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Annex 1: Groundwater supply schemes operated by NamWater and municipalities

No	Scheme name	Lat	Long	Geology	Production (Tm ³ /a)	Depth (m)	Quality class
1	Aasvoelnes	-19,44000	20,11000	Kalahari	18	145	A
2	Ai-Ais	-27,90000	17,50000	Alluvium (Fish River)	58	15	A-B
3	Aminuis	-23,64000	19,37000	Sandstone, shale (Karoo)	86	186	B
4	Andara	-17,97200	21,26600	Kalahari (calcrete, sand)	10	55	D
5	Anichab	-20,95000	14,84000	Alluvium (Ugab River)	25	10-15	B
6	Anker	-19,77000	14,55000	Quartzite, granite (Huab Complex)	31	57-66	C
7	Aranos	-24,14700	19,11800	Sandstone (Karoo)	300	204-387	A
8	Ariamsvlei	-28,12000	19,84000	Meta-sediments (Nama Group)	40	100-120	B-C
9	Aroab	-26,80000	19,63000	Sandstone (Nama Group)	60	77-124	A
10	Aus	-26,66000	16,27400	Granite-gneiss (Namaqualand)	24	42-142	A-C
11	Bagani	-18,10900	21,65000	Kalahari	1	114	C-D
12	Berg Aukas	-19,50300	18,23600	Dolomite (Otavi Group, Damara)	700	92-98	B
13	Bergsig	-20,21000	14,06000	Basalt	2	12	A-B
14	Berseba	-25,99000	17,76000	Sandstone (Nama Group)	40	34-42	A
15	Bethanien	-26,50000	17,13000	Shale, limestone (Nama Group)	120	75	B-D
16	Brandwag	-19,68000	17,98000	Dolomite (Otavi Group, Damara)	0	15-60	B
17	Buinja	-17,86000	19,36000	Kalahari	6	57-79	A
18	Buitepos	-22,28000	19,99000	Tsumis Quartzite (Damara)	9	40-60	B
19	Bukalo	-17,72000	24,53000	Kalahari	70	40-54	B
20	Chinchimane	-17,98500	24,12400	Kalahari	30	50	B-C
21	Daan Viljoen	-22,54000	16,95000	Mica schist (Khomas, Damara)	60	76-125	B
22	Dordabis	-22,95000	17,66000	Quartzite (Rehoboth Sequence)	20	42-76	A-B
23	Epukiro Post 3	-21,58000	19,45000	Marble, quartzite, schist (Damara)	60	50-180	B-D
24	Epukiro Post 10	-21,52000	19,47000	Marble, quartzite, schist (Damara)	20	126-182	A-B
25	Ernst Meyer	-22,37000	19,40000	Kalahari & quartzite (Damara)	18	55-60	A
26	Erwee	-19,69000	14,30000	Quartzite, granite (Huab Complex)	30	58-65	B-C
27	Fransfontein	-20,21000	15,05000	Shale, dolomite, sandstone, limestone (Damara)	140	61-151	B
28	Gabis	-28,10000	18,61000	Namaqualand gneiss	19	56-86	C-D
29	Gainachas	-25,76000	17,71000	Sandstone (Nama Group)	3	32-39	A
30	Gibeon	-24,74000	17,89000	Sandstone (Dwyka, Karoo)	340	30-43	A
31	Gobabeb	-23,56000	15,04000	Alluvium (Kuseb River)	2	30-40	B-D
32	Gobabis NE	-22,24000	19,11000	Damara Sequence	80		
	Black Nossob	-22,32000	18,92000	Damara Sequence	0	30	
	Grunental	-22,37200	18,39400	Damara Sequence	110	60-108	A
	South Station	-22,51000	18,98000	Damara Sequence	30	72-76	A
	Witvlei (> Gobabis)	-22,41000	18,47000	Damara Sequence	16	65	A
33	Goblentz	-20,09900	18,14500	Kalahari	800	100-450	A-B
34	Gochas	-24,75000	18,74000	Sandstone & shale (Karoo)	70	130-235	A
35	Grinau	-27,72000	18,38000	Granite (Namaqