	9.53	10.59	20.53	6.65	4.23	1.80	3.23	1.51	2.54	2.27	88.76
1972	6	5.36	15.29	11.27	9.58	8.96	10.23	10.06	0.02	0.06	1.11	6.09	7.95	85.98
1973	6	8.39	14.55	6.73	12.37	11.58	13.89	5.19	14.85	3.63	0.89	0.63	3.70	96.42
1974	6	5.13	13.34	13.10	10.48	9.17	9.48	4.77	1.87	0.44	1.69	2.10	16.94	88.52
1975	6	3.89	9.29	20.25	12.90	19.74	34.83	7.08	10.01	0.61	1.00	2.62	8.99	131.20
1976	6	26.48	5.34	9.47	11.97	15.71	8.53	2.46	0.67	3.05	1.18	6.04	7.17	98.07
1977	5	11.04	16.10	17.21	10.23	8.76	11.15	45.37	5.01	1.81	0.30	10.63	6.88	144.49
1978	5	15.61	11.21	10.32	8.78	8.79	12.27	3.05	2.45	0.55	8.53	4.85	5.06	91.47
1979	5	9.39	7.06	9.25	13.81	10.05	8.24	4.36	2.86	1.00	1.69	1.57	14.42	83.72
1980	6	4.95	20.04	11.70	18.31	9.18	5.96	1.49	11.54	1.14	0.68	11.19	5.26	101.43
1981	5	5.36	8.43	6.24	12.77	9.45	20.37	6.72	2.46	1.64	3.66	1.50	4.91	83.50
1982	5	9.65	6.34	5.40	8.86	6.74	4.47	4.20	1.11	0.36	18.75	1.63	5.84	73.36
1983	5	6.75	15.14	14.98	13.60	18.78	8.25	7.94	1.38	3.18	8.91	1.95	2.65	103.51
1984	5	8.47	12.62	6.65	11.62	24.31	4.79	2.71	0.34	1.53	0.75	0.00	2.18	75.97
1985	5	20.48	13.26	9.35	12.90	8.42	9.45	4.04	0.81	1.10	0.40	7.46	7.87	95.53
1986	5	13.49	13.53	8.24	8.87	3.92	9.31	1.54	1.81	2.01	0.18	5.44	37.89	106.23
1987	5	7.53	12.91	10.33	10.46	17.94	22.17	6.08	7.67	1.41	3.08	4.55	3.57	107.70
1988	5	8.03	17.24	17.09	5.78	22.34	8.02	14.86	1.66	1.93	2.16	0.35	2.86	102.30
1989	5	20.72	23.16	11.88	15.18	3.96	16.05	2.59	0.58	1.22	0.05	4.00	2.06	101.44
1990	3	11.65	5.79	9.02	17.22	13.52	6.79	1.53	2.29	1.00	1.13	2.48	6.73	79.15
1991	3	14.36	12.62	9.25	8.52	4.27	5.72	5.34	0.82	0.76	0.23	3.16	6.04	71.08
1992	3	4.27	6.12	9.83	12.95	4.97	1.97	5.01	1.09	0.32	0.04	3.57	16.38	66.53
1993	3	10.76	10.19	16.53	10.23	24.90	7.16	1.22	0.25	1.00	5.30	8.36	0.99	96.88
1994	3	9.71	3.93	19.62	7.33	5.70	16.30	15.94	2.34	8.54	1.06	0.56	5.18	96.21
1995	3	8.27	4.95	23.78	19.28	13.32	6.70	5.88	1.83	1.38	9.19	1.75	2.22	98.56
1996	3	12.94	22.51	9.56	13.72	14.80	6.53	14.50	3.72	23.74	4.50	2.43	6.58	135.52
1997	3	8.40	15.66	7.17	12.42	19.66	17.55	6.10	3.51	0.46	1.05	5.42	3.18	100.57
1998	3	3.48	14.15	18.28	10.36	13.63	9.30	4.75	0.00	0.00	0.99	0.00	0.00	74.95
1999	3	13.56	9.27	18.79	23.42	10.85	17.53	14.80	6.05	0.31	1.20	0.00	2.74	118.53
2000	3	7.15	9.12	12.56	15.36	9.18	10.11	12.69	0.22	0.78	7.72	2.65	5.01	92.54
2001	3	10.68	22.66	11.40	14.83	8.60	4.85	5.09	4.53	0.90	9.36	6.99	10.60	110.50
2002	3	4.02	6.40	11.22	4.82	6.63	24.88	4.16	3.07	1.55	1.09	4.72	4.72	77.28
2003	3	4.47	5.24	8.35	11.90	10.56	14.84	3.32	1.61	5.78	11.25	2.09	11.21	90.6

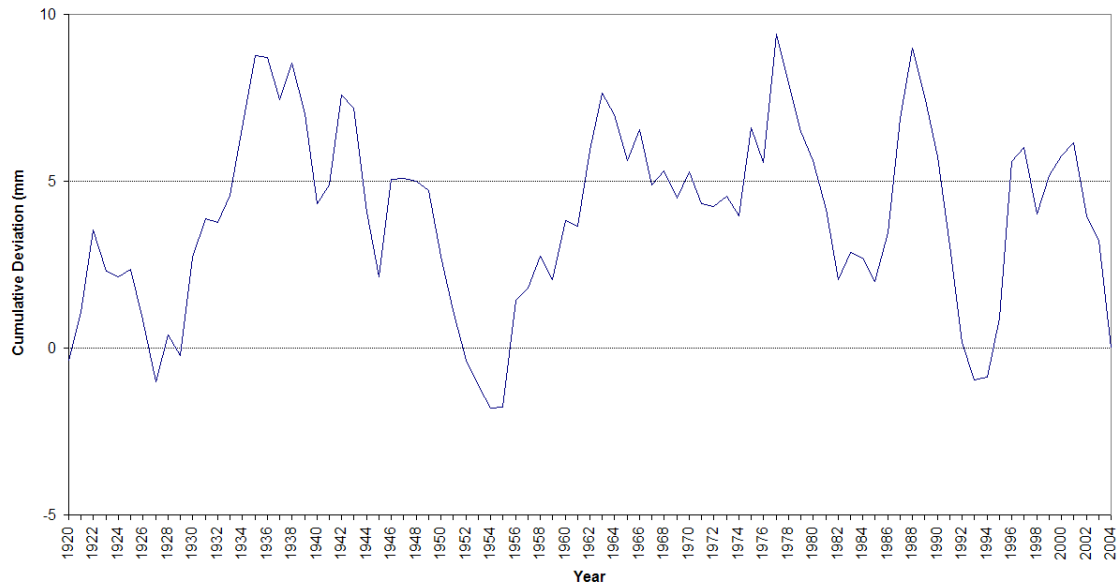
Monthly Point Rainfall Record for : Zalu Dam

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
Min	0.0	16.7	17.8	28.7	31.0	16.5	3.9	0.0	0.0	0.0	0.0	0.0	633.7
Mean	115.6	117.1	110.4	113.6	114.4	114.3	64.0	42.0	29.7	35.1	36.1	65.4	957.7
Max	308.8	308.8	264.4	251.7	291.0	331.9	467.7	228.3	260.9	380.0	153.4	361.5	1427.1
1920	172.9	121.4	138.5	99.4	109.5	127.6	66.2	8.6	0.0	3.1	1.1	73.5	921.8
1921	195.0	172.9	153.3	94.3	61.7	27.2	27.3	170.6	70.0	0.0	79.0	49.1	1100.2
1922	78.5	195.0	66.2	251.7	214.0	137.8	15.8	21.4	8.5	194.9	2.1	20.0	1205.8
1923	106.4	78.5	111.7	196.1	137.2	24.4	19.3	25.7	13.6	4.0	41.5	73.9	832.3
1924	99.6	106.4	137.4	93.7	113.3	174.6	67.3	20.6	6.1	21.4	6.8	94.7	941.9
1925	126.2	99.6	97.7	127.0	108.0	192.8	30.6	35.1	68.8	2.0	14.5	77.4	979.6
1926	27.0	126.2	123.7	84.7	79.4	256.7	3.9	14.3	0.4	6.9	25.4	57.9	806.5
1927	103.6	27.0	138.1	127.5	129.9	77.8	16.4	39.9	13.6	4.0	73.9	22.1	773.7
1928	131.2	103.6	94.7	108.6	70.7	138.7	16.5	44.5	154.1	65.0	45.4	124.5	1097.3
1929	72.0	131.2	79.1	94.8	56.8	104.8	57.0	21.2	74.3	24.3	70.9	109.8	896.0
1930	70.2	72.0	96.6	204.3	148.0	180.8	43.8	5.5	3.1	380.0	18.0	29.6	1251.8
1931	234.7	70.2	97.2	62.9	200.4	85.9	14.2	63.6	32.9	41.3	17.8	153.4	1074.5
1932	179.4	234.7	177.9	28.7	112.7	92.0	29.2	24.7	7.5	12.4	10.6	36.8	946.8
1933	127.8	179.4	160.6	178.2	81.5	112.7	42.6	27.6	6.3	101.0	4.5	16.2	1038.5
1934	91.7	127.8	160.1	89.2	53.7	124.6	133.4	120.5	139.2	13.7	83.3	23.4	1160.6
1935	287.7	91.7	17.8	102.8	248.1	162.8	21.3	128.0	30.4	19.6	2.3	60.2	1172.7
1936	69.9	287.7	56.6	93.3	167.7	127.8	31.6	9.3	9.5	33.9	27.2	38.8	953.4
1937	117.3	69.9	146.7	112.7	89.2	40.0	123.4	18.8	42.3	34.9	20.6	15.4	831.2
1938	65.0	117.3	118.9	124.8	153.6	88.9	44.7	65.7	12.3	60.3	49.8	165.3	1066.8
1939	148.4	65.0	127.1	61.5	77.6	94.0	35.7	107.5	15.2	10.2	21.5	40.7	804.5
1940	100.3	148.4	91.3	77.0	38.4	74.1	42.2	9.3	25.6	15.2	26.9	39.9	688.5
1941	245.9	100.3	59.9	231.7	57.4	109.2	27.6	68.5	0.0	3.2	56.0	55.3	1015.1
1942	143.8	245.9	162.9	92.5	68.8	144.1	124.6	28.4	40.1	15.2	114.0	45.4	1225.9
1943	52.9	143.8	130.5	88.2	138.6	64.9	41.4	14.9	30.8	27.4	10.2	176.0	919.5
1944	16.7	52.9	44.0	143.4	116.1	108.4	24.1	35.8	9.0	17.5	7.2	70.3	645.4
1945	142.0	16.7	72.6	87.5	139.1	142.6	66.3	11.7	13.4	16.5	4.4	51.0	763.8
1946	308.8	142.0	94.6	102.0	105.6	146.7	121.3	39.1	104.2	20.7	7.5	57.6	1250.0
1947	73.5	308.8	115.8	94.4	155.6	111.6	61.0	5.0	1.8	0.8	10.2	22.8	961.2
1948	166.0	73.5	104.2	90.4	227.2	113.4	74.7	6.4	0.6	14.0	24.2	53.7	948.3
1949	43.6	166.0	84.5	148.1	105.9	89.1	77.5	73.5	2.6	38.7	70.7	30.3	930.5
1950	18.2	43.6	201.0	119.9	72.9	118.7	26.0	21.9	17.8	10.7	50.8	61.1	762.5
1951	76.7	18.2	171.9	131.4	87.1	102.5	80.7	23.0	6.6	8.3	0.9	85.4	792.9
1952	159.9	76.7	79.2	94.3	102.8	74.4	58.8	11.4	8.8	2.7	42.8	98.1	810.0
1953	69.6	159.9	136.5	86.1	77.5	114.5	17.7	69.5	38.2	17.0	8.7	87.8	882.8
1954	97.9	69.6	77.9	186.9	162.2	109.1	42.6	18.9	22.3	0.5	4.7	95.2	887.7
1955	206.0	97.9	38.1	34.6	154.7	192.9	78.1	24.5	32.7	10.0	15.1	78.1	962.7
1956	104.4	206.0	264.4	123.8	109.4	151.2	125.2	15.7	33.5	9.3	41.3	92.2	1276.4
1957	143.4	104.4	121.1	150.4	169.9	92.2	125.6	2.8	0.0	26.8	12.2	46.7	995.6
1958	85.3	143.4	103.8	59.0	112.6	82.7	66.3	228.3	1.2	56.3	67.4	47.3	1053.6
1959	132.9	85.3	99.7	98.4	74.4	121.7	76.7	61.7	1.7	20.9	40.2	73.1	886.8
1960	155.4	132.9	148.1	128.3	79.6	113.1	202.9	46.5	11.4	53.0	18.5	44.1	1133.7
1961	147.0	155.4	106.0	100.9	110.2	145.8	32.0	35.9	0.5	1.2	69.4	37.2	941.4
1962	117.4	147.0	87.4	194.9	74.9	288.6	42.3	39.2	14.5	149.1	9.7	19.9	1184.9
1963	40.8	117.4	106.8	195.2	125.6	112.0	111.6	15.8	213.9	11.5	16.8	62.0	1129.4
1964	127.3	40.8	75.2	108.4	68.0	25.5	32.2	60.9	181.0	41.9	70.4	61.1	892.7
1965	74.9	127.3	82.1	104.3	73.9	16.5	42.8	176.9	13.3	3.9	35.6	70.1	821.7
1966	121.2	74.9	105.8	144.9	97.2	214.8	125.2	10.9	37.9	85.2	17.2	14.9	1050.0
1967	113.4	121.2	67.3	91.0	94.3	67.7	49.7	2.5	11.1	10.5	66.6	96.0	791.3
1968	117.6	113.4	101.3	51.8	169.1	162.2	39.3	142.8	13.4	17.3	30.6	41.5	1000.3
1969	112.1	117.6	91.2	57.7	95.5	32.1	41.8	40.3	62.6	4.3	153.4	66.2	875.0
1970	83.6	112.1	91.7	108.0	99.7	78.8	72.7	151.9	5.5	83.4	100.6	49.0	1036.9
1971	155.9	83.6	105.2	96.7	206.2	64.3	41.1	13.7	32.0	15.5	26.9	21.6	862.7
1972	153.2	155.9	102.7	94.7	80.8	91.7	103.4	0.1	0.6	11.1	67.3	89.1	950.7
1973	116.2	153.2	81.2	97.4	125.5	109.5	47.6	155.4	44.2	12.0	7.2	39.0	988.4
1974	83.8	116.2	126.0	89.0	92.9	83.4	49.3	18.7	6.4	16.7	27.5	189.0	898.9
1975	43.9	83.8	168.0	99.1	188.6	331.9	77.7	95.8	5.8	8.5	27.0	91.6	1221.6
1976	158.3	43.9	78.3	118.1	155.4	80.5	24.0	8.8	33.4	16.0	63.8	72.2	852.6
1977	100.2	158.3	163.8	98.5	78.5	91.0	467.7	55.7	20.4	5.2	41.5	62.1	1343.0
1978	65.2	100.2	79.6	83.0	84.1	128.3	32.9	23.1	6.6	95.7	47.6	64.1	810.5
1979	149.8	65.2	92.7	71.1	98.9	67.5	27.5	38.4	5.8	16.7	16.0	163.3	813.0
1980	84.9	149.8	107.5	130.9	86.9	52.3	19.3	107.1	10.0	9.2	84.2	27.5	869.6
1981	58.4	84.9	72.8	123.0	63.6	224.7	79.3	19.6	16.8	18.3	5.5	45.9	812.7
1982	126.5	58.4	45.2	85.9	65.1	44.7	37.5	15.1	7.3	188.8	19.4	53.9	748.0
1983	155.6	126.5	103.4	142.4	101.7	78.7	91.4	30.4	49.4	88.5	22.1	48.8	1038.8
1984	137.8	155.6	98.6	104.8	291.0	57.4	27.8	6.4	18.8	11.9	1.8	27.8	939.8
1985	95.4	137.8	89.1	156.9	56.7	82.9	49.3	10.2	10.8	1.4	105.8	92.7	889.0
1986	140.9	95.4	65.8	123.1	31.0	132.4	33.8	23.6	22.8	3.4	67.5	361.5	1101.4
1987	155.1	140.9	92.4	82.2	193.6	271.8	59.2	106.2	30.6	70.5	63.5	34.2	1300.3
1988	182.1	155.1	207.3	49.2	231.7	88.6	126.1	21.0	33.1	18.9	2.9	54.3	1170.3
1989	53.5	182.1	49.3	123.2	45.4	179.0	22.2	11.0	7.6	3.2	99.7	38.2	814.3
1990	136.6	53.5	79.7	134.0	131.4	62.4	12.6	35.0	9.3	7.4	39.5	72.9	774.2
1991	74.4	136.6	68.2	107.1	57.7	62.7	65.3	4.9	12.3	0.8	39.0	63.5	692.4
1992	93.6	74.4	108.4	83.3	69.1	29.8	47.8	13.3	7.8	2.8	35.8	100.5	666.6
1993	42.2	93.6	158.3	67.4	246.6	88.9	6.0	5.8	10.9	44.8	76.5	4.9	846.0
1994	77.1	42.2	176.7	87.3	49.9	187.2	154.4	31.8	88.5	10.2	5.5	56.6	967.5
1995	233.0	77.1	261.8	117.3	138.6	47.8	52.0	18.7	9.2	122.5	17.0	38.7	1133.6
1996	147.2	233.0	88.4	134.6	150.5	88.9	158.5	28.0	260.9	45.1	22.0	69.9	1427.1
1997	133.0	147.2	67.4	116.7	184.8	165.0	57.3	33.0	4.3	9.9	50.9	29.9	999.5
1998	87.1	133.0	171.8	97.4	128.1	87.4	44.7	0.0	0.0	9.3	0.0	0.0	758.9
1999	85.7	87.1	176.6	220.1	102.0	164.8	139.1	56.9	2.9	11.3	0.0	25.8	1072.4
2000	213.0	85.7	118.1	144.4	86.3	95.0	119.3	2.1	7.3	72.6	24.9	47.1	1015.8
2001	60.2	213.0	107.2	139.4	80.8	45.6	47.8	42.6	8.5	88.0	65.7	99.6	998.4
2002	49.3	60.2	105.5	45.3	62.3	233.9	39.1	28.9	14.6	10.2	44.4	44.4	737.9
2003	76.4	49.3	78.5	111.9	99.3	139.5	31.2	15.1	54.3	105.8	19.6	105.4	886.2
2004	0.0	76.4	75.8	221.7	81.4	61.6	55.3	23.6	8.2	2.9	11.8	15.0	633.7

Mass Rainfall Plot : Zalu Dam Point Rainfall



Deviation of Annual Average from Mean : Zalu Dam Point Rainfall



Monthly simulated inflow record into Zalu Dam (Million m³)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1920	0.16	0.34	0.67	0.61	0.53	0.67	0.64	0.42	0.21	0.12	0.08	0.13	4.58
1921	0.29	2.66	2.90	1.08	0.38	0.20	0.11	0.86	1.15	0.72	0.53	0.53	11.40
1922	2.36	5.92	2.11	4.83	6.66	3.43	0.90	0.26	0.16	3.20	1.48	0.34	31.63
1923	0.22	0.25	0.35	2.48	2.11	0.72	0.20	0.12	0.10	0.09	0.11	0.22	6.98
1924	0.37	0.53	1.04	0.70	0.51	2.89	1.40	0.45	0.26	0.19	0.15	0.24	8.72
1925	0.38	0.49	0.51	0.52	0.56	3.84	1.60	0.34	0.36	0.36	0.24	0.26	9.46
1926	0.49	1.57	1.08	0.57	0.38	5.63	2.17	0.23	0.12	0.09	0.09	0.14	12.55
1927	0.32	0.33	0.37	0.52	0.72	0.62	0.36	0.22	0.18	0.14	0.20	0.24	4.21
1928	0.29	0.45	0.50	0.45	0.37	0.49	0.44	0.29	2.28	1.75	0.88	2.30	10.48
1929	3.87	3.14	1.10	0.41	0.28	0.29	0.33	0.27	0.32	0.39	0.45	1.19	12.05
1930	0.85	0.53	0.44	2.83	2.74	4.25	1.61	0.33	0.17	12.45	4.59	0.44	31.23
1931	0.47	0.52	0.47	0.32	2.01	1.11	0.40	0.28	0.30	0.33	0.30	1.55	8.04
1932	1.44	7.38	5.67	1.36	0.29	0.35	0.31	0.20	0.14	0.12	0.10	0.10	17.45
1933	0.12	1.12	2.77	3.46	1.29	0.55	0.47	0.32	0.21	0.35	0.41	0.25	11.31
1934	0.19	0.39	1.96	1.00	0.34	0.37	1.58	2.93	4.97	1.87	0.64	0.54	16.79
1935	0.41	0.44	0.29	0.19	4.28	4.38	1.33	0.73	0.70	0.50	0.30	0.24	13.79
1936	0.51	10.02	3.67	0.36	1.10	1.52	0.75	0.29	0.16	0.15	0.17	0.18	18.87
1937	0.24	0.30	0.48	0.59	0.51	0.33	0.40	0.43	0.35	0.35	0.30	0.21	4.49
1938	0.20	0.38	0.56	0.62	1.92	1.05	0.47	0.40	0.35	0.36	0.43	3.47	10.21
1939	2.11	0.79	0.60	0.44	0.28	0.30	0.28	0.41	0.47	0.34	0.23	0.20	6.42
1940	0.21	0.48	0.61	0.43	0.23	0.17	0.17	0.13	0.11	0.12	0.13	0.15	2.94
1941	0.26	0.44	0.40	3.34	1.43	0.44	0.36	0.32	0.27	0.18	0.18	0.26	7.89
1942	0.40	6.71	4.82	1.27	0.39	0.50	2.02	1.04	0.44	0.35	0.53	0.65	19.13
1943	0.71	2.89	1.83	0.69	0.58	0.54	0.36	0.22	0.17	0.19	0.17	1.73	10.09
1944	1.18	0.63	0.33	0.32	0.49	0.60	0.46	0.28	0.20	0.16	0.13	0.17	4.94
1945	3.49	1.50	0.28	0.21	0.37	1.43	0.90	0.42	0.24	0.18	0.13	0.14	9.30
1946	0.22	0.57	0.63	0.50	0.46	1.31	2.13	1.02	1.24	0.87	0.44	0.31	9.70
1947	0.31	8.63	3.44	0.59	1.31	0.94	0.63	0.39	0.20	0.11	0.08	0.08	16.72
1948	0.38	0.62	0.57	0.44	4.25	2.01	0.70	0.45	0.23	0.14	0.13	0.16	10.08
1949	0.30	2.39	1.20	0.62	0.66	0.59	0.53	0.57	0.46	0.34	0.41	0.41	8.46
1950	0.45	0.41	2.42	1.28	0.52	0.50	0.42	0.25	0.17	0.15	0.17	0.26	6.99
1951	1.32	0.75	0.86	0.79	0.61	0.54	0.55	0.44	0.27	0.17	0.12	0.18	6.61
1952	0.26	0.29	0.29	0.27	0.32	0.34	0.32	0.24	0.15	0.11	0.12	0.29	2.99
1953	0.57	3.41	2.31	0.79	0.38	0.41	0.35	0.30	0.34	0.32	0.23	0.27	9.67
1954	6.09	2.52	0.49	1.75	3.03	1.37	0.56	0.34	0.22	0.16	0.11	0.20	16.84
1955	0.37	0.50	0.37	0.16	0.25	3.44	1.64	0.52	0.36	0.28	0.20	0.24	8.33
1956	0.53	5.84	9.37	3.03	0.68	2.16	2.59	1.02	0.37	0.27	0.24	0.37	26.47
1957	0.64	0.98	0.82	1.55	3.24	1.41	1.55	0.81	0.26	0.17	0.15	0.15	11.73
1958	0.21	0.49	0.66	0.44	0.35	0.38	0.38	6.07	2.42	0.49	0.55	0.54	12.98
1959	0.52	0.53	0.50	0.43	0.34	0.42	0.52	0.54	0.40	0.27	0.24	0.32	5.03
1960	0.38	0.54	1.88	1.10	0.57	0.53	5.27	2.21	0.47	0.39	0.35	0.28	13.96
1961	0.28	1.24	0.89	0.55	0.50	1.46	0.81	0.34	0.22	0.14	0.18	0.24	6.84
1962	0.45	2.67	1.29	2.73	1.25	7.76	2.97	0.42	0.29	1.98	1.07	0.36	23.24
1963	0.42	1.08	0.82	3.28	1.82	0.81	1.44	0.80	5.74	2.37	0.44	0.34	19.34
1964	1.58	0.89	0.35	0.30	0.28	0.18	0.11	0.14	3.17	1.65	0.78	0.72	10.15
1965	5.08	3.62	1.08	0.45	0.35	0.20	0.12	1.51	0.94	0.39	0.26	0.31	14.32
1966	0.34	0.34	0.37	0.52	0.58	4.78	3.59	1.05	0.36	0.49	0.52	0.32	13.28
1967	0.24	0.41	0.43	0.32	0.31	0.30	0.26	0.18	0.11	0.10	0.16	0.38	3.20
1968	0.58	0.87	0.72	0.40	0.60	2.95	1.31	1.98	1.06	0.42	0.30	0.26	11.43
1969	0.35	0.59	0.62	0.38	0.27	0.21	0.14	0.15	0.24	0.27	1.58	1.10	5.89
1970	5.53	3.04	0.87	0.50	0.46	0.42	0.40	2.61	1.25	0.59	1.90	1.10	18.65
1971	4.72	2.06	0.63	0.49	3.52	1.53	0.37	0.22	0.17	0.17	0.16	0.15	14.20
1972	0.15	0.43	0.64	0.53	0.39	0.37	0.50	0.42	0.22	0.13	0.18	0.38	4.34
1973	0.56	2.66	1.26	0.43	0.47	0.60	0.52	2.66	1.40	0.56	0.33	0.22	11.68
1974	0.22	0.39	0.59	0.53	0.42	0.39	0.34	0.24	0.16	0.13	0.13	2.40	5.94
1975	1.25	0.50	1.78	0.98	3.03	12.08	4.28	1.18	0.74	0.36	0.23	0.33	26.74
1976	8.30	3.17	0.40	0.35	1.10	0.77	0.39	0.20	0.15	0.16	0.22	0.36	15.56
1977	0.56	3.23	3.55	1.26	0.43	0.38	17.22	6.36	0.63	0.38	0.28	0.31	34.60
1978	1.79	1.21	0.62	0.38	0.30	0.43	0.43	0.28	0.18	0.31	0.48	0.51	6.90
1979	0.61	0.58	0.46	0.32	0.29	0.29	0.22	0.17	0.15	0.13	0.11	0.83	4.16
1980	0.77	2.23	1.20	0.66	0.57	0.39	0.21	0.30	0.36	0.27	0.32	0.36	7.64
1981	0.29	0.30	0.29	0.33	0.31	3.74	1.76	0.52	0.31	0.23	0.17	0.15	8.40
1982	0.30	0.38	0.26	0.17	0.16	0.14	0.12	0.10	0.08	2.19	1.20	0.49	5.59
1983	0.48	1.05	0.80	0.74	0.66	0.52	0.51	0.46	0.40	0.60	0.63	0.47	7.32
1984	0.42	1.96	1.10	0.53	7.79	2.96	0.34	0.17	0.12	0.11	0.09	0.08	15.65
1985	0.34	2.23	1.15	1.02	0.62	0.35	0.30	0.21	0.14	0.10	0.24	0.55	7.25
1986	2.25	1.28	0.56	0.44	0.30	0.33	0.35	0.25	0.19	0.15	0.20	12.06	18.35
1987	4.61	2.33	1.16	0.44	2.41	8.95	3.21	1.00	0.77	0.68	0.74	0.61	26.90
1988	0.55	2.69	5.43	1.82	3.70	1.69	1.54	0.85	0.39	0.31	0.21	0.18	19.36
1989	1.43	5.04	1.86	0.39	0.29	1.14	0.70	0.27	0.15	0.10	0.23	0.34	11.94
1990	0.47	0.48	0.36	0.39	0.59	0.54	0.30	0.17	0.14	0.12	0.13	0.22	3.92
1991	1.13	2.70	1.16	0.41	0.30	0.22	0.22	0.19	0.13	0.10	0.10	0.18	6.85
1992	0.32	0.40	0.43	0.38	0.28	0.17	0.13	0.11	0.09	0.07	0.09	0.25	2.72
1993	0.54	0.70	2.21	1.01	4.83	2.06	0.40	0.18	0.10	0.13	0.27	0.28	12.71
1994	0.23	0.21	0.50	0.54	0.33	1.61	3.89	1.56	0.63	0.61	0.37	0.27	10.75
1995	0.37	0.45	6.11	2.51	1.28	0.71	0.32	0.22	0.16	0.39	0.53	0.39	13.43
1996	0.49	6.78	2.68	0.60	1.83	1.02	3.02	1.37	8.53	3.45	0.65	0.51	30.92
1997	0.56	2.33	1.11	0.43	2.61	3.78	1.42	0.44	0.27	0.18	0.19	0.21	13.52
1998	0.18	0.36	2.44	1.20	0.59	0.59	0.45	0.26	0.13	0.09	0.07	0.05	6.39
1999	0.19	0.41	2.22	5.36	2.04	2.67	3.43	1.38	0.48	0.28	0.17	0.11	18.75
2000	0.16	0.27	0.41	0.58	0.58	0.51	0.87	0.59	0.27	0.29	0.34	0.31	5.18
2001	0.44	5.50	2.32	0.78	0.60	0.35	0.23	0.21	0.19	0.31	0.52	1.04	12.47
2002	0.74	0.43	0.38	0.26	0.16	3.21	1.46	0.37	0.24	0.18	0.22	0.72	7.82
2003	0.23	0.21	0.19	0.25	0.33	0.52	0.50	0.30	0.25	0.57	0.63	0.66	4.63
2004	0.65	0.52	0.39	3.10	1.42	0.40	0.30	0.23	0.17	0.12	0.09	0.08	7.47
AVERAGE	1.00	1.75	1.36	0.97	1.16	1.50	1.17	0.71	0.63	0.61	0.40	0.60	11.86

Monthly Reserve / IFR record released from Zalu Dam (Million m³)

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
1920	0.09	0.20	0.27	0.23	0.26	0.37	0.31	0.19	0.16	0.09	0.07	0.07	2.31
1921	0.15	0.72	0.34	0.23	0.22	0.14	0.10	0.20	0.19	0.18	0.17	0.16	2.80
1922	0.27	0.84	0.33	0.24	0.28	0.46	0.31	0.15	0.12	0.18	0.17	0.15	3.50
1923	0.10	0.14	0.13	0.24	0.28	0.37	0.12	0.08	0.08	0.08	0.08	0.11	1.81
1924	0.20	0.45	0.30	0.23	0.26	0.45	0.32	0.19	0.17	0.15	0.11	0.11	2.94
1925	0.21	0.40	0.23	0.22	0.26	0.47	0.32	0.18	0.18	0.18	0.15	0.13	2.93
1926	0.25	0.66	0.30	0.23	0.22	0.47	0.32	0.13	0.09	0.08	0.07	0.07	2.89
1927	0.18	0.19	0.15	0.22	0.27	0.36	0.22	0.13	0.14	0.12	0.14	0.11	2.23
1928	0.15	0.35	0.22	0.21	0.21	0.31	0.27	0.16	0.19	0.18	0.17	0.16	2.58
1929	0.27	0.79	0.31	0.17	0.11	0.17	0.19	0.15	0.18	0.18	0.16	0.16	2.84
1930	0.26	0.45	0.18	0.24	0.28	0.47	0.32	0.18	0.13	0.18	0.17	0.16	3.02
1931	0.24	0.44	0.20	0.11	0.28	0.40	0.26	0.16	0.18	0.17	0.16	0.16	2.76
1932	0.27	0.84	0.34	0.24	0.14	0.21	0.17	0.11	0.09	0.09	0.07	0.07	2.64
1933	0.08	0.62	0.34	0.24	0.27	0.34	0.29	0.17	0.16	0.17	0.16	0.13	2.97
1934	0.09	0.25	0.33	0.23	0.19	0.24	0.32	0.20	0.19	0.18	0.17	0.16	2.55
1935	0.23	0.33	0.11	0.09	0.28	0.47	0.31	0.20	0.19	0.18	0.16	0.11	2.66
1936	0.25	0.84	0.34	0.14	0.27	0.42	0.31	0.16	0.12	0.13	0.12	0.09	3.19
1937	0.12	0.16	0.21	0.23	0.26	0.20	0.26	0.19	0.18	0.17	0.16	0.10	2.24
1938	0.10	0.24	0.24	0.23	0.28	0.39	0.29	0.19	0.18	0.18	0.16	0.16	2.64
1939	0.27	0.57	0.25	0.20	0.11	0.18	0.16	0.19	0.19	0.17	0.15	0.10	2.54
1940	0.10	0.39	0.25	0.18	0.09	0.12	0.12	0.08	0.08	0.09	0.10	0.07	1.67
1941	0.13	0.35	0.17	0.24	0.27	0.30	0.22	0.17	0.17	0.15	0.13	0.13	2.43
1942	0.22	0.84	0.34	0.24	0.23	0.31	0.32	0.20	0.19	0.17	0.17	0.16	3.39
1943	0.26	0.77	0.32	0.23	0.27	0.33	0.22	0.13	0.13	0.15	0.12	0.16	3.09
1944	0.27	0.51	0.12	0.11	0.25	0.36	0.28	0.16	0.15	0.14	0.10	0.09	2.54
1945	0.27	0.65	0.10	0.09	0.21	0.41	0.31	0.19	0.16	0.15	0.10	0.07	2.71
1946	0.10	0.48	0.26	0.22	0.25	0.41	0.32	0.20	0.19	0.18	0.16	0.15	2.92
1947	0.17	0.84	0.34	0.23	0.27	0.39	0.30	0.19	0.15	0.08	0.07	0.07	3.10
1948	0.21	0.50	0.24	0.20	0.28	0.44	0.31	0.19	0.16	0.12	0.10	0.08	2.83
1949	0.16	0.70	0.32	0.23	0.27	0.35	0.29	0.20	0.19	0.17	0.16	0.16	3.20
1950	0.24	0.28	0.33	0.24	0.26	0.31	0.27	0.14	0.13	0.13	0.12	0.13	2.58
1951	0.27	0.56	0.29	0.23	0.27	0.33	0.30	0.19	0.17	0.14	0.08	0.09	2.92
1952	0.13	0.15	0.11	0.10	0.17	0.21	0.18	0.14	0.11	0.08	0.08	0.14	1.60
1953	0.26	0.81	0.33	0.23	0.22	0.28	0.22	0.17	0.18	0.17	0.15	0.14	3.16
1954	0.27	0.71	0.22	0.24	0.28	0.41	0.30	0.18	0.16	0.14	0.08	0.10	3.09
1955	0.20	0.41	0.15	0.08	0.09	0.46	0.32	0.20	0.18	0.17	0.14	0.11	2.51
1956	0.25	0.84	0.34	0.24	0.27	0.44	0.32	0.20	0.18	0.17	0.15	0.16	3.56
1957	0.26	0.60	0.29	0.24	0.28	0.41	0.32	0.20	0.17	0.14	0.11	0.07	3.09
1958	0.10	0.40	0.27	0.20	0.19	0.26	0.24	0.20	0.19	0.18	0.17	0.16	2.56
1959	0.25	0.45	0.22	0.18	0.19	0.29	0.29	0.20	0.19	0.17	0.15	0.15	2.73
1960	0.21	0.47	0.33	0.23	0.26	0.33	0.32	0.20	0.19	0.18	0.16	0.14	3.02
1961	0.14	0.63	0.29	0.22	0.25	0.42	0.31	0.18	0.16	0.12	0.13	0.11	2.96
1962	0.24	0.73	0.32	0.24	0.27	0.47	0.32	0.19	0.17	0.18	0.17	0.16	3.46
1963	0.23	0.61	0.29	0.24	0.28	0.38	0.32	0.20	0.19	0.18	0.16	0.15	3.23
1964	0.27	0.59	0.13	0.10	0.11	0.12	0.10	0.09	0.19	0.18	0.17	0.16	2.21
1965	0.27	0.81	0.30	0.21	0.19	0.14	0.11	0.20	0.19	0.18	0.15	0.15	2.90
1966	0.19	0.20	0.15	0.22	0.27	0.47	0.32	0.20	0.18	0.18	0.17	0.15	2.70
1967	0.12	0.28	0.18	0.11	0.16	0.18	0.15	0.10	0.08	0.08	0.11	0.16	1.71
1968	0.26	0.58	0.28	0.16	0.27	0.45	0.31	0.20	0.19	0.18	0.16	0.13	3.17
1969	0.19	0.49	0.26	0.15	0.11	0.14	0.11	0.09	0.16	0.17	0.17	0.16	2.20
1970	0.27	0.79	0.29	0.22	0.25	0.29	0.26	0.20	0.19	0.18	0.17	0.16	3.27
1971	0.27	0.68	0.26	0.21	0.28	0.42	0.23	0.13	0.13	0.14	0.11	0.07	2.93
1972	0.09	0.31	0.26	0.22	0.23	0.24	0.29	0.19	0.16	0.10	0.13	0.16	2.38
1973	0.26	0.72	0.32	0.18	0.25	0.36	0.29	0.20	0.19	0.18	0.16	0.11	3.22
1974	0.10	0.25	0.25	0.22	0.24	0.27	0.20	0.14	0.12	0.10	0.10	0.16	2.15
1975	0.27	0.41	0.32	0.23	0.28	0.47	0.32	0.20	0.19	0.18	0.15	0.15	3.17
1976	0.27	0.80	0.17	0.13	0.27	0.37	0.25	0.11	0.11	0.14	0.14	0.16	2.92
1977	0.26	0.80	0.34	0.24	0.24	0.26	0.32	0.20	0.19	0.18	0.16	0.15	3.34
1978	0.27	0.63	0.26	0.15	0.15	0.29	0.27	0.16	0.14	0.17	0.17	0.16	2.82
1979	0.26	0.49	0.19	0.11	0.14	0.17	0.14	0.09	0.11	0.10	0.08	0.16	2.04
1980	0.26	0.69	0.32	0.23	0.26	0.27	0.13	0.17	0.18	0.17	0.16	0.16	3.00
1981	0.15	0.16	0.11	0.12	0.16	0.47	0.32	0.20	0.18	0.16	0.12	0.07	2.22
1982	0.16	0.24	0.10	0.08	0.08	0.11	0.11	0.08	0.08	0.18	0.17	0.16	1.55
1983	0.25	0.61	0.29	0.23	0.27	0.32	0.29	0.19	0.19	0.18	0.17	0.16	3.15
1984	0.23	0.68	0.31	0.22	0.28	0.45	0.20	0.09	0.09	0.08	0.07	0.07	2.77
1985	0.19	0.69	0.31	0.23	0.27	0.21	0.16	0.11	0.09	0.08	0.15	0.16	2.65
1986	0.27	0.64	0.24	0.20	0.15	0.20	0.22	0.14	0.14	0.13	0.14	0.16	2.63
1987	0.27	0.69	0.31	0.20	0.28	0.47	0.32	0.20	0.19	0.18	0.17	0.16	3.44
1988	0.26	0.75	0.34	0.24	0.28	0.43	0.32	0.20	0.18	0.17	0.14	0.09	3.40
1989	0.27	0.84	0.32	0.16	0.14	0.40	0.31	0.15	0.11	0.08	0.15	0.15	3.08
1990	0.24	0.39	0.14	0.16	0.27	0.33	0.16	0.09	0.09	0.09	0.10	0.11	2.17
1991	0.27	0.76	0.31	0.17	0.15	0.15	0.14	0.10	0.09	0.08	0.07	0.09	2.38
1992	0.18	0.26	0.18	0.15	0.11	0.12	0.11	0.08	0.08	0.07	0.07	0.13	1.54
1993	0.26	0.54	0.33	0.23	0.28	0.44	0.26	0.10	0.08	0.10	0.16	0.14	2.92
1994	0.11	0.13	0.22	0.22	0.18	0.43	0.32	0.20	0.19	0.18	0.16	0.14	2.48
1995	0.20	0.35	0.34	0.24	0.27	0.37	0.18	0.13	0.12	0.18	0.17	0.16	2.71
1996	0.25	0.84	0.34	0.23	0.28	0.39	0.32	0.20	0.19	0.18	0.17	0.16	3.55
1997	0.26	0.69	0.31	0.18	0.28	0.47	0.32	0.19	0.17	0.15	0.13	0.10	3.25
1998	0.09	0.24	0.33	0.24	0.27	0.35	0.28	0.15	0.09	0.08	0.07	0.05	2.24
1999	0.09	0.28	0.33	0.24	0.28	0.45	0.32	0.20	0.19	0.17	0.12	0.07	2.74
2000	0.09	0.15	0.18	0.23	0.27	0.32	0.31	0.20	0.17	0.17	0.16	0.15	2.40
2001	0.23	0.84	0.33	0.23	0.27	0.21	0.14	0.11	0.14	0.17	0.17	0.16	3.00
2002	0.26	0.31	0.15	0.10	0.08	0.46	0.32	0.19	0.16	0.15	0.13	0.11	2.42
2003	0.11	0.13	0.10	0.10	0.18	0.32	0.29	0.17	0.17	0.18	0.17	0.16	2.08
2004	0.26	0.44	0.15	0.24	0.27	0.28	0.16	0.13	0.13	0.09	0.07	0.07	2.29
Average	0.21	0.52	0.26	0.20	0.23	0.33	0.25	0.16	0.15	0.15	0.14	0.13	2.72

Appendix 3: Surface Sampling Protocol

Surface Sampling Protocol

Introduction

This protocol gives effect to the surface water sampling protocol, a component of the Zalu pre-feasibility study.

The purpose of the surface water sampling protocol in the area of the proposed Zalu Dam site is to monitor natural surface water resources in the area:

It is critical that all steps are followed in the sequence set out in this protocol.

The protocol is intended for use by those involved in the collection of surface water samples in the area of the proposed Zalu Dam site. The sampling procedures are based on SABS procedures (SABS ISO 5667), ASTM Standards on Environmental Sampling (ASTM, 1995) and Department of Water Affairs and Forestry Sampling Guide (DWAf, 2000).

Objectives of the protocol

The main objectives of the protocol are to:

- describe the procedures required to ensure uniform, reproducible and reliable sampling by using techniques which are consistent and suitable for the site and in accordance with internationally acceptable sampling practices;
- ensure that data obtained from the sampling protocol can be confidently used to:
 - characterise water quality to identify sources of pollution, track pollution and indicate trends (against background values);
 - assess performance against legal standards and environmental guidelines;
 - assess risk

Responsible persons

The key personnel who can be contacted in the event of any difficulties, emergencies or uncertainties are detailed in the following table.

Responsible persons and contact details

Company	Name	Contact details
SRK	Laetitia Coetser	012 361 9821 083 655 8362

Sampling Protocol

The locations of the sampling points are described in Table 1. The surface water sampling schedule will be updated as required for future assessments and should include a review of sampling sites to ensure that all potential impacts are being covered.

- The SRK Project manager and the field technician must sign off the sampling schedule after it has been discussed and approved.
- Changes to, and deviation from, the schedule can only be made if discussed with the SRK project manager and a signed off amended version of the monitoring schedule compiled.
- The route between sampling points should be planned to ensure minimum time between sampling and delivery of the samples to laboratory and allow for any

time constraints e.g. opening times, availability of security, arrangements with farmers, etc.

Table 57: Zalu Dam Pre-feasibility study surface monitoring points

Sample name	Relative location	GPS Co-ordinates		Parameters measured
		Latitude	Longitude	
SURFACE WATER				
Z5	Xura River - Upstream of proposed dam site	44769.20	3465682.00	Nitrate and nitrite as N Cadmium Calcium Chloride Chromium Cobalt Copper Fluoride <i>E.coli</i> Iron Lead Magnesium Manganese Nickel Potassium Sodium Sulfate Zinc pH Conductivity Field measurements: EC, temperature, pH
Z4	First Tributary	44819.97	3465776.40	
Z3	Xura River - After confluence with Z4	44856.02	3465775.45	
Z2	Second Tributary	45142.56	3465021.27	
Z6	Xura River – After confluence with Z2	45247.00	3465761.00	
Z1	Downstream (Dam wall) of proposed dam site	45400.00	3466000.00	

Sampling equipment

Sampling equipment checklist

Field survival

- Map of sampling site locations
- Business cards and ID
- Cell phone
- Authorization (letter, etc.)
- Emergency telephone numbers (police, fire brigade, responsible persons, etc)
- Field notebook
- Waterproof pens, markers and pencils
- Masking tape and rubber bands
- Sampling log sheets/ chain of custody forms
- First aid kit, knife
- Insect repellent (wash hands thoroughly after applying)
- Hat, sunscreen, drinking water
- Protective clothing: safety glasses, gloves, safety shoes etc
- Rain gear
- Toolbox with basic tools
- Tape measure
- Flashlight and extra batteries

Physical positioning

- Camera, film (optional)
- Topographic map
- Global positioning system (optional)

Field equipment

- Calibrated hand-held pH, electrical conductivity (EC) and temperature meters
- Buffers and copies of manufacturers protocols for field equipment
- Squeeze bottle with deionised water
- Paper towel
- Sample labels
- Data recording sheets

Surface Water

- Sample containers (refer to Section 0) and labels

- Filtration equipment including 0.45 micron filters (for dissolved metals)
- Pre-prepared sample bottles containing dilute acid or sodium hydroxide for dissolved metals
- Cooler box and frozen ice bricks (**not** ice cubes)

Containers

- Use disposable plastic bottles whenever possible
- Alternatively well cleaned bottles may be used – these can often be obtained from the laboratory.
- A 1 l plastic bottle is sufficient for the parameters to be analysed.
- A 200 ml plastic bottle can be used for samples filtered on site.
- The appropriate dilute acid or hydroxide should be added to bottles before going on site
- If samples are taken for microbiological analysis, sterile glass or sterile disposable plastic bottles must be used.

Preservatives and laboratory requirements

- Surface waters, and particularly wastewaters, are susceptible to being changed as a result of physical, chemical or biological reactions that may take place between sampling and analysis. These changes can be prevented/minimised by preservation. Sample preservation techniques for various tests vary significantly. A summary of preservation techniques and maximum holding times for the parameters in the above table are presented in the Table 2 below.
- In most instances it is adequate to collect one sample and cool it to 2 - 5°C for routine parameters and chromium VI. A separate sample is collected for heavy metals, filtered on site and acidified to pH < 2 with nitric acid. However, when analysing for a particular parameter, for example, during a pollution incident, the specific preservation techniques in Table 2 for that parameter should be followed.
- The laboratory will require an order form and a Chain of Custody document, which must record the sample name, date of sampling, preservation of sample and analyses required.

Table 58: General guide to preservation techniques

Parameter	Preservation technique	Recommended maximum storage	Comment
Alkalinity	Cooling to 2 - 5°C	24 hours	
Ammonia	Acidification to pH < 2 with H ₂ SO ₄ and cooling to 2 - 5°C	24 hours	No acidification required if delivered to the laboratory within 6 hours
Chromium VI	Cooling to 2 - 5°C Addition of NaOH to pH>8	24 hours	Sample separately
Calcium	None	24 hours	Storage time can be extended to 48 hours if sample is acidified to pH < 2 with nitric acid
Chloride	None	1 month	

Parameter	Preservation technique	Recommended maximum storage	Comment
Electrical conductivity	Cooling to 2 - 5°C	24 hours	Field tests are recommended
Fluorides	None	1 month	
Heavy metals	Filtration on site and acidification to pH < 2 with nitric acid	1 month	Samples for total, as opposed to dissolved metals should not be filtered. Storage time for mercury is 13 days.
Magnesium	None	24 hours	Storage time can be extended to 48 hours if sample is acidified to pH < 2 with nitric acid
Nitrate	Acidification to pH < 2 with H ₂ SO ₄ or cooling to 2 - 5°C	24 hours	Storage time can be extended to 48 hours if sample is filtered prior to cooling.
Ortho phosphate	Filtration on site and cooling to 2 - 5°C	24 hours	Analyse as soon as possible
pH	Cooling to 2 - 5°C	6 hours	Field tests are recommended
Potassium	None	1 month	
Sodium	None	1 month	
Sulfate	Cooling to 2 - 5°C	1 week	

Assembly and checking of field sampling equipment

- Assemble, check and calibrate the equipment within twenty-four hours of the sampling time.
- In addition, re-calibrate the pH meter in the field before use.
- Check calibration periodically during sampling, and again after sampling.
- Check all electronic equipment and batteries for proper operation.
- Clean all equipment that makes contact with a water-quality sample before reuse (pumps, tubing, filtration equipment and water level probes) using the following cleaning procedure:
 - wash with non-phosphate detergent;
 - rinse with tap water;
 - rinse with deionized/distilled water;
 - air dry in dust-free environment;
 - wrap cleaned equipment in plastic for transport to the site; and
 - clean the cooler box and ice bricks.

Sample collection

Sample collection contains four major components that must be kept in mind at all times. The following aspects must be considered for all sampling visits:

- **personal health and safety:** make sure that the field technician (and any samplers he/she supervises) have had the appropriate safety training and that all the safety precautions listed in the protocol are adhered to;

- **collecting a representative sample:** the primary objective of the sampling schedule is to collect a sample that represents the water quality at that particular time and ensure that the sample does not undergo any change between sampling and analysis;
- **quality control:** described in Section 0;
- **record keeping:** complete and accurate records are essential (refer to Section 0).

Health and safety guidelines

Before collecting water quality samples, the health and safety requirements should be reviewed because sample collection may occur at contaminated sites or in remote, rugged country far from immediate medical attention. The following principles apply:

- receive prior training in personal safety at a level appropriate for the types of chemicals likely to be encountered;
- consult the SRK project manager on safety issues;
- have emergency telephone numbers on hand;
- determine the location of the nearest hospital, clinic or physician beforehand;
- notify others of itinerary and whereabouts;
- take precautions against poisonous reptiles and insects;
- carry identification and means of communication (cell phone);
- if handling sample preservatives such as acid, always wear splash-proof goggles and non-contaminating gloves;
- the proper handling of water quality samples also includes wearing disposable, powderless gloves (gloves not only protect field personnel against potential contaminants and preservatives such as acids, but also prevent potential contamination to the water sample).

Field measurements

- The pH, EC and temperature measurement of all water samples must be recorded when each sample is taken.
- Instruments must be calibrated in standard solutions before going on-site. The pH meter must be against a "pH 7 Buffer Solution". The pH meter also has to be calibrated using a second buffer solution if the pH is higher than 9 or lower than 4. The EC meter must be calibrated against a suitable standard solution.
- Probes should be rinsed with the sample before use and allowed to stabilize before the reading is taken (approximately 2 - 3 minutes). The measurements should be recorded on the sampling data sheet.
- Instruments should be placed in moving water when readings are taken.
- Probes must be rinsed thoroughly with distilled water after each reading. The protective cap for the pH meter must be replaced after each reading and care should be taken not to get the recording unit wet.

Field data sheets

- Sample collection in the field requires adequate documentation for quality assurance and control.
- The project-sampling file may contain detailed written notes describing how samples were taken, field measurements, previous laboratory analyses, chain-of-custody records, maps, photographs and correspondence. Make these as legible and complete as possible because of their importance as official and legal documents.
- In the field, data sheets must be completed for each sampling point for each sampling visit. There are examples of sampling data sheets for both surface and ground water attached in Appendices B and C, respectively.
- Comments on the weather, for example, recent rains, and any circumstances that may affect the water quality data should also be recorded on the data sheets.

Surface water

- Do field measurements in situ as described in Section 0 and record on the surface water data sheet on-site as described in Section 0.

Grab sampling

- Bottles should be labelled with waterproof markers. Information required is the sample name and date.
- Rinse bottle with water to be sampled.
- At the sampling point remove the cap of the sample bottle but do not contaminate inner surface of cap and neck of sample bottles with hands (gloves should be worn).
- Take samples by holding bottle with hand near base and plunge the sample bottle, neck downward below the water surface (wear gloves to protect your hands from contact with the water).
- Turn bottle until neck points slightly upward and mouth of bottle is directed toward the current/flow (can also be created artificially by pushing bottle forward horizontally in a direction away from the hand).
- Avoid collecting surface scum or bottom sediment.
- The bottle should be filled to the top and lightly squeezed when screwing on the top to exclude air as exchange between any air and water may alter the parameters of concern.
- Preserve another sample for heavy metals as indicated in Table5-1.
- Note the position of sampling, for example, inlet, outlet, centre of pond etc.

Storage and delivery of samples

- Place bottle in cooler box and deliver to the laboratory as soon as possible, at least within 24 hours of being collected.

- The instructions to the laboratory should include a completed Chain of Custody form containing details of analyses required (the suite of analyses must be consistent over the monitoring programme), detection limits required, reporting requirements and an order.
- The Chain of Custody forms must be signed by all parties including the laboratory and the field technician or his/her representative.
- The laboratory must check that the correct number of samples has been delivered.
- The laboratory must capture both the sampling and analysis date and the date analyses were completed. This information must be included in results of analyses received from the laboratory.
- The laboratory should report the ionic balance for each sample, where applicable, and not present results that are out of balance.
- The laboratory must retain samples for 6 weeks after analysis is complete in case of further analyses required.

Laboratory Quality Assurance

- The laboratory should conduct internal quality assurance checks (blanks, standards, duplicates, etc.) on a regular basis to provide a high degree of confidence that the analyses can be relied upon.
- The laboratory should ideally be a member of an external quality assurance program, such as the South African National Accreditation Service (SANAS 17025) or equivalent;
- It is essential to ensure that the analysis covers all major constituents so that the laboratory can provide a cation/anion balance, which is critical in ensuring the validity of the data.

Data assessment and management

Receipt of lab results and assessment

- The field technician must conduct data reconciliation on the day the results are received from the labs.
- The field technician must submit this reconciliation to the SRK project manager for information and action within 1 week of receipt of results from the laboratory. These notes should be filed.
- Results must be checked and any queries must be made via email to the lab within 3 days. Factors to consider include:
 - are detection limits adequate?
 - are ion balances < 10% depending on TDS concentration (low concentration allows for greater variability in ion balance)?
 - are results consistent with expected trends?
- A copy of laboratory results must be filed.

- Where samples were taken from non-mine boreholes, the results may need to be forwarded to the owners of these boreholes.
- All the field data, rest water levels, data in the sampling data sheets, and analytical results must be inputted into a computer database within 1 week of receipt of results. The database should have one sample site per spreadsheet. Dates should go down the rows and parameters monitored across the columns.
- Ion balances must be checked to determine whether they are in the specified range.
- Statistical analyses (e.g. average, median, minimum, maximum, standard deviations and percentiles) must be performed on the data, depending on evaluation and reporting requirements.

Report writing

- The report should summarise all available results of monitoring and indicate how this compares with the historical dataset. Particular attention should be paid to temporal and spatial trends.
- As far as possible, sources of possible pollution should be identified and the significance of impacts determined in relation to downstream user requirements. Where necessary, recommendations on control measures should be made.
- Possible changes to the sampling protocol and sampling schedule should also be suggested.
- Reports should be signed by the author and reviewed and signed by the SRK project manager.

Appendix 4: Certificate of Water Analysis



Amatola Water - Amanzi - Water is life

Scientific Services Division

Nahoon Dam Complex
Nahoon Dam
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Enquiries: Ms. L. Ndonga
Date: 02 November, 2006
Our Ref: 70234

Submitted By: Mr. Gert Nel

SRK Consulting
PO Box 15739
Beacon Bay
5205

Analysis of Sample's

The samples submitted on 13-October-2006 have been analysed and the results are set out in the attached report.

An account for the analysis will follow.

Yours faithfully

Scientific Services Manager

Enclosure:

CONFIDENTIALITY NOTICE

This message is intended only for the use of the individual or entity to which it is addressed and it contains information that is strictly confidential. If the reader of this message is not the intended recipient, or the employee or agent responsible for delivering the message to the intended recipient, you are hereby notified that any disclosure, distribution or copying or taking of any action in reliance on the contents of this communication, is strictly prohibited. If you have received this communication in error, please notify us immediately by telephone to arrange for the return of the documents to us.

1 of 6 Report no 70234



Amatola Water - Amanzi - *Water is life*

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ATTENTION Mr. Gert Nel

Report number : 70234

Date Reported : 2006/11/02

Test Report

SRK Consulting

P.O. Box 15739
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Chemical results in milligrams per litre (unless otherwise stated)

<u>Description:</u>	Z1	Z2	Z3	Z8
<u>Sample Number:</u>	40534	40535	40536	40539
<u>Received Date:</u>	2006/10/13	2006/10/13	2006/10/13	2006/10/13
<u>Comment:</u>				
(Nitrate & Nitrite) as N	2.7	1.7	6.0	2.8
Cadmium as Cd (µg/l)	1.4	1.4	1.4	1.4
Calcium as Ca	6.1	4.2	5.7	4.4
Chloride as Cl	19	25	14	20
Chromium as Cr (µg/l)	<0.1	<0.1	<0.1	<0.1
Cobalt as Co (µg/l)	1.3	1.2	1.2	1.2
Conductivity (mS/m)	15	16	14	15
Copper as Cu (µg/l)	0.1	0.1	0.1	0.1
E coli only (colilert) (count /100ml)		816	770	613
Fluoride Umgeli (µg/l)	232	<100	<100	<100
Hardness (calcium)	15	10	14	11
Hardness (magnesium)	28	21	26	21
Hardness (total)	43	31	40	32
Heterotrophic plate count @37°C (CFU / 1ml)		452	631	608
Iron (total) as Fe (µg/l)	5383	4358	5330	3408
Lead as Pb (µg/l)	1.6	1.5	1.5	1.5
Magnesium as Mg	6.7	5.2	6.3	5.2
Manganese as Mn (µg/l)	27	20	25	9.9
Nickel as Ni (µg/l)	1.2	1.1	1.2	1.1
pH (pH units)	7.50	7.29	6.54	7.23
Potassium as K	2.0	1.0	0.93	0.93
Sodium as Na	13	14	12	9.6
Sulphate as SO4	12	10	3.5	9.4

* Not Requested

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ATTENTION Mr. Gert Nel

Report number : 70234

Date Reported : 2006/11/02

Test Report

SRK Consulting

P.O. Box 15739
Beacon Bay
5205
043 - 748 1811
gnel@srk.co.za

Chemical results in milligrams per litre (unless otherwise stated)

<u>Description:</u>	Z1	Z2	Z3	Z6
<u>Sample Number:</u>	40534	40535	40536	40539
<u>Received Date:</u>	2006/10/13	2006/10/13	2006/10/13	2006/10/13
<u>Comment:</u>				
Total coliform (count / 100ml)		>2420	>2420	>2420
Total Solids - dissolved	73	78	73	76
Zinc as Zn	0.08	0.07	0.05	0.04

* Not Requested

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Report number : 70234

Date Reported : 2006/11/02

Test Report

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Chemical results in milligrams per litre (unless otherwise stated)

Description:	Z4	Z5
Sample Number:	40537	40538
Received Date:	2006/10/13	2006/10/13
Comment:		
(Nitrate & Nitrite) as N	2.4	2.5
Cadmium as Cd (µg/l)	1.4	1.4
Calcium as Ca	3.9	6.1
Chloride as Cl	31	20
Chromium as Cr (µg/l)	<0.1	<0.1
Cobalt as Co (µg/l)	1.2	1.2
Conductivity (mS/m)	14	14
Copper as Cu (µg/l)	0.1	0.1
E coli only (colilert) (count /100ml)		687
Fluoride (µg/l)	<100	<100
Hardness (calcium)	9.7	15
Hardness (magnesium)	19	28
Hardness (total)	29	43
Heterotrophic plate count @37°C (CFU / 1ml)	272	384
Iron (total) as Fe (µg/l)	2338	5389
Lead as Pb (µg/l)	1.5	1.5
Magnesium as Mg	4.5	6.7
Manganese as Mn (µg/l)	4.9	22
Nickel as Ni (µg/l)	1.2	1.2
pH (pH units)	6.82	7.11
Potassium as K	1.0	1.6
Sodium as Na	12	12
Sulphate as SO4	7.7	11

* Not Requested

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Report number : 70234

Date Reported : 2006/11/02

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Chemical results in milligrams per litre (unless otherwise stated)

<u>Description:</u>	<u>Z4</u>	<u>Z5</u>
<u>Sample Number:</u>	40537	40538
<u>Received Date:</u>	2006/10/13	2006/10/13
<u>Comment:</u>		
Total coliform (count / 100ml)		>2420
Total Solids - dissolved	87	71
Zinc as Zn	0.06	0.07

* Not Requested

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Chemical results in milligrams per litre (unless otherwise stated)

This report relates only to the samples supplied to the SCIENTIFIC SERVICES DIVISION and does not relate to similar samples. Although SCIENTIFIC SERVICES will endeavor to perform analyses correctly, neither SCIENTIFIC SERVICES nor its members shall be liable for loss or damage attributed directly or indirectly to the inaccuracy of these results or their interpretation.

See Annexure A for comments

.....
Technical Signatory : Microbiology

.....
Technical Signatory : Chemistry

Authorized By:

Scientific Services Manager Date:

* Not Requested

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Surface Water Data Sheet

SURFACE WATER DATA SHEET

Date: 11 October 2006

Weather conditions: Recent heavy rains experienced

Sample site	Sampled (supply reason if 'no')	pH	EC (mS\m)	Comments
Z1	Yes	7.07	13	NA
Z2	Yes	7.38	14	NA
Z3	Yes	7.17	12	NA
Z4	Yes	6.95	15	NA
Z5	Yes	7.02	12	NA
Z6	Yes	7.03	13	NA

Appendix 5: Cost Estimates

ESTIMATED COST FOR ZALU DAM					
Pre Feasibility Stage					
Rock Fill Dam Central Spillway			March 2006 price levels		
Wall height = 26.50m					
NO	DESCRIPTION	UNIT	RATE (Rand/Unit)	QUANTITY	AMOUNT (Rand)
1	Site & basin clearing				
	(a) Sparse	ha	3,263	1.00	3,263
	(b) Bush	ha	9,789	0.30	2,937
	(c) Trees	ha	16,314	0.30	4,894
2	River diversion	Sum			76,786
3	Excavation				
	(a) Soft Excavation	m ³	23	26,150	601,450
	(b) Hard Excavation	m ³	41	9,150	375,150
	(c) Foundation Preparation	m ³	41	4,270	175,070
4	Drilling and Grouting				
	(a) Curtain Grouting	m	261	1,500	391,500
	(b) Consolidation Grouting	m	261	800	208,800
5	Formwork				
	(a) Straight	m ²	117	10,530	1,232,010
	(b) Curved	m ²	186	1,150	213,900
6	Concrete				
	(a) Rollcrete	m ³	376	22,610	8,501,360
	(b) Skin	m ³	461	4,800	2,212,800
	(c) Mass	m ³	424	2,450	1,038,800
	(d) Structural	m ³	545	5,400	2,943,000
7	Embankment				
	Earthfill	m ³	46	60,000	2,764,291
8	Reinforcing	t	5,827	216	1,258,632
9	Fencing	km	16,314	1	16,314
10	Mechanical Items	%	10(Civil)		2,202,096
	SUB TOTAL				24,223,053
11	Landscaping (% of 1-10)	%	5		1,211,153
12	Miscellaneous (% of 1-10)	%	10		2,422,305
	SUB TOTAL A				27,856,511
13	Preliminary & General (% of Subtotal A)	%	30		8,356,953
14	Preliminary Works				
	(a) Access road	km	138,215	2	276,430
	(b) Electricity to Site	km	76,786	2	153,572
	(c) Water to site (construction & potable)	sum	30,714	1	30,714
15	Accommodation				
	(a) Permanent		Included in P&G		0
	(b) Temporary				
	SUB TOTAL B				36,674,181
16	Contingencies (% of Subtotal B)	%	10		3,667,418
	SUB TOTAL C				40,341,599
17	Planning Design & Supervision, Fees, Time Cost & Transport (% of Subtotal C)	%	15		6,051,240
	SUB TOTAL D				46,392,839
18	VAT (% of Subtotal D)	%	14		6,494,997
	NET PROJECT COST				52,887,836
19	Cost of Relocations				0
20	Cost Land Acquisition	m	0	700,000	0
	ESTIMATED TOTAL COST				52,887,836

ESTIMATED COST FOR ZALU DAM					
Pre Feasibility Stage					
Rock Fill Dam Side Spillway Wall height = 26.50m			March 2006 price levels		
NO	DESCRIPTION	UNIT	RATE (Rand/Unit)	QUANTITY	AMOUNT (Rand)
1	Site & basin clearing				
	(a) Sparse	ha	3,263	1.00	3,263
	(b) Bush	ha	9,789	0.30	2,937
	(c) Trees	ha	16,314	0.30	4,894
2	River diversion	Sum	77,000	1	77,000
3	Excavation				
	(a) Soft Excavation	m ³	23	23,535	541,305
	(b) Hard Excavation	m ³	41	8,235	337,635
	(c) Foundation Preparation	m ³	41	3,843	157,563
4	Drilling and Grouting				
	(a) Curtain Grouting	m	261	1,470	383,670
	(b) Consolidation Grouting	m	261	760	198,360
5	Formwork				
	(a) Straight	m ²	117	9,477	1,108,809
	(b) Curved	m ²	186	1,150	213,900
6	Concrete				
	(a) Rollcrete	m ³	376	0	0
	(b) Skin	m ³	461	4,800	2,212,800
	(c) Mass	m ³	424	2,450	1,038,800
	(d) Structural	m ³	545	18,900	10,300,500
7	Embankment				
	Earthfill	m ³	101	38,000	3,851,579
8	Reinforcing	t	5,827	378	2,202,606
9	Fencing	km	16,314	1	16,314
10	Mechanical Items	%	10(Civil)		2,265,194
	SUB TOTAL				24,917,129
11	Landscaping (% of 1-10)	%	5		1,245,856
12	Miscellaneous (% of 1-10)	%	10		2,491,713
	SUB TOTAL A				28,654,698
13	Preliminary & General (% of Subtotal A)	%	30		8,596,410
14	Preliminary Works				
	(a) Access road	km	138,215	2	276,430
	(b) Electricity to Site	km	76,786	2	153,572
	(c) Water to site (construction & potable)	sum	30,714	1	30,714
15	Accommodation				
	(a) Permanent		Included in P&G		0
	(b) Temporary				
	SUB TOTAL B				37,711,824
16	Contingencies (% of Subtotal B)	%	10		3,771,182
	SUB TOTAL C				41,483,006
17	Planning Design & Supervision, Fees, Time Cost & Transport (% of Subtotal C)	%	15		6,222,451
	SUB TOTAL D				47,705,457
18	VAT (% of Subtotal D)	%	14		6,678,764
	NET PROJECT COST				54,384,221
19	Cost of Relocations				0
20	Cost Land Acquisition	m	0	750,000	0
	ESTIMATED TOTAL COST				54,384,221

ESTIMATED COST FOR ZALU DAM					
Pre Feasibility Stage					
Earth Fill Dam Central Spillway			March 2006 price levels		
Wall height = 26.50m					
NO	DESCRIPTION	UNIT	RATE (Rand/Unit)	QUANTITY	AMOUNT (Rand)
1	Site & basin clearing				
	(a) Sparse	ha	3,263	1.00	3,263
	(b) Bush	ha	9,789	0.30	2,937
	(c) Trees	ha	16,314	0.30	4,894
2	River diversion	Sum			76,786
3	Excavation				
	(a) Soft Excavation	m ³	23	27,458	631,523
	(b) Hard Excavation	m ³	41	10,065	412,665
	(c) Foundation Preparation	m ³	41	4,697	192,577
4	Drilling and Grouting				
	(a) Curtain Grouting	m	261	1,470	383,670
	(b) Consolidation Grouting	m	261	760	198,360
5	Formwork				
	(a) Straight	m ²	117	11,583	1,355,211
	(b) Curved	m ²	186	1,150	213,900
6	Concrete				
	(a) Rollcrete	m ³	376	0	0
	(b) Skin	m ³	461	4,800	2,212,800
	(c) Mass	m ³	424	2,940	1,246,560
	(d) Structural	m ³	545	20,250	11,036,250
7	Embankment				
	Earthfill	m ³	46	60,000	2,764,291
8	Reinforcing	t	5,827	405	2,359,935
9	Fencing	km	16,314	1	16,314
10	Mechanical Items	%	10(Civil)		2,311,194
	SUB TOTAL				25,423,130
11	Landscaping (% of 1-10)	%	5		1,271,156
12	Miscellaneous (% of 1-10)	%	10		2,542,313
	SUB TOTAL A				29,236,599
13	Preliminary & General (% of Subtotal A)	%	30		8,770,980
14	Preliminary Works				
	(a) Access road	km	138,215	2	276,430
	(b) Electricity to Site	km	76,786	2	153,572
	(c) Water to site (construction & potable)	sum	30,714	1	30,714
15	Accommodation				
	(a) Permanent		Included in P&G		0
	(b) Temporary				
	SUB TOTAL B				38,468,295
16	Contingencies (% of Subtotal B)	%	10		3,846,829
	SUB TOTAL C				42,315,124
17	Planning Design & Supervision, Fees, Time Cost & Transport (% of Subtotal C)	%	15		6,347,269
	SUB TOTAL D				48,662,393
18	VAT (% of Subtotal D)	%	14		6,812,735
	NET PROJECT COST				55,475,128
19	Cost of Relocations				0
20	Cost Land Acquisition	m	0	750,000	0
	ESTIMATED TOTAL COST				55,475,128

ESTIMATED COST FOR ZALU DAM					
Pre Feasibility Stage					
Earth Fill Dam Side Spillway			March 2006 price levels		
Wall height = 26.50m					
NO	DESCRIPTION	UNIT	RATE (Rand/Unit)	QUANTITY	AMOUNT (Rand)
1	Site & basin clearing				
	(a) Sparse	ha	3,263	1.00	3,263
	(b) Bush	ha	9,789	0.30	2,937
	(c) Trees	ha	16,314	0.30	4,894
2	River diversion	Sum			76,786
3	Excavation				
	(a) Soft Excavation	m ³	23	23,535	541,305
	(b) Hard Excavation	m ³	41	8,235	337,635
	(c) Foundation Preparation	m ³	41	3,843	157,563
4	Drilling and Grouting				
	(a) Curtain Grouting	m	261	1,470	383,670
	(b) Consolidation Grouting	m	261	760	198,360
5	Formwork				
	(a) Straight	m ²	117	9,477	1,108,809
	(b) Curved	m ²	186	1,150	213,900
6	Concrete				
	(a) Rollcrete	m ³	376	29,385	11,048,572
	(b) Skin	m ³	461	4,800	2,212,800
	(c) Mass	m ³	424	2,205	934,920
	(d) Structural	m ³	545	5,400	2,943,000
7	Embankment				
	Earthfill	m ³	101	37,000	3,750,222
8	Reinforcing	t	5,827	270	1,573,290
9	Fencing	km	16,314	1	16,314
10	Mechanical Items	%	10(Civil)		2,550,824
	SUB TOTAL				28,059,064
11	Landscaping (% of 1-10)	%	5		1,402,953
12	Miscellaneous (% of 1-10)	%	10		2,805,906
	SUB TOTAL A				32,267,924
13	Preliminary & General (% of Subtotal A)	%	30		9,680,377
14	Preliminary Works				
	(a) Access road	km	138,215	2	276,430
	(b) Electricity to Site	km	76,786	2	153,572
	(c) Water to site (construction & potable)	sum	30,714	1	30,714
15	Accommodation				
	(a) Permanent		Included in P&G		0
	(b) Temporary				
	SUB TOTAL B				42,409,017
16	Contingencies (% of Subtotal B)	%	10		4,240,902
	SUB TOTAL C				46,649,919
17	Planning Design & Supervision, Fees, Time Cost & Transport (% of Subtotal C)	%	15		6,997,488
	SUB TOTAL D				53,647,407
18	VAT (% of Subtotal D)	%	14		7,510,637
	NET PROJECT COST				61,158,044
19	Cost of Relocations				0
20	Cost Land Acquisition	m	0	750,000	0
	ESTIMATED TOTAL COST				61,158,044

ESTIMATED COST FOR ZALU DAM													
Rollcrete Dam		March 2006 price levels											
Wall height = 26.50m													
NO	DESCRIPTION	UNIT	RATE (Rand/Unit)	QUANTITY	AMOUNT (Rand March 1999)	2000 PPI Index 9.2% Rate Excalation	2001 PPI Index 8.4% Rate Excalation	2002 PPI Index 14.2% Rate Excalation	2003 PPI Index 1.7% Rate Excalation	2004 PPI Index 0.6% Rate Excalation	2005 PPI Index 3.1% Rate Excalation	2006 PPI Index 7.7% Rate Excalation	AMOUNT (Rand March 2006)
1	Site & basin clearing												
	(a) Sparse	ha	2,125	0.50	1,062.50	2,320.50	2,515.42	2,872.61	2,921.45	2,938.98	3,030.08	3,263.40	1,631.70
	(b) Bush	ha	6,374	0.15	956.10	6,960.41	7,545.08	8,616.48	8,762.96	8,815.54	9,088.82	9,788.66	1,468.30
	(c) Trees	ha	10,623	0.15	1,593.45	11,600.32	12,574.74	14,360.36	14,604.48	14,692.11	15,147.56	16,313.93	2,447.09
2	River diversion	Sum			50,000	0	0	0	0	0	0	0	0
3	Excavation												
	(a) Soft Excavation	m ³	15	19,500	292,500	16	18	20	21	21	21	23	449,197
	(b) Hard Excavation	m ³	27	6,830	184,410	29	32	36	37	37	38	41	283,202
	(c) Foundation Preparation	m ³	27	4,800	129,600	29	32	36	37	37	38	41	199,029
4	Drilling and Grouting												
	(a) Curtain Grouting	m	170	2,100	357,000	186	201	230	234	235	242	261	548,251
	(b) Consolidation Grouting	m	170	0	0	186	201	230	234	235	242	261	0
5	Formwork												
	(a) Straight	m ²	76	9,820	746,320	83	90	103	104	105	108	117	1,146,137
	(b) Curved	m ²	121	1,160	140,360	132	143	164	166	167	173	186	215,553
6	Concrete												
	(a) Rollcrete	m ³	245	34,570	8,469,650	268	290	331	337	339	349	376	13,006,990
	(b) Skin	m ³	300	6,100	1,830,000	328	355	406	412	415	428	461	2,810,363
	(c) Mass	m ³	276	2,240	618,240	301	327	373	379	382	394	424	949,442
	(d) Structural	m ³	355	6,240	2,215,200	388	420	480	488	491	506	545	3,401,921
7	Reinforcing	t	3,794	215	815,710	4,143	4,491	5,129	5,216	5,247	5,410	5,827	1,252,700
8	Fencing	km	10,623	1	10,623	11,600	12,575	14,360	14,604	14,692	15,148	16,314	16,314
9	Mechanical Items	%	10(Civil)		1,600,000								2,428,465
	SUB TOTAL				17,463,225								26,713,111
10	Landscaping (% of 1-9)	%	5		873,161								1,335,656
5	Miscellaneous (% of 1-9)	%	10		1,746,323								2,671,311
	SUB TOTAL A				20,082,709								33,148,542
6	Preliminary Works (% of Subtotal A)	%	30		6,024,813								9,944,563
7	Preliminary Works												
	(a) Access road	km	90,000	3	270,000	98,280	106,536	121,664	123,732	124,474	128,333	138,215	414,644
	(b) Electricity to Site	km	50,000	1	50,000	54,600	59,186	67,591	68,740	69,152	71,296	76,786	76,786
	(c) Water to site (construction & potable)	sum	20,000	1	20,000	21,840	23,675	27,036	27,496	27,661	28,518	30,714	30,714
8	Accommodation												
	(a) Permanent		Included in P&G										
	(b) Temporary												
	SUB TOTAL B				26,447,521								43,615,248
9	Contingencies (% of Subtotal B)	%	10		2,644,752								4,361,525
	SUB TOTAL C				29,092,274								47,976,773
10	Planning Design & Supervision, Fees, Time Cost & Transport (% of Subtotal C)	%	15		4,363,841								7,196,516
	SUB TOTAL D				33,456,115								55,173,289
11	VAT (% of Subtotal D)	%	14		4,683,856								7,724,260
	NET PROJECT COST				38,139,971								62,897,550
12	Cost of Relocations				0								
13	Cost Land Acquisition	m	750,000	1	750,000	819,000.00	887,796.00	1,013,863.03	1,031,098.70	1,037,285.30	1,069,441.14	1,151,788.11	1,151,788.11
	ESTIMATED TOTAL COST				38,889,971								64,049,338

1. RAW WATER GRAVITY MAIN from Zalu dam outlet to WTW: Option 1: GRAVITY MAIN						Base Date March 2006							
Raw water GRAVITY main from NEW ZALU Dam to existing WTW						2000 PPI Index	2001 PPI Index	2002 PPI Index	2003 PPI Index	2004 PPI Index	2005 PPI Index	2006 PPI Index	AMOUNT
No.	DESCRIPTION	UNIT	RATE	QUANTITY	TOTAL April 1999	9.2% Rate Escalation	8.4% Rate Escalation	14.2% Rate Escalation	1.7% Rate Escalation	0.6% Rate Escalation	3.1% Rate Escalation	7.7% Rate Escalation	(Rand March 2006)
1	SITE CLEARANCE												
	Clear and grub	ha	1,400	6	8,120	1,529	1,657	1,893	1,925	1,936	1,996	2,150	12,470
	Transport materials to unspecified sites and dump	m ³ km	5	50	250	5	6	7	7	7	7	8	384
	Remove topsoil to nominal depth of 150mm and stockpile	m ³	45	834	37,517	49	53	61	62	62	64	69	57,615
2	EARTHWORKS (PIPE TRENCHES)												
	<i>Excavation in all materials, backfill & compaction</i>												
	Exceeding 0m but not exceeding 1.0m	m	10	0	0	11	12	14	14	14	14	16	0
	Exceeding 1.0m but not exceeding 2.0m	m	20	5,529	111,133	22	24	27	28	28	29	31	170,669
	Exceeding 2.0m but not exceeding 3.0m	m	26	291	7,566	28	31	35	36	36	37	40	11,619
	<i>Excavation</i>					0	0	0	0	0	0	0	0
	Intermediate excavation	m ³	60	7,857	471,420	66	71	81	82	83	86	92	723,968
	Hard rock excavation	m ³	120	524	62,856	131	142	162	165	166	171	184	96,529
	Excavate and dispose of unsuitable material from trench bottom (provisional)	m ³	60	139	8,340	66	71	81	82	83	86	92	12,808
	<i>Excavation Ancillaries</i>					0	0	0	0	0	0	0	0
	Make up deficiency in backfill material (Provisional)	m ³	23	500	11,255	25	27	30	31	31	32	35	17,284
	Opening up and closing down of designated borrow pit	No.	2,000	6	12,000	2,184	2,367	2,704	2,750	2,766	2,852	3,071	18,429
	Compaction in road reserves	m ³	15	26	387	16	18	20	21	21	21	23	594
	<i>Finishing</i>					0	0	0	0	0	0	0	0
	Reinstate road surfaces		20	86	1,720	22	24	27	27	28	29	31	2,641
3	MEDIUM PRESSURE PIPELINES					0	0	0	0	0	0	0	0
	<i>Supply, lay and bed pipes and bends complete with couplings</i>												
	500 mm NB class 9 mPVC pipe	m	642	5,820	3,734,461	701	760	867	882	887	915	985	5,735,077
	500 mm NB class 12 mPVC pipe	m	0	0	0	0	0	0	0	0	0	0	0
	500 mm NB class 16 mPVC pipe	m	0	0	0	0	0	0	0	0	0	0	0
	<i>Valves & chambers</i>					0	0	0	0	0	0	0	0
	50 mm air valve installation complete with chamber & manhole	No.	6,000	12	72,000	6,552	7,102	8,111	8,249	8,298	8,556	9,214	110,572
	80 mm scour valve installation complete with chamber & manhole	No.	2,750	12	33,000	3,003	3,255	3,717	3,781	3,803	3,921	4,223	50,679
	Install Anchor / Thrust blocks	No.	800	14	11,520	874	947	1,081	1,100	1,106	1,141	1,229	17,691
	Supply and install PI and route markers	No.	60	24	1,440	66	71	81	82	83	86	92	2,211
4	BEDDING (PIPES)					0	0	0	0	0	0	0	0
	<i>Provision of bedding</i>												
	Selected fill material	m ³	60	3,620	217,218	66	71	81	82	83	86	92	333,585
	Concrete bedding (cradle)	m ³	800	36	28,960	874	947	1,081	1,100	1,106	1,141	1,229	44,474
	SUB TOTAL (A)				4,831,162								7,419,300
	MISCELLANEOUS												
	(% of sub total A)	%	10		483,116								741,930
	PRELIMINARY & GENERAL												
	(% of sub total A)	%	30		1,449,349								2,225,790
	PRELIMINARY WORKS												
	(a) Access road	km	100,000	0	30,000	109,200	118,373	135,182	137,480	138,305	142,592	153,572	46,072
	SUB TOTAL B				6,793,627								10,433,092
	CONTINGENCIES												
	(% of sub total B)	%	10		679,363								1,043,309
	SUB-TOTAL C				7,472,990								11,476,401
	PLANNING DESIGN & SUPERVISION												
	(% of sub total C)	%	15		1,120,948								1,721,460
	SUB TOTAL D				8,593,938								13,197,861
	VAT (% of sub total D)	%	14		1,203,151								1,847,701
	NETT PROJECT COST				9,797,089								15,045,561
	Cost of relocations	Sum	0		0	0	0	0	0	0	0	0	0
	Cost of land acquisition	m ²	10	34,920	349,200	11	12	14	14	14	14	15	536,273
	ESTIMATED TOTAL COST				10,146,289								15,581,834

						Base Date March 2006							
2. RAW WATER PUMP STATION at Zalu dam: Option 1.1 New RWPS at ZALU Dam Site						2000 PPI Index 9.2% Total Excalation	2001 PPI Index 8.4% Total Excalation	2002 PPI Index 14.2% Total Excalation	2003 PPI Index 1.7% Total Excalation	2004 PPI Index 0.6% Total Excalation	2005 PPI Index 3.1% Total Excalation	2006 PPI Index 7.7% Total Excalation	AMOUNT (Rand March 2006)
No.	DESCRIPTION	UNIT	RATE	QUANTITY	TOTAL								
1	MECHANICAL				142,400	155,501	168,563	192,499	195,771	196,946	203,051	218,686	218,686
	Pumps & motors	sum	85,440		85,440								
	Valves & fittings	sum	35,600		35,600								
	Pipework	sum	21,360		21,360								
2	ELECTRICAL	sum	56,960		56,960	62,200	67,425	77,000	78,309	78,778	81,220	87,474	87,474
3	CIVILS	sum	104,427		104,427	114,034	123,613	141,166	143,566	144,427	148,904	160,370	160,370
	MISCELLANEOUS												
	(% of items 1 to 3)	%	10		30,377	33,171	35,958	41,064	41,762	42,012	43,315	46,650	46,650
	SUB-TOTAL A				334,163	364,906	395,559	451,728	459,407	462,164	476,491	513,180	513,180
4	PRELIMINARY & GENERAL												
	(% of sub total A)	%	20		66,833	72,981	79,112	90,346	91,881	92,433	95,298	102,636	102,636
5	PRELIMINARY WORKS												
	(a) Access road	km	100,000	0	0	0	0	0	0	0	0	0	0
	SUB TOTAL B				400,996	437,888	474,670	542,073	551,289	554,596	571,789	615,817	615,817
	CONTINGENCIES												
	(% of sub total B)	%	15		60,149	65,683	71,201	81,311	82,693	83,189	85,768	92,372	92,372
	SUB-TOTAL C				461,145	503,571	545,871	623,384	633,982	637,786	657,557	708,189	708,189
6	PLANNING DESIGN & SUPERVISION												
	(% of sub total C)	%	15		69,172	75,536	81,881	93,508	95,097	95,668	98,634	106,228	106,228
	SUB TOTAL D				530,317	579,106	627,751	716,892	729,079	733,454	756,191	814,417	814,417
	VAT (% of sub total D)	%	14		74,244	81,075	87,885	100,365	102,071	102,684	105,867	114,018	114,018
	NETT PROJECT COST				604,562	660,181	715,637	817,257	831,150	836,137	862,057	928,436	928,436
7	Cost of relocations	Sum	0		0	0	0	0	0	0	0	0	0
8	Cost of land acquisition	m ²	10	225	2,250	2,457	2,663	3,042	3,093	3,112	3,208	3,455	3,455
	ESTIMATED TOTAL COST				606,812	662,638	718,300	820,299	834,244	839,249	865,266	931,891	931,891

3. RAW WATER PUMP STATION AT LUSIKISIKI WEIR: Options 1.2, 2, IMMEDIATE AUGMENTATION Upgrade Existing RWPS							Base Date Mrch 2006							
No.	PAY REF	DESCRIPTION	UNIT	RATE	QUANTITY	TOTAL	2000 PPI Index 9.2% Total Excalation	2001 PPI Index 8.4% Total Excalation	2002 PPI Index 14.2% Total Excalation	2003 PPI Index 1.7% Total Excalation	2004 PPI Index 0.6% Total Excalation	2005 PPI Index 3.1% Total Excalation	2006 PPI Index 7.7% Total Excalation	AMOUNT (Rand March 2006)
1		MECHANICAL				R 165,733.33	180,981	196,183	224,041	227,850	229,217	236,323	254,520	254,520
		Pumps & motors	sum	99,440.00		R 99,440.00	108,588	117,710	134,425	136,710	137,530	141,794	152,712	152,712
		Valves & fittings	sum	41,433.33		R 41,433.33	45,245	49,046	56,010	56,962	57,304	59,081	63,630	63,630
		Pipework	sum	24,860.00		R 24,860.00	27,147	29,427	33,606	34,177	34,383	35,448	38,178	38,178
2		ELECTRICAL	sum	66,293.33		R 66,293.33	72,392	78,473	89,616	91,140	91,687	94,529	101,808	101,808
3		CIVILS	sum	66,293.33		R 66,293.33	72,392	78,473	89,616	91,140	91,687	94,529	101,808	101,808
4		MISCELLANEOUS												
		(% of items 1 to 3)	%	10.00		R 29,832.00	32,577	35,313	40,327	41,013	41,259	42,538	45,814	45,814
		SUB-TOTAL A				R 328,151.99	358,342	388,443	443,602	451,143	453,850	467,919	503,949	503,949
5		PRELIMINARY & GENERAL					0	0	0	0	0	0	0	0
		(% of sub total A)	%	20.00		R 65,630.40	71,668	77,689	88,720	90,229	90,770	93,584	100,790	100,790
6		PRELIMINARY WORKS												
		(a) Access road	km	100,000.00	0.0	R 0.00	0	0	0	0	0	0	0	0
		SUB TOTAL B				R 393,782.39	430,010	466,131	532,322	541,371	544,620	561,503	604,738	604,738
		CONTINGENCIES												
		(% of sub total B)	%	15.00		R 59,067.36	64,502	69,920	79,848	81,206	81,693	84,225	90,711	90,711
		SUB-TOTAL C				R 452,849.75	494,512	536,051	612,170	622,577	626,313	645,728	695,449	695,449
7		PLANNING DESIGN & SUPERVISION												
		(% of sub total C)	%	15.00		R 67,927.46	74,177	80,408	91,826	93,387	93,947	96,859	104,317	104,317
		SUB TOTAL D				R 520,777.21	568,689	616,459	703,996	715,964	720,259	742,587	799,767	799,767
		VAT (% of sub total D)	%	14.00		R 72,908.81	79,616	86,304	98,559	100,235	100,836	103,962	111,967	111,967
		NETT PROJECT COST				R 593,686.02	648,305	702,763	802,555	816,199	821,096	846,550	911,734	911,734
8		Cost of relocations	Sum	0.00		R 0.00	0	0	0	0	0	0	0	0
9		Cost of land acquisition	m ²	10.00	225.0	R 2,250.00	2,457	2,663	3,042	3,093	3,112	3,208	3,455	3,455
		ESTIMATED TOTAL COST				R 595,936.02	650,762	705,426	805,597	819,292	824,208	849,758	915,189	915,189

Base Date March 2006													
4. RAW WATER RISING MAIN from Zalu outlet to WTW: Option 1.1													
Raw water RISING MAIN from NEW ZALU RWPS to existing WTW													
No.	DESCRIPTION	UNIT	RATE	QUANTITY	TOTAL	2000 PPI Index 9.2% Total Excavation	2001 PPI Index 8.4% Total Excavation	2002 PPI Index 14.2% Total Excavation	2003 PPI Index 1.7% Total Excavation	2004 PPI Index 0.6% Total Excavation	2005 PPI Index 3.1% Total Excavation	2006 PPI Index 7.7% Total Excavation	AMOUNT (Rand March 2006)
1	SITE CLEARANCE												
	Clear and grub	ha	1,400.00	5.3	R 7,420.00	8,103	8,783	10,030	10,201	10,262	10,580	11,395	11,395
	Transport materials to unspecified sites and dump	m ³ km	5.00	50.0	R 250.00	273	296	338	344	346	356	384	384
	Remove topsoil to nominal depth of 150mm and stockpile	m ³	45.00	759.2	R 34,164.00	37,307	40,441	46,183	46,969	47,250	48,715	52,466	52,466
2	EARTHWORKS (PIPE TRENCHES)												
	<i>Excavation in all materials, backfill & compaction</i>												
	Exceeding 0 m but not exceeding 1.0 m	m	10.10	0.0	R 0.00	0	0	0	0	0	0	0	0
	Exceeding 1.0 m but not exceeding 2.0 m	m	20.10	5,035.0	R 101,203.50	110,514	119,797	136,809	139,134	139,969	144,308	155,420	155,420
	Exceeding 2.0 m but not exceeding 3.0 m	m	26.00	265.0	R 6,890.00	7,524	8,156	9,314	9,472	9,529	9,825	10,581	10,581
	<i>Excavation</i>												
	Intermediate excavation	m ³	60.00	7,155.0	R 429,300.00	468,796	508,174	580,335	590,201	593,742	612,148	659,284	659,284
	Hard rock excavation	m ³	120.00	477.0	R 57,240.00	62,506	67,757	77,378	78,693	79,166	81,620	87,904	87,904
	Excavate and dispose of unsuitable material from trench bottom (provisional)		60.00	126.5	R 7,590.00	8,288	8,984	10,260	10,435	10,497	10,823	11,656	11,656
	<i>Excavation Ancillaries</i>												
	Make up deficiency in backfill material (Provisional)	m ³	22.50	455.5	R 10,248.75	11,192	12,132	13,854	14,090	14,175	14,614	15,739	15,739
	Opening up and closing down of designated borrow pit	No.	2,000.00	6.0	R 12,000.00	13,104	14,205	16,222	16,498	16,597	17,111	18,429	18,429
	Compaction in road reserves	m ³	15.00	25.8	R 387.00	423	458	523	532	535	552	594	594
	<i>Finishing</i>												
	Reinstate road surfaces	m ³	20.00	86.0	R 1,720.00	1,878	2,036	2,325	2,365	2,379	2,453	2,641	2,641
3	MEDIUM PRESSURE PIPELINES												
	Supply, lay and bed pipes and bends complete with couplings for												
	315 mm NB class 9 mPVC pipe	m	261.00	1,600.0	R 417,600.00	456,019	494,325	564,519	574,116	577,560	595,465	641,316	641,316
	315 mm NB class 9 mPVC pipe	m	332.00	3,700.0	R 1,228,400.00	1,341,413	1,454,091	1,660,572	1,688,802	1,698,935	1,751,602	1,886,475	1,886,475
	<i>Valves & chambers</i>												
	50 mm air valve installation complete with chamber & manhole	No.	6,000.00	11.0	R 66,000.00	72,072	78,126	89,220	90,737	91,281	94,111	101,357	101,357
	80 mm scour valve installation complete with chamber	No.	2,750.00	11.0	R 30,250.00	33,033	35,808	40,892	41,588	41,837	43,134	46,455	46,455
	Install Anchor / Thrust blocks	No.	800.00	13.2	R 10,560.00	11,532	12,500	14,275	14,518	14,605	15,058	16,217	16,217
	Supply and install PI and route markers	No.	60.00	22.0	R 1,320.00	1,441	1,563	1,784	1,815	1,826	1,882	2,027	2,027
4	BEDDING (PIPES)												
	<i>Provision of bedding</i>												
	Selected fill material	m ³	60.00	3,296.8	R 197,808.00	216,006	234,151	267,400	271,946	273,578	282,059	303,777	303,777
	Concrete bedding (cradle)	m ³	800.00	33.0	R 26,400.00	28,829	31,250	35,688	36,295	36,512	37,644	40,543	40,543
	SUB TOTAL (A)				R 2,646,751.25	2,890,252	3,133,034	3,577,924	3,638,749	3,660,582	3,774,060	4,064,662	4,064,662
5	MISCELLANEOUS												
	(% of sub total)	%	10.00		R 264,675.13	289,025	313,303	357,792	363,875	366,058	377,406	406,466	406,466
6	PRELIMINARY & GENERAL												
	(% of sub total A)	%	30.00		R 794,025.38	867,076	939,910	1,073,377	1,091,625	1,098,174	1,132,218	1,219,399	1,219,399
7	PRELIMINARY WORKS												
	(a) Access road	km	100,000.00	0.3	R 30,000.00	32,760	35,512	40,555	41,244	41,491	42,778	46,072	46,072
	SUB TOTAL B				R 3,735,451.75	4,079,113	4,421,759	5,049,649	5,135,493	5,166,306	5,326,461	5,736,599	5,736,599
	CONTINGENCIES												
	(% of sub total B)	%	10.00		R 373,545.18	407,911	442,176	504,965	513,549	516,631	532,646	573,660	573,660
	SUB-TOTAL C				R 4,108,996.93	4,487,025	4,863,935	5,554,613	5,649,042	5,682,936	5,859,107	6,310,258	6,310,258
8	PLANNING DESIGN & SUPERVISION												
	(% of sub total C)	%	15.00		R 616,349.54	673,054	729,590	833,192	847,356	852,440	878,866	946,539	946,539
	SUB TOTAL D				R 4,725,346.46	5,160,078	5,593,525	6,387,805	6,496,398	6,535,377	6,737,973	7,256,797	7,256,797
	VAT (% of sub total D)	%	14.00		R 661,548.50	722,411	783,093	894,293	909,496	914,953	943,316	1,015,952	1,015,952
	NETT PROJECT COST				R 5,386,894.97	5,882,489	6,376,618	7,282,098	7,405,894	7,450,329	7,681,289	8,272,749	8,272,749
9	Cost of relocations	Sum	0.00		R 0.00	0	0	0	0	0	0	0	0
10	Cost of land acquisition	m ²	10.00	31,800.0	R 318,000.00	347,256	376,426	429,878	437,186	439,809	453,443	488,358	488,358
	ESTIMATED TOTAL COST				R 5,704,894.97	6,229,745	6,753,044	7,711,976	7,843,080	7,890,138	8,134,733	8,761,107	8,761,107

5. RWRM: Options 1.2, IMMEDIATE AUGMENTATION from existing Lusikisiki weir to WTW						Base Date March 2006							
No.	DESCRIPTION	UNIT	RATE	QUANTITY	TOTAL	2000 PPI Index 9.2% Total Excavation	2001 PPI Index 8.4% Total Excavation	2002 PPI Index 14.2% Total Excavation	2003 PPI Index 1.7% Total Excavation	2004 PPI Index 0.6% Total Excavation	2005 PPI Index 3.1% Total Excavation	2006 PPI Index 7.7% Total Excavation	AMOUNT (Rand March 2006)
1	SITE CLEARANCE												
	Clear and grub	ha	1,400.00	0.7	R 980.00	1,070	1,160	1,325	1,347	1,355	1,397	1,505	1,505
	Transport materials to unspecified sites and dump	m ³ km	5.00	50.0	R 250.00	273	296	338	344	346	356	384	384
	Remove topsoil to nominal depth of 150mm and stockpile	m ³	45.00	96.0	R 4,320.00	4,717	5,114	5,840	5,939	5,975	6,160	6,634	6,634
2	EARTHWORKS (PIPE TRENCHES)												
	<i>Excavation in all materials, backfill & compaction</i>												
	Exceeding 0 m but not exceeding 1.0 m	m	10.10	0.0	R 0.00	0	0	0	0	0	0	0	0
	Exceeding 1.0 m but not exceeding 2.0 m	m	20.10	636.5	R 12,793.65	13,971	15,144	17,295	17,589	17,694	18,243	19,647	19,647
	Exceeding 2.0 m but not exceeding 3.0 m	m	26.00	33.5	R 871.00	951	1,031	1,177	1,197	1,205	1,242	1,338	1,338
	<i>Excavation</i>												
	Intermediate excavation	m ³	60.00	904.5	R 54,270.00	59,263	64,241	73,363	74,610	75,058	77,385	83,343	83,343
	Hard rock excavation	m ³	120.00	60.3	R 7,236.00	7,902	8,565	9,782	9,948	10,008	10,318	11,112	11,112
	Excavate and dispose of unsuitable material from trench bottom (provisional)	m ³	60.00	16.0	R 960.00	1,048	1,136	1,298	1,320	1,328	1,369	1,474	1,474
	<i>Excavation Ancillaries</i>												
	Make up deficiency in backfill material (Provisional)	m ³	22.50	57.6	R 1,296.00	1,415	1,534	1,752	1,782	1,792	1,848	1,990	1,990
	Opening up and closing down of designated borrow pit	No.	2,000.00	1.0	R 2,000.00	2,184	2,367	2,704	2,750	2,766	2,852	3,071	3,071
	Compaction in road reserves	m ³	15.00	25.8	R 387.00	423	458	523	532	535	552	594	594
	<i>Finishing</i>												
	Reinstate road surfaces	m ³	20.00	86.0	R 1,720.00	1,878	2,036	2,325	2,365	2,379	2,453	2,641	2,641
3	MEDIUM PRESSURE PIPELINES												
	Supply, lay and bed pipes and bends complete with couplings for												
	355 mm NB class 9 mPVC pipe	m	332.00	275.0	R 91,300.00	99,700	108,074	123,421	125,519	126,272	130,187	140,211	140,211
	355 mm NB class 12 mPVC pipe	m	429.00	395.0	R 169,455.00	185,045	200,589	229,072	232,966	234,364	241,630	260,235	260,235
	355 mm NB class 16 mPVC pipe	m	542.00	0.0	R 0.00	0	0	0	0	0	0	0	0
	<i>Valves & chambers</i>												
	50 mm air valve installation complete with chamber & manhole	No.	6,000.00	2.0	R 12,000.00	13,104	14,205	16,222	16,498	16,597	17,111	18,429	18,429
	80 mm scour valve installation complete with chamber	No.	2,750.00	2.0	R 5,500.00	6,006	6,511	7,435	7,561	7,607	7,843	8,446	8,446
	Install Anchor / Thrust blocks	No.	800.00	1.8	R 1,440.00	1,572	1,705	1,947	1,980	1,992	2,053	2,211	2,211
	Supply and install PI and route markers	No.	60.00	3.0	R 180.00	197	213	243	247	249	257	276	276
4	BEDDING (PIPES)												
	<i>Provision of bedding</i>												
	Selected fill material	m ³	60.00	416.8	R 25,008.00	27,309	29,603	33,806	34,381	34,587	35,659	38,405	38,405
	Concrete bedding (cradle)	m ³	800.00	4.2	R 3,360.00	3,669	3,977	4,542	4,619	4,647	4,791	5,160	5,160
	SUB TOTAL A				R 395,326.65	431,697	467,959	534,409	543,494	546,755	563,705	607,110	607,110
5	MISCELLANEOUS												
	(% of sub total)	%	10.00		R 39,532.67	43,170	46,796	53,441	54,349	54,676	56,370	60,711	60,711
6	PRELIMINARY & GENERAL												
	(% of sub total A)	%	30.00		R 118,598.00	129,509	140,388	160,323	163,048	164,027	169,111	182,133	182,133
7	PRELIMINARY WORKS												
	(a) Access road	km	100,000.00	0.1	R 10,000.00	10,920	11,837	13,518	13,748	13,830	14,259	15,357	15,357
	SUB TOTAL B				R 563,457.31	615,295	666,980	761,691	774,640	779,288	803,446	865,311	865,311
	CONTINGENCIES												
	(% of sub total B)	%	10.00		R 56,345.73	61,530	66,698	76,169	77,464	77,929	80,345	86,531	86,531
	SUB-TOTAL C				R 619,803.04	676,825	733,678	837,861	852,104	857,217	883,790	951,842	951,842
8	PLANNING DESIGN & SUPERVISION												
	(% of sub total C)	%	15.00		R 92,970.46	101,524	110,052	125,679	127,816	128,583	132,569	142,776	142,776
	SUB TOTAL D				R 712,773.50	778,349	843,730	963,540	979,920	985,799	1,016,359	1,094,619	1,094,619
	VAT (% of sub total D)	%	14.00		R 99,788.29	108,969	118,122	134,896	137,189	138,012	142,290	153,247	153,247
	NETT PROJECT COST				R 812,561.79	887,317	961,852	1,098,435	1,117,109	1,123,811	1,158,649	1,247,865	1,247,865
9	Cost of relocations	Sum	0.00		R 0.00	0	0	0	0	0	0	0	0
10	Cost of land acquisition	m ²	10.00	4,020.0	R 40,200.00	43,898	47,586	54,343	55,267	55,598	57,322	61,736	61,736
	ESTIMATED TOTAL COST				R 852,761.79	931,216	1,009,438	1,152,778	1,172,375	1,179,410	1,215,971	1,309,601	1,309,601

6. RAW WATER RISING MAIN from Lusikisiki dam outlet to WTW: Option 2						Base Date March 2006							
Raw water RISING main from NEW RWPS to existing WTW						2000 PPI Index 9.2% Total Excalation	2001 PPI Index 8.4% Total Excalation	2002 PPI Index 14.2% Total Excalation	2003 PPI Index 1.7% Total Excalation	2004 PPI Index 0.6% Total Excalation	2005 PPI Index 3.1% Total Excalation	2006 PPI Index 7.7% Total Excalation	AMOUNT (Rand March 2006)
No.	DESCRIPTION	UNIT	RATE	QUANTITY	TOTAL								
1	SITE CLEARANCE												
	Clear and grub	ha	1,400.00	1.6	R 2,240.00	2,446	2,652	3,028	3,080	3,098	3,194	3,440	3,440
	Transport materials to unspecified sites and dump	m ³ km	5.00	50.0	R 250.00	273	296	338	344	346	356	384	384
	Remove topsoil to nominal depth of 150mm and stockpile	m ³	45.00	223.5	R 10,057.50	10,983	11,905	13,596	13,827	13,910	14,341	15,445	15,445
2	EARTHWORKS (PIPE TRENCHES)					0	0	0	0	0	0	0	0
	<i>Excavation in all materials, backfill & compaction</i>					0	0	0	0	0	0	0	0
	Exceeding 0 m but not exceeding 1.0 m	m	10.10	0.0	R 0.00	0	0	0	0	0	0	0	0
	Exceeding 1.0 m but not exceeding 2.0 m	m	20.10	1,482.0	R 29,788.20	32,529	35,261	40,268	40,953	41,198	42,476	45,746	45,746
	Exceeding 2.0 m but not exceeding 3.0 m	m	26.00	78.0	R 2,028.00	2,215	2,401	2,741	2,788	2,805	2,892	3,114	3,114
	<i>Excavation</i>					0	0	0	0	0	0	0	0
	Intermediate excavation	m ³	60.00	2,106.0	R 126,360.00	137,985	149,576	170,816	173,720	174,762	180,179	194,053	194,053
	Hard rock excavation	m ³	120.00	140.4	R 16,848.00	18,398	19,943	22,775	23,163	23,302	24,024	25,874	25,874
	Excavate and dispose of unsuitable material from trench bottom (provisional)	m ³	60.00	37.2	R 2,232.00	2,437	2,642	3,017	3,069	3,087	3,183	3,428	3,428
	<i>Excavation Ancillaries</i>					0	0	0	0	0	0	0	0
	Make up deficiency in backfill material (Provisional)	m ³	22.50	134.1	R 3,017.25	3,295	3,572	4,079	4,148	4,173	4,302	4,634	4,634
	Opening up and closing down of designated borrow pit	No.	2,000.00	2.0	R 4,000.00	4,368	4,735	5,407	5,499	5,532	5,704	6,143	6,143
	Compaction in road reserves	m ³	15.00	25.8	R 387.00	423	458	523	532	535	552	594	594
	<i>Finishing</i>					0	0	0	0	0	0	0	0
	Reinstate road surfaces	m ³	20.00	86.0	R 1,720.00	1,878	2,036	2,325	2,365	2,379	2,453	2,641	2,641
3	MEDIUM PRESSURE PIPELINES					0	0	0	0	0	0	0	0
	Supply, lay and bed pipes and bends complete with couplings for					0	0	0	0	0	0	0	0
	355 mm NB class 9 mPVC pipe	m	332.00	575.0	R 190,900.00	208,463	225,974	258,062	262,449	264,024	272,208	293,168	293,168
	355 mm NB class 12 mPVC pipe	m	429.00	985.0	R 422,565.00	461,441	500,202	571,231	580,942	584,427	602,545	648,940	648,940
	355 mm NB class 16 mPVC pipe	m	542.00	0.0	R 0.00	0	0	0	0	0	0	0	0
	<i>Valves & chambers</i>					0	0	0	0	0	0	0	0
	50 mm air valve installation complete with chamber & manhole	No.	6,000.00	4.0	R 24,000.00	26,208	28,409	32,444	32,995	33,193	34,222	36,857	36,857
	80 mm scour valve installation complete with chamber	No.	2,750.00	4.0	R 11,000.00	12,012	13,021	14,870	15,123	15,214	15,685	16,893	16,893
	Install Anchor / Thrust blocks	No.	800.00	4.2	R 3,360.00	3,669	3,977	4,542	4,619	4,647	4,791	5,160	5,160
	Supply and install PI and route markers	No.	60.00	7.0	R 420.00	459	497	568	577	581	599	645	645
4	BEDDING (PIPES)					0	0	0	0	0	0	0	0
	<i>Provision of bedding</i>					0	0	0	0	0	0	0	0
	Selected fill material	m ³	60.00	970.4	R 58,224.00	63,581	68,921	78,708	80,046	80,527	83,023	89,416	89,416
	Concrete bedding (cradle)	m ³	800.00	9.7	R 7,760.00	8,474	9,186	10,490	10,668	10,732	11,065	11,917	11,917
	SUB TOTAL (A)				R 917,156.95	1,001,535	1,085,664	1,239,829	1,260,906	1,268,471	1,307,794	1,408,494	1,408,494
5	MISCELLANEOUS					0	0	0	0	0	0	0	0
	(% of sub total)	%	10.00		R 91,715.70	100,154	108,566	123,983	126,091	126,847	130,779	140,849	140,849
6	PRELIMINARY & GENERAL					0	0	0	0	0	0	0	0
	(% of sub total A)	%	30.00		R 275,147.09	300,461	325,699	371,949	378,272	380,541	392,338	422,548	422,548
7	PRELIMINARY WORKS					0	0	0	0	0	0	0	0
	(a) Access road	km	100,000.00	0.1	R 10,000.00	10,920	11,837	13,518	13,748	13,830	14,259	15,357	15,357
	SUB TOTAL B				R 1,294,019.73	1,413,070	1,531,767	1,749,278	1,779,016	1,789,690	1,845,171	1,987,249	1,987,249
	CONTINGENCIES					0	0	0	0	0	0	0	0
	(% of sub total B)	%	10.00		R 129,401.97	141,307	153,177	174,928	177,902	178,969	184,517	198,725	198,725
	SUB-TOTAL C				R 1,423,421.70	1,554,376	1,684,944	1,924,206	1,956,918	1,968,659	2,029,688	2,185,974	2,185,974
8	PLANNING DESIGN & SUPERVISION					0	0	0	0	0	0	0	0
	(% of sub total C)	%	15.00		R 213,513.26	233,156	252,742	288,631	293,538	295,299	304,453	327,896	327,896
	SUB TOTAL D				R 1,636,934.96	1,787,533	1,937,686	2,212,837	2,250,455	2,263,958	2,334,141	2,513,870	2,513,870
	VAT (% of sub total D)	%	14.00		R 229,170.89	250,255	271,276	309,797	315,064	316,954	326,780	351,942	351,942
	NETT PROJECT COST				R 1,866,105.85	2,037,788	2,208,962	2,522,634	2,565,519	2,580,912	2,660,920	2,865,811	2,865,811
9	Cost of relocations	Sum	0.00		R 0.00	0	0	0	0	0	0	0	0
10	Cost of land acquisition	m ²	10.00	9,360.0	R 93,600.00	102,211	110,797	126,530	128,681	129,453	133,466	143,743	143,743
	ESTIMATED TOTAL COST				R 1,959,705.85	2,139,999	2,319,759	2,649,164	2,694,200	2,710,365	2,794,387	3,009,555	3,009,555

7. WATER TREATMENT WORKS: All Options						Base Date March 2006							
Refurbish Existing WTW - Sand Filters Only						Modifications Only i.e. only minor civils							
No.	DESCRIPTION	UNIT	RATE	QUANTITY	TOTAL	2000 PPI Index 9.2% Total Excalation	2001 PPI Index 8.4% Total Excalation	2002 PPI Index 14.2% Total Excalation	2003 PPI Index 1.7% Total Excalation	2004 PPI Index 0.6% Total Excalation	2005 PPI Index 3.1% Total Excalation	2006 PPI Index 7.7% Total Excalation	AMOUNT (Rand March 2006)
1	MECHANICAL				R 1,854,160.00	2,024,743	2,194,821	2,506,486	2,549,096	2,564,391	2,643,887	2,847,466	2,847,466
	Filtration Plant	sum	1,685,600.00		R 1,685,600.00	1,840,675	1,995,292	2,278,623	2,317,360	2,331,264	2,403,533	2,588,605	2,588,605
	Pipework	sum	84,280.00		R 84,280.00	92,034	99,765	113,931	115,868	116,563	120,177	129,430	129,430
	Pumps & motors	sum	84,280.00		R 84,280.00	92,034	99,765	113,931	115,868	116,563	120,177	129,430	129,430
2	ELECTRICAL	sum	370,832.00		R 370,832.00	404,949	438,964	501,297	509,819	512,878	528,777	569,493	569,493
3	CIVILS	sum	92,708.00		R 92,708.00	101,237	109,741	125,324	127,455	128,220	132,194	142,373	142,373
4	MISCELLANEOUS												
	(% of items 1 to 3)	%	10.00		R 231,770.00	253,093	274,353	313,311	318,637	320,549	330,486	355,933	355,933
	SUB-TOTAL A				R 2,549,470.00	2,784,021	3,017,879	3,446,418	3,505,007	3,526,037	3,635,344	3,915,266	3,915,266
5	PRELIMINARY & GENERAL												
	(% of sub total A)	%	20.00		R 509,894.00	556,804	603,576	689,284	701,001	705,207	727,069	783,053	783,053
6	PRELIMINARY WORKS												
	(a) Access road	km	100,000.00	0.1	R 10,000.00	10,920	11,837	13,518	13,748	13,830	14,259	15,357	15,357
	SUB TOTAL B				R 3,069,364.00	3,351,745	3,633,292	4,149,220	4,219,756	4,245,075	4,376,672	4,713,676	4,713,676
	CONTINGENCIES												
	(% of sub total B)	%	15.00		R 460,404.60	502,762	544,994	622,383	632,963	636,761	656,501	707,051	707,051
	SUB-TOTAL C				R 3,529,768.60	3,854,507	4,178,286	4,771,603	4,852,720	4,881,836	5,033,173	5,420,727	5,420,727
7	PLANNING DESIGN & SUPERVISION												
	(% of sub total C)	%	15.00		R 529,465.29	578,176	626,743	715,740	727,908	732,275	754,976	813,109	813,109
	SUB TOTAL D				R 4,059,233.89	4,432,683	4,805,029	5,487,343	5,580,628	5,614,112	5,788,149	6,233,836	6,233,836
	VAT (% of sub total D)	%	14.00		R 568,292.74	620,576	672,704	768,228	781,288	785,976	810,341	872,737	872,737
	NETT PROJECT COST				R 4,627,526.63	5,053,259	5,477,733	6,255,571	6,361,916	6,400,087	6,598,490	7,106,574	7,106,574
8	Cost of relocations	Sum	0.00		R 0.00	0	0	0	0	0	0	0	0
9	Cost of land acquisition	m ²	10.00	0.0	R 0.00	0	0	0	0	0	0	0	0
	ESTIMATED TOTAL COST				R 4,627,526.63	5,053,259	5,477,733	6,255,571	6,361,916	6,400,087	6,598,490	7,106,574	7,106,574

8. CLEAR WATER PUMP STATION at WTW: All Options						Base Date March 2006							
Existing Clear Water Pump Station (Refurbish)						2000 PPI Index 9.2% Total Excalation	2001 PPI Index 8.4% Total Excalation	2002 PPI Index 14.2% Total Excalation	2003 PPI Index 1.7% Total Excalation	2004 PPI Index 0.6% Total Excalation	2005 PPI Index 3.1% Total Excalation	2006 PPI Index 7.7% Total Excalation	AMOUNT (Rand March 2006)
No.	DESCRIPTION	UNIT	RATE	QUANTITY	TOTAL								
1	MECHANICAL				R 183,633.33	200,528	217,372	248,239	252,459	253,974	261,847	282,009	282,009
	Pumps & motors	sum	110,180.00		R 110,180.00	120,317	130,423	148,943	151,475	152,384	157,108	169,205	169,205
	Valves & fittings	sum	45,908.33		R 45,908.33	50,132	54,343	62,060	63,115	63,493	65,462	70,502	70,502
	Pipework	sum	27,545.00		R 27,545.00	30,079	32,606	37,236	37,869	38,096	39,277	42,301	42,301
2	ELECTRICAL	sum	73,453.33		R 73,453.33	80,211	86,949	99,295	100,984	101,589	104,739	112,804	112,804
3	CIVILS	sum	27,545.00		R 27,545.00	30,079	32,606	37,236	37,869	38,096	39,277	42,301	42,301
4	MISCELLANEOUS												
	(% of items 1 to 3)	%	10.00		R 28,463.17	31,082	33,693	38,477	39,131	39,366	40,586	43,711	43,711
	SUB-TOTAL A				R 313,094.83	341,900	370,619	423,247	430,442	433,025	446,449	480,825	480,825
5	PRELIMINARY & GENERAL												
	(% of sub total A)	%	20.00		R 62,618.97	68,380	74,124	84,649	86,088	86,605	89,290	96,165	96,165
6	PRELIMINARY WORKS												
	(a) Access road	km	100,000.00	0.0	R 0.00	0	0	0	0	0	0	0	0
	SUB TOTAL B				R 375,713.80	410,279	444,743	507,896	516,531	519,630	535,738	576,990	576,990
	CONTINGENCIES												
	(% of sub total B)	%	15.00		R 56,357.07	61,542	66,711	76,184	77,480	77,944	80,361	86,549	86,549
	SUB-TOTAL C				R 432,070.87	471,821	511,454	584,081	594,010	597,574	616,099	663,539	663,539
7	PLANNING DESIGN & SUPERVISION												
	(% of sub total C)	%	15.00		R 64,810.63	70,773	76,718	87,612	89,102	89,636	92,415	99,531	99,531
	SUB TOTAL D				R 496,881.50	542,595	588,173	671,693	683,112	687,210	708,514	763,070	763,070
	VAT (% of sub total D)	%	14.00		R 69,563.41	75,963	82,344	94,037	95,636	96,209	99,192	106,830	106,830
	NETT PROJECT COST				R 566,444.90	618,558	670,517	765,730	778,747	783,420	807,706	869,899	869,899
8	Cost of relocations	Sum	0.00		R 0.00	0	0	0	0	0	0	0	0
9	Cost of land acquisition	m ²	10.00	225.0	R 2,250.00	2,457	2,663	3,042	3,093	3,112	3,208	3,455	3,455
	ESTIMATED TOTAL COST				R 568,694.90	621,015	673,180	768,772	781,841	786,532	810,914	873,355	873,355

9. CLEAR WATER RISING MAIN from WTW to Reservoir A: All Options						Base Date March 2006							
NEW Clear Water RISING Main from existing WTW to Reservoir A						2000 PPI Index 9.2% Total Excalation	2001 PPI Index 8.4% Total Excalation	2002 PPI Index 14.2% Total Excalation	2003 PPI Index 1.7% Total Excalation	2004 PPI Index 0.6% Total Excalation	2005 PPI Index 3.1% Total Excalation	2006 PPI Index 7.7% Total Excalation	AMOUNT (Rand March 2006)
No.	DESCRIPTION	UNIT	RATE	QUANTITY	TOTAL								
1	SITE CLEARANCE												
	Clear and grub	ha	1,400.00	1.6	R 2,240.00	2,446	2,652	3,028	3,080	3,098	3,194	3,440	3,440
	Transport materials to unspecified sites and dump	m ³ km	5.00	50.0	R 250.00	273	296	338	344	346	356	384	384
	Remove topsoil to nominal depth of 150mm and stockpile	m ³	45.00	304.5	R 13,702.50	14,963	16,220	18,523	18,838	18,951	19,539	21,043	21,043
2	EARTHWORKS (PIPE TRENCHES)												
	<i>Excavation in all materials, backfill & compaction</i>												
	Exceeding 0 m but not exceeding 1.0 m	m	10.10	0.0	R 0.00	0	0	0	0	0	0	0	0
	Exceeding 1.0 m but not exceeding 2.0 m	m	20.10	2,019.7	R 40,595.97	44,331	48,055	54,878	55,811	56,146	57,887	62,344	62,344
	Exceeding 2.0 m but not exceeding 3.0 m	m	26.00	106.3	R 2,763.80	3,018	3,272	3,736	3,800	3,822	3,941	4,244	4,244
	<i>Excavation</i>												
	Intermediate excavation	m ³	60.00	2,870.1	R 172,206.00	188,049	203,845	232,791	236,749	238,169	245,552	264,460	264,460
	Hard rock excavation	m ³	120.00	191.3	R 22,956.00	25,068	27,174	31,032	31,560	31,749	32,733	35,254	35,254
	Excavate and dispose of unsuitable material from trench bottom (provisional)	m ³	60.00	50.8	R 3,048.00	3,328	3,608	4,120	4,190	4,216	4,346	4,681	4,681
	<i>Excavation Ancillaries</i>												
	Make up deficiency in backfill material (Provisional)	m ³	22.50	182.7	R 4,110.75	4,489	4,866	5,557	5,651	5,685	5,862	6,313	6,313
	Opening up and closing down of designated borrow pit	No.	2,000.00	3.0	R 6,000.00	6,552	7,102	8,111	8,249	8,298	8,556	9,214	9,214
	Compaction in road reserves	m ³	15.00	25.8	R 387.00	423	458	523	532	535	552	594	594
	<i>Finishing</i>												
	Reinstate road surfaces	m ³	20.00	86.0	R 1,720.00	1,878	2,036	2,325	2,365	2,379	2,453	2,641	2,641
3	MEDIUM PRESSURE PIPELINES												
	Supply, lay and bed pipes and bends complete with couplings for												
	355 mm NB class 9 mPVC pipe	m	332.00	916.0	R 304,112.00	332,090	359,986	411,104	418,093	420,601	433,640	467,030	467,030
	355 mm NB class 12 mPVC pipe	m	429.00	450.0	R 193,050.00	210,811	228,519	260,968	265,405	266,997	275,274	296,470	296,470
	355 mm NB class 16 mPVC pipe	m	542.00	760.0	R 411,920.00	449,817	487,601	556,841	566,307	569,705	587,366	632,593	632,593
	<i>Valves & chambers</i>												
	50 mm air valve installation complete with chamber & manhole	No.	6,000.00	5.0	R 30,000.00	32,760	35,512	40,555	41,244	41,491	42,778	46,072	46,072
	80 mm scour valve installation complete with chamber	No.	2,750.00	5.0	R 13,750.00	15,015	16,276	18,587	18,903	19,017	19,606	21,116	21,116
	Install Anchor / Thrust blocks	No.	800.00	5.4	R 4,320.00	4,717	5,114	5,840	5,939	5,975	6,160	6,634	6,634
	Supply and install PI and route markers	No.	60.00	9.0	R 540.00	590	639	730	742	747	770	829	829
4	BEDDING (PIPES)												
	<i>Provision of bedding</i>												
	Selected fill material	m ³	60.00	1,322.5	R 79,350.00	86,650	93,929	107,267	109,090	109,745	113,147	121,859	121,859
	Concrete bedding (cradle)	m ³	800.00	13.2	R 10,560.00	11,532	12,500	14,275	14,518	14,605	15,058	16,217	16,217
	SUB TOTAL (A)				R 1,317,582.02	1,438,800	1,559,659	1,781,130	1,811,409	1,822,278	1,878,769	2,023,434	2,023,434
5	MISCELLANEOUS												
	(% of sub total)	%	10.00		R 131,758.20	143,880	155,966	178,113	181,141	182,228	187,877	202,343	202,343
6	PRELIMINARY & GENERAL												
	(% of sub total A)	%	30.00		R 395,274.61	431,640	467,898	534,339	543,423	546,683	563,631	607,030	607,030
7	PRELIMINARY WORKS												
	(a) Access road	km	100,000.00	0.1	R 10,000.00	10,920	11,837	13,518	13,748	13,830	14,259	15,357	15,357
	SUB TOTAL B				R 1,854,614.83	2,025,239	2,195,360	2,507,101	2,549,721	2,565,020	2,644,535	2,848,164	2,848,164
	CONTINGENCIES												
	(% of sub total B)	%	10.00		R 185,461.48	202,524	219,536	250,710	254,972	256,502	264,454	284,816	284,816
	SUB-TOTAL C				R 2,040,076.31	2,227,763	2,414,895	2,757,811	2,804,693	2,821,522	2,908,989	3,132,981	3,132,981
8	PLANNING DESIGN & SUPERVISION												
	(% of sub total C)	%	15.00		R 306,011.45	334,164	362,234	413,672	420,704	423,228	436,348	469,947	469,947
	SUB TOTAL D				R 2,346,087.76	2,561,928	2,777,130	3,171,482	3,225,397	3,244,750	3,345,337	3,602,928	3,602,928
	VAT (% of sub total D)	%	14.00		R 328,452.29	358,670	388,798	444,008	451,556	454,265	468,347	504,410	504,410
	NETT PROJECT COST				R 2,674,540.04	2,920,598	3,165,928	3,615,490	3,676,953	3,699,015	3,813,684	4,107,338	4,107,338
9	Cost of relocations	Sum	0.00		R 0.00	0	0	0	0	0	0	0	0
10	Cost of land acquisition	m ²	10.00	12,756.0	R 127,560.00	139,296	150,996	172,438	175,369	176,421	181,891	195,896	195,896
	ESTIMATED TOTAL COST				R 2,802,100.04	3,059,893	3,316,924	3,787,928	3,852,322	3,875,436	3,995,575	4,303,234	4,303,234

10. RESERVOIR: All Options						Base Date March 2006							
A single reservoir in the vicinity of Reservoir A						2000 PPI Index 9.2% Total Excalation	2001 PPI Index 8.4% Total Excalation	2002 PPI Index 14.2% Total Excalation	2003 PPI Index 1.7% Total Excalation	2004 PPI Index 0.6% Total Excalation	2005 PPI Index 3.1% Total Excalation	2006 PPI Index 7.7% Total Excalation	AMOUNT (Rand March 2006)
No.	DESCRIPTION	UNIT	RATE	QUANTITY	TOTAL								
1	SITE CLEARANCE												
	Clear and grub	m ²	0.70	1,344.8	R 941.36	1,028	1,114	1,273	1,294	1,302	1,342	1,446	1,446
	Transport materials to unspecified sites and dump	t.km	2.30	50.0	R 115.00	126	136	155	158	159	164	177	177
	Remove topsoil to 150mm and stockpile	m ²	3.70	983.1	R 3,637.47	3,972	4,306	4,917	5,001	5,031	5,187	5,586	5,586
2	EARTHWORKS												
	<i>Bulk Excavation</i>												
	Exc. In all materials, use for backfill	m ³	28.70	491.5	R 14,106.05	15,404	16,698	19,069	19,393	19,509	20,114	21,663	21,663
	<i>E.O.</i>												
	Intermediate excavation	m ³	35.00	49.2	R 1,722.00	1,880	2,038	2,328	2,367	2,382	2,455	2,645	2,645
	Hard rock excavation	m ³	149.80	24.6	R 3,685.08	4,024	4,362	4,982	5,066	5,097	5,255	5,659	5,659
	<i>Restricted excavation</i>												
	Exc. For restricted foundations, footings, chambers & trenches in all materials	m ³	48.00	4.7	R 225.12	246	266	304	309	311	321	346	346
	<i>E.O.</i>												
	Intermediate excavation	m ³	50.00	0.5	R 25.00	27	30	34	34	35	36	38	38
	Hard rock excavation	m ³	149.80	0.2	R 29.96	33	35	41	41	41	43	46	46
	Extra exc. for working space	m ²	28.70	27.8	R 797.86	871	944	1,079	1,097	1,103	1,138	1,225	1,225
	Importing of materials	m ³	35.00	24.8	R 868.00	948	1,027	1,173	1,193	1,200	1,238	1,333	1,333
3	CONCRETE (STRUCTURAL)												
	<i>FORMWORK</i>												
	<i>Rough vertical plane</i>												
	for walls and slabs below ground level	m ²	98.30	55.6	R 5,465.48	5,968	6,470	7,388	7,514	7,559	7,793	8,393	8,393
	<i>Smooth vertical plane</i>												
	for walls above ground	m ²	58.30	1,046.5	R 61,010.95	66,624	72,220	82,476	83,878	84,381	86,997	93,696	93,696
	<i>Smooth horizontal plane</i>												
	Slabs above ground level	m ²	92.90	950.0	R 88,255.00	96,374	104,470	119,305	121,333	122,061	125,845	135,535	135,535
	Smooth narrow width (0-300m) curved	m	24.30	111.1	R 2,699.73	2,948	3,196	3,650	3,712	3,734	3,850	4,146	4,146
	Box out holes for specials	No.	71.30	5.0	R 356.50	389	422	482	490	493	508	547	547
	Box out holes for manhole covers	No.	118.80	3.0	R 356.40	389	422	482	490	493	508	547	547
	<i>REINFORCEMENT</i>												
	Mild steel bars	t	4,200.00	7.1	R 29,820.00	32,563	35,299	40,311	40,996	41,242	42,521	45,795	45,795
	High tensile steel bars	t	4,200.00	63.8	R 267,960.00	292,612	317,192	362,233	368,391	370,601	382,090	411,511	411,511
	High tensile welded mesh	t	5,000.00	1.4	R 7,000.00	7,644	8,286	9,463	9,624	9,681	9,981	10,750	10,750
	<i>CONCRETE</i>												
	50mm binding layer to res. & chambers	m ³	50.00	49.5	R 2,475.00	2,703	2,930	3,346	3,403	3,423	3,529	3,801	3,801
	<i>Strength concrete : 30MPa/20mm</i>												
	kl Reservoir incl. chambers	m ³	850.00	709.4	R 602,981.50	658,456	713,766	815,121	828,978	833,952	859,804	926,009	926,009
	<i>UNFORMED SURFACE FINISHES</i>												
	chamber floor slabs, horizontal joints	m ²	3.00	990.6	R 2,971.80	3,245	3,518	4,017	4,086	4,110	4,238	4,564	4,564
	floor slabs and chamber roof slabs	m ²	4.50	1,975.2	R 8,888.40	9,706	10,521	12,015	12,220	12,293	12,674	13,650	13,650
	<i>JOINTS</i>												
	Horizontal joint at base with water stop	m	30.00	110.2	R 3,306.00	3,610	3,913	4,469	4,545	4,572	4,714	5,077	5,077
	intermediate level of reservoir wall	m	9.00	110.2	R 991.80	1,083	1,174	1,341	1,364	1,372	1,414	1,523	1,523
	<i>MISCELLANEOUS</i>												
	Build in pipes	No.	150.00	5.0	R 750.00	819	888	1,014	1,031	1,037	1,069	1,152	1,152
	Install valves in chambers	No.	1,800.00	3.0	R 5,400.00	5,897	6,392	7,300	7,424	7,468	7,700	8,293	8,293
	Water level indicator	No.	5,300.00	1.0	R 5,300.00	5,788	6,274	7,165	7,286	7,330	7,557	8,139	8,139
	Supply of Valves	No.	2,800.00	3.0	R 8,400.00	9,173	9,943	11,355	11,548	11,618	11,978	12,900	12,900
	Flow meter	No.	4,500.00	1.0	R 4,500.00	4,914	5,327	6,083	6,187	6,224	6,417	6,911	6,911
	Strainer	No.	2,000.00	1.0	R 2,000.00	2,184	2,367	2,704	2,750	2,766	2,852	3,071	3,071
	LevelDex float valve	No.	13,000.00	1.0	R 13,000.00	14,196	15,388	17,574	17,872	17,980	18,537	19,964	19,964
	50 Micron PVC sheeting, in two layers on top of walls as a bond breaker to roof slabs	m	2.50	220.4	R 551.00	602	652	745	758	762	786	846	846
	70 Micron PVC sheeting placed as bond breaker	m ²	4.00	983.1	R 3,932.40	4,294	4,655	5,316	5,406	5,439	5,607	6,039	6,039

	between base and blinding												
	Manhole covers for:												
	a) Reservoirs	No.	600.00	1.0	R 600.00	655	710	811	825	830	856	921	921
	b) Chambers	No.	600.00	3.0	R 1,800.00	1,966	2,131	2,433	2,475	2,489	2,567	2,764	2,764
	Ladders: supply and install	No.	1,800.00	1.0	R 1,800.00	1,966	2,131	2,433	2,475	2,489	2,567	2,764	2,764
4	MEDIUM PRESSURE PIPELINES												
	Supply & place pipes and specials for:												
	Inlet pipe	No.	1,900.00	1.0	R 1,900.00	2,075	2,249	2,568	2,612	2,628	2,709	2,918	2,918
	Outlet pipe	No.	1,500.00	1.0	R 1,500.00	1,638	1,776	2,028	2,062	2,075	2,139	2,304	2,304
	Scour pipe	No.	700.00	1.0	R 700.00	764	829	946	962	968	998	1,075	1,075
	Ventilation pipe	No.	450.00	4.0	R 1,800.00	1,966	2,131	2,433	2,475	2,489	2,567	2,764	2,764
	Overflow pipe	No.	500.00	4.0	R 2,000.00	2,184	2,367	2,704	2,750	2,766	2,852	3,071	3,071
5	BEDDING (PIPES)												
	Provision of bedding	m ³	30.00	4.0	R 120.00	131	142	162	165	166	171	184	184
6	BRICKWORK												
	Brickwork to all chambers	m ²	157.00	12.7	R 1,993.90	2,177	2,360	2,695	2,741	2,758	2,843	3,062	3,062
7	STERILEATION AND HYDROTESTING	No.	1,000.00	1.0	R 1,000.00	1,092	1,184	1,352	1,375	1,383	1,426	1,536	1,536
8	MISCELLANEOUS												
	(% of items 1 to 7)				R 116,999.32	127,763	138,495	158,162	160,850	161,816	166,832	179,678	179,678
	SUB TOTAL (A)				R 1,286,738.08	1,405,118	1,523,148	1,739,435	1,769,005	1,779,619	1,834,788	1,976,066	1,976,066
9	PRELIMINARY & GENERAL												
	(% of sub total A)	%	30.00		R 386,021.42	421,535	456,944	521,830	530,702	533,886	550,436	592,820	592,820
10	PRELIMINARY WORKS												
	(a) Access road	km	100,000.00	0.0	R 0.00	0	0	0	0	0	0	0	0
	SUB TOTAL B				R 1,672,759.50	1,826,653	1,980,092	2,261,265	2,299,707	2,313,505	2,385,224	2,568,886	2,568,886
	CONTINGENCIES												
	(% of sub total B)	%	15.00		R 250,913.93	273,998	297,014	339,190	344,956	347,026	357,784	385,333	385,333
	SUB-TOTAL C				R 1,923,673.43	2,100,651	2,277,106	2,600,455	2,644,663	2,660,531	2,743,007	2,954,219	2,954,219
11	PLANNING DESIGN & SUPERVISION												
	(% of sub total C)	%	15.00		R 288,551.01	315,098	341,566	390,068	396,699	399,080	411,451	443,133	443,133
	SUB TOTAL D				R 2,212,224.44	2,415,749	2,618,672	2,990,523	3,041,362	3,059,611	3,154,458	3,397,352	3,397,352
	VAT (% of sub total D)	%	14.00		R 309,711.42	338,205	366,614	418,673	425,791	428,345	441,624	475,629	475,629
	NETT PROJECT COST				R 2,521,935.87	2,753,954	2,985,286	3,409,197	3,467,153	3,487,956	3,596,083	3,872,981	3,872,981
12	Cost of relocations	Sum	0.00		R 0.00	0	0	0	0	0	0	0	0
13	Cost of land acquisition	m ²	10.00	1,344.8	R 13,448.00	14,685	15,919	18,179	18,488	18,599	19,176	20,652	20,652
	ESTIMATED TOTAL COST				R 2,535,383.87	2,768,639	3,001,205	3,427,376	3,485,641	3,506,555	3,615,258	3,893,633	3,893,633

LUSIKISIKI GROUNDWATER FEASIBILITY STUDY PHASE 2 Immedaiaate Ground Water Measures Cost Estimates								
Boreholes	Cumulative 12 h Yield (l/s)	Depth (m)	Static Head (m)	Distance (m)	Pipe Dia. (mm)	Estimated Costs Pipes (R)	Estimated Costs Pump (R)	Estimated Costs Total (R)
EC 054	10.5	100	140				150,000	
				900	90	855,000		
EC 055	11.6	98	140				50,000	
				700	110	679,000		
EC 072	13.7	150	140				120,000	
				7850	140	7,850,000		
Reservoir B						30,000		
ESTIMATED TOTAL								9,734,000
EC 078	1.25	100	161				70,000	
				1400	50	980,000		
EC 051	5.85	110	100				80,000	
				920	90	85,500		
EC 052	7.18	105	100				50,000	
				3450	110	3,346,500		
Reservoir C						30,000		
ESTIMATED TOTAL								4,642,000
TOTAL								14,376,000

SUMMARY OF CONVEYOR COSTS FOR DIFFERENT OPTIONS						
Description	AMOUNT March 2006 (R)	Option				
		Option 1: Gravity Main	1.1	1.2	2	Immediate Augmentation
1. RAW WATER GRAVITY MAIN from Zalu dam outlet to WTW: OPTION 1: GRAVITY MAIN	15,581,834	15,581,834				
2. RAW WATER PUMP STATION at Zalu dam: Option 1.1	931,891		931,891			
3. RAW WATER PUMP STATION AT LUSIKISIKI WEIR: Options 1.2, 2, IMMEDIATE AUGMENTATION	915,189			915,189	915,189	915,189
4. RAW WATER RISING MAIN from Zalu outlet to WTW: Option 1.1	8,761,107		8,761,107			
5. RWRM: Options 1.2, IMMEDIATE AUGMENTATION from existing Lusikisiki weir to WTW	1,309,601			1,309,601		1,309,601
6. RAW WATER RISING MAIN from Lusikisiki dam outlet to WTW: Option 2	3,009,555				3,009,555	
7. WATER TREATMENT WORKS: All Options	7,106,574	7,106,574	7,106,574	7,106,574	7,106,574	7,106,574
8. CLEAR WATER PUMP STATION at WTW: All Options	873,355	873,355	873,355	873,355	873,355	873,355
9. CLEAR WATER RISING MAIN from WTW to Reservoir A: All Options	4,303,234	4,303,234	4,303,234	4,303,234	4,303,234	4,303,234
10. RESERVOIR: All Options	3,893,633	3,893,633	3,893,633	3,893,633	3,893,633	3,893,633
TOTAL		31,758,630	25,869,794	18,401,586	20,101,539	18,401,586

COST COMPARISON FOR DIFFERENT TYPES OF DAMS AND CONVEYOR SYSTEMS					
DAM	COST ESTIMATE AMOUNT March 2006 (R)	CONVEYOR SYSTEM		TOTAL	
		1.1	1.2	Dam + Conveyor System 1.1	Dam + Conveyor System 1.2
Rockfill Dam Central Spillway	52,887,836	25,869,794	18,401,586	78,757,630	71,289,422
Rockfill Dam Side Spillway	54,384,221	25,869,794	18,401,586	80,254,015	72,785,807
Earthfill Dam Central Spillway	55,475,128	25,869,794	18,401,586	81,344,922	73,876,714
Earthfill Dam Side Spillway	61,158,044	25,869,794	18,401,586	87,027,838	79,559,630
Rollcrete Dam	64,049,338	25,869,794	18,401,586	89,919,132	82,450,924

LUSIKISIKI GROUNDWATER FEASIBILITY STUDY PHASE 2								
Immeiate Ground Water Measures Cost Estimates								
Boreholes	Cumulative 12 h Yield (l/s)	Depth (m)	Static Head (m)	Distance (m)	Pipe Dia. (mm)	Estimated Costs Pipes (R)	Estimated Costs Pump (R)	Estimated Costs Total (R)
EC 054	10.5	100	140				150,000	
				900	90	855,000		
EC 055	11.6	98	140				50,000	
				700	110	679,000		
EC 072	13.7	150	140				120,000	
				7850	140	7,850,000		
Reservoir B						30,000		
ESTIMATED TOTAL								9,734,000
EC 078	1.25	100	161				70,000	
				1400	50	980,000		
EC 051	5.85	110	100				80,000	
				920	90	85,500		
EC 052	7.18	105	100				50,000	
				3450	110	3,346,500		
Reservoir C						30,000		
ESTIMATED TOTAL								4,642,000
TOTAL								14,376,000

Additional Ground Water Cost Estimates

Immediate Ground Water Measures Cost Estimates

Number of BH 6 No

Total Cost 14,376,000 R

Average cost per BH 2,396,000 R/BH

New Boreholes

Average Yield/BH 1.5 l/s

Additional Yield 40 l/s

Number of BH needed 27 No

TOTAL COST ADD. 63,893,333 R

BH

Appendix 6: Economic Analysis

	Zalu Dam: Rock Fill Dam Central Spillway + Conveyor System 1.2: NET PRESENT COST NPV			NET PRESENT COST (2008) AT 6%			NET PRESENT COST (2008) AT 8%			NET PRESENT COST (2008) AT 10%		
YEAR	TOTAL CAPITAL COSTS	TOTAL O&M	TOTAL ELECTRICITY COSTS	CAPITAL	TOTAL O&M	ELECTRICITY	CAPITAL	TOTAL O&M	ELECTRICITY	CAPITAL	TOTAL O&M	ELECTRICITY
2008												
2009	14 257 884			13 450 834			13 201 745			12 961 713		
2010	21 386 827			19 034 200			18 335 757			17 675 063		
2011	21 386 827			17 956 792			16 977 553			16 068 239		
2012	14 257 884	3 392 040		11 293 580	2 686 813		10 479 971	2 493 251		9 738 327	2 316 809	
2013		3 392 040			2 534 730			2 308 565			2 106 190	
2014		3 392 040			2 391 254			2 137 560			1 914 718	
2015		3 392 040			2 255 900			1 979 223			1 740 653	
2016		3 392 040			2 128 208			1 832 614			1 582 412	
2017		3 392 040			2 007 743			1 696 864			1 438 556	
2018		3 392 040			1 894 097			1 571 171			1 307 778	
2019		3 392 040			1 786 884			1 454 788			1 188 889	
2020		3 392 040			1 685 740			1 347 026			1 080 808	
2021		3 392 040			1 590 321			1 247 246			982 553	
2022		3 392 040			1 500 303			1 154 857			893 230	
2023		3 392 040			1 415 380			1 069 312			812 027	
2024		3 392 040			1 335 264			990 104			738 207	
2025		3 392 040			1 259 683			916 763			671 097	
2026		3 392 040			1 188 380			848 855			610 088	
2027		3 392 040			1 121 113			785 977			554 626	
2028		3 392 040			1 057 654			727 756			504 205	
2029		3 392 040			997 787			673 848			458 368	
2030		3 392 040			941 308			623 934			416 698	
2031		3 392 040			888 027			577 716			378 817	
2032		3 392 040			837 761			534 922			344 379	
TOTAL	71 289 422	71 232 837		61 735 406	33 504 350		58 995 025	26 972 352		56 443 343	22 041 109	

Zalu Dam: Rock Fill Dam Central Spillway + Conveyor System 1.2: NET PRESENT COST NPV

YEAR	TOTAL CAPITAL COSTS	TOTAL MAINTENANCE CIVIL WORKS	TOTAL MAINTENANCE M&E	TOTAL MAINTENANCE PIPELINES	Net Present value for base year of Water Delivered at			TOTAL TRANSFER (million m ³)
					6%	8%	10%	
2008								
2009	14 257 884							
2010	21 386 827							
2011	21 386 827							
2012	14 257 884	356 447	2 851 577	712 894				3,520,000
2013		356 447	2 851 577	712 894				3,520,000
2014		356 447	2 851 577	712 894				3,520,000
2015		356 447	2 851 577	712 894	2 341 001	2 053 886	1 806 317	3,520,000
2016		356 447	2 851 577	712 894	2 208 492	1 901 746	1 642 106	3,520,000
2017		356 447	2 851 577	712 894	2 083 483	1 760 876	1 492 824	3,520,000
2018		356 447	2 851 577	712 894	1 965 550	1 630 441	1 357 112	3,520,000
2019		356 447	2 851 577	712 894	1 854 292	1 509 668	1 233 739	3,520,000
2020		356 447	2 851 577	712 894	1 749 332	1 397 840	1 121 580	3,520,000
2021		356 447	2 851 577	712 894	1 650 313	1 294 297	1 019 619	3,520,000
2022		356 447	2 851 577	712 894	1 556 899	1 198 423	926 926	3,520,000
2023		356 447	2 851 577	712 894	1 468 773	1 109 651	842 660	3,520,000
2024		356 447	2 851 577	712 894	1 385 635	1 027 454	766 055	3,520,000
2025		356 447	2 851 577	712 894	1 307 203	951 347	696 413	3,520,000
2026		356 447	2 851 577	712 894	1 233 210	880 877	633 103	3,520,000
2027		356 447	2 851 577	712 894	1 163 406	815 626	575 548	3,520,000
2028		356 447	2 851 577	712 894	1 097 553	755 210	523 226	3,520,000
2029		356 447	2 851 577	712 894	1 035 427	699 268	475 660	3,520,000
2030		356 447	2 851 577	712 894	976 818	647 471	432 418	3,520,000
2031		356 447	2 851 577	712 894	921 526	599 510	393 107	3,520,000
2032		356 447	2 851 577	712 894	869 364	555 102	357 370	3,520,000
TOTAL	71 289 422	7 485 389	59 883 115	14 970 779	26 868 277	20 788 693	16 295 781	73 920 000

	PRESENT WORTH OF COSTS	TOTAL WATER DELIVERED	WATER TARIFF @ R/m3	NPV WATER DELIVERED	UNIT REFERENCE VALUE (R/m3)
Discounted at 6%	95 239 756	26 868 277	1.00	26 868 277	R 3.54
Discounted at 8%	85 967 377	20 788 693	1.00	20 788 693	R 4.14
Discounted at 10%	78 484 452	16 295 781	1.00	16 295 781	R 4.82

	Zalu Dam: Earth Fill Dam Central Spillway + Conveyor System 1.2: NET PRESENT COST NPV			NET PRESENT COST (2008) AT6%			NET PRESENT COST (2008) AT8%			NET PRESENT COST (2008) AT10%		
YEAR	TOTAL CAPITAL COSTS	TOTAL O&M	TOTAL ELECTRICITY COSTS	CAPITAL	TOTAL O&M	ELECTRICITY	CAPITAL	TOTAL O&M	ELECTRICITY	CAPITAL	TOTAL O&M	ELECTRICITY
2008												
2009	14 775 343			13 939 003			13 680 873			13 432 130		
2010	22 163 014			19 725 004			19 001 212			18 316 541		
2011	22 163 014			18 608 494			17 593 715			16 651 401		
2012	14 775 343	3 508 468		11 703 455	2 779 035		10 860 318	2 578 829		10 091 758	2 396 331	
2013		3 508 468			2 621 731			2 387 804			2 178 483	
2014		3 508 468			2 473 331			2 210 930			1 980 439	
2015		3 508 468			2 333 332			2 047 157			1 800 399	
2016		3 508 468			2 201 256			1 895 516			1 636 726	
2017		3 508 468			2 076 657			1 755 107			1 487 933	
2018		3 508 468			1 959 110			1 625 100			1 352 666	
2019		3 508 468			1 848 217			1 504 722			1 229 697	
2020		3 508 468			1 743 601			1 393 261			1 117 906	
2021		3 508 468			1 644 907			1 290 056			1 016 278	
2022		3 508 468			1 551 799			1 194 497			923 889	
2023		3 508 468			1 463 961			1 106 015			839 899	
2024		3 508 468			1 381 095			1 024 088			763 545	
2025		3 508 468			1 302 920			948 230			694 132	
2026		3 508 468			1 229 170			877 991			631 029	
2027		3 508 468			1 159 594			812 954			573 663	
2028		3 508 468			1 093 957			752 736			521 511	
2029		3 508 468			1 032 035			696 977			474 101	
2030		3 508 468			973 618			645 349			431 001	
2031		3 508 468			918 507			597 546			391 819	
2032		3 508 468			866 516			553 283			356 199	
TOTAL	73 876 714	73 677 828		63 975 956	34 654 351		61 136 119	27 898 149		58 491 829	22 797 646	

Zalu Dam: Earth Fill Dam Central Spillway + Conveyor System 1.2: NET PRESENT COST NPV

YEAR	TOTAL CAPITAL COSTS	TOTAL MAINTENANCE CIVIL WORKS	TOTAL MAINTENANCE M&E	TOTAL MAINTENANCE PIPELINES	Net Present value for base year of Water Delivered at			TOTAL TRANSFER (million m ³)
					6%	8%	10%	
2008								
2009	14 775 343							
2010	22 163 014							
2011	22 163 014							
2012	14 775 343	369 384	2 955 069	738 767				3,520,000
2013		369 384	2 955 069	738 767				3,520,000
2014		369 384	2 955 069	738 767				3,520,000
2015		369 384	2 955 069	738 767	2 341 001	2 053 886	1 806 317	3,520,000
2016		369 384	2 955 069	738 767	2 208 492	1 901 746	1 642 106	3,520,000
2017		369 384	2 955 069	738 767	2 083 483	1 760 876	1 492 824	3,520,000
2018		369 384	2 955 069	738 767	1 965 550	1 630 441	1 357 112	3,520,000
2019		369 384	2 955 069	738 767	1 854 292	1 509 668	1 233 739	3,520,000
2020		369 384	2 955 069	738 767	1 749 332	1 397 840	1 121 580	3,520,000
2021		369 384	2 955 069	738 767	1 650 313	1 294 297	1 019 619	3,520,000
2022		369 384	2 955 069	738 767	1 556 899	1 198 423	926 926	3,520,000
2023		369 384	2 955 069	738 767	1 468 773	1 109 651	842 660	3,520,000
2024		369 384	2 955 069	738 767	1 385 635	1 027 454	766 055	3,520,000
2025		369 384	2 955 069	738 767	1 307 203	951 347	696 413	3,520,000
2026		369 384	2 955 069	738 767	1 233 210	880 877	633 103	3,520,000
2027		369 384	2 955 069	738 767	1 163 406	815 626	575 548	3,520,000
2028		369 384	2 955 069	738 767	1 097 553	755 210	523 226	3,520,000
2029		369 384	2 955 069	738 767	1 035 427	699 268	475 660	3,520,000
2030		369 384	2 955 069	738 767	976 818	647 471	432 418	3,520,000
2031		369 384	2 955 069	738 767	921 526	599 510	393 107	3,520,000
2032		369 384	2 955 069	738 767	869 364	555 102	357 370	3,520,000
TOTAL	73 876 714	7 757 055	62 056 440	15 514 110	26 868 277	20 788 693	16 295 781	73 920 000

	PRESENT WORTH OF COSTS	TOTAL WATER DELIVERED	WATER TARIFF @ R/m3	NPV WATER DELIVERED	UNIT REFERENCE VALUE (R/m3)
Discounted at 6%	98 630 307	26 868 277	1.00	26 868 277	R 3.67
Discounted at 8%	89 034 268	20 788 693	1.00	20 788 693	R 4.28
Discounted at 10%	81 289 475	16 295 781	1.00	16 295 781	R 4.99

	Groundwater + Conveyor System 1.2: NET PRESENT COST NPV			NET PRESENT COST (2008) AT 6%			NET PRESENT COST (2008) AT 8%			NET PRESENT COST (2008) AT 10%		
YEAR	TOTAL CAPITAL COSTS	TOTAL O&M	TOTAL ELECTRICITY COSTS	CAPITAL	TOTAL O&M	ELECTRICITY	CAPITAL	TOTAL O&M	ELECTRICITY	CAPITAL	TOTAL O&M	ELECTRICITY
2008												
2009	16 458 984			15 527 343			15 239 800			14 962 713		
2010	24 688 476			21 972 655			21 166 389			20 403 699		
2011	24 688 476			20 728 920			19 598 508			18 548 817		
2012	16 458 984	2 652 863		13 037 057	2 101 316		12 097 844	1 949 934		11 241 707	1 811 941	
2013		2 652 863			1 982 374			1 805 494			1 647 219	
2014		2 652 863			1 870 164			1 671 754			1 497 472	
2015		2 652 863			1 764 306			1 547 920			1 361 338	
2016		2 652 863			1 664 439			1 433 260			1 237 580	
2017		2 652 863			1 570 226			1 327 092			1 125 073	
2018		2 652 863			1 481 345			1 228 789			1 022 794	
2019		2 652 863			1 397 495			1 137 768			929 812	
2020		2 652 863			1 318 392			1 053 489			845 284	
2021		2 652 863			1 243 766			975 452			768 440	
2022		2 652 863			1 173 364			903 197			698 582	
2023		2 652 863			1 106 947			836 293			635 074	
2024		2 652 863			1 044 290			774 346			577 340	
2025		2 652 863			985 179			716 987			524 855	
2026		2 652 863			929 414			663 876			477 141	
2027		2 652 863			876 806			614 700			433 764	
2028		2 652 863			827 175			569 167			394 331	
2029		2 652 863			780 354			527 007			358 483	
2030		2 652 863			736 183			487 969			325 894	
2031		2 652 863			694 512			451 823			296 267	
2032		2 652 863			655 200			418 355			269 334	
TOTAL	82 294 919	55 710 132		71 265 976	26 203 249		68 102 541	21 094 671		65 156 936	17 238 020	

Groundwater + Conveyor System 1.2: NET PRESENT COST NPV

YEAR	TOTAL CAPITAL COSTS	TOTAL MAINTENANCE CIVIL WORKS	TOTAL MAINTENANCE M&E	TOTAL MAINTENANCE PIPELINES	Net Present value for base year of Water Delivered at			TOTAL TRANSFER (million m ³)
					6%	8%	10%	
2008								
2009	16 458 984							
2010	24 688 476							
2011	24 688 476							
2012	16 458 984	411 475	3 291 797	822 949				3,520,000
2013		411 475	3 291 797	822 949				3,520,000
2014		411 475	3 291 797	822 949				3,520,000
2015		411 475	3 291 797	822 949	2 341 001	2 053 886	1 806 317	3,520,000
2016		411 475	3 291 797	822 949	2 208 492	1 901 746	1 642 106	3,520,000
2017		411 475	3 291 797	822 949	2 083 483	1 760 876	1 492 824	3,520,000
2018		411 475	3 291 797	822 949	1 965 550	1 630 441	1 357 112	3,520,000
2019		411 475	3 291 797	822 949	1 854 292	1 509 668	1 233 739	3,520,000
2020		411 475	3 291 797	822 949	1 749 332	1 397 840	1 121 580	3,520,000
2021		411 475	3 291 797	822 949	1 650 313	1 294 297	1 019 619	3,520,000
2022		411 475	3 291 797	822 949	1 556 899	1 198 423	926 926	3,520,000
2023		411 475	3 291 797	822 949	1 468 773	1 109 651	842 660	3,520,000
2024		411 475	3 291 797	822 949	1 385 635	1 027 454	766 055	3,520,000
2025		411 475	3 291 797	822 949	1 307 203	951 347	696 413	3,520,000
2026		411 475	3 291 797	822 949	1 233 210	880 877	633 103	3,520,000
2027		411 475	3 291 797	822 949	1 163 406	815 626	575 548	3,520,000
2028		411 475	3 291 797	822 949	1 097 553	755 210	523 226	3,520,000
2029		411 475	3 291 797	822 949	1 035 427	699 268	475 660	3,520,000
2030		411 475	3 291 797	822 949	976 818	647 471	432 418	3,520,000
2031		411 475	3 291 797	822 949	921 526	599 510	393 107	3,520,000
2032		411 475	3 291 797	822 949	869 364	555 102	357 370	3,520,000
TOTAL	82 294 919	8 640 966	69 127 732	17 281 933	26 868 277	20 788 693	16 295 781	73 920 000

	PRESENT WORTH OF COSTS	TOTAL WATER DELIVERED	WATER TARIFF @ R/m3	NPV WATER DELIVERED	UNIT REFERENCE VALUE (R/m3)
Discounted at 6%	97 469 225	26 868 277	1.00	26 868 277	R 3.63
Discounted at 8%	89 197 212	20 788 693	1.00	20 788 693	R 4.29
Discounted at 10%	82 394 956	16 295 781	1.00	16 295 781	R 5.06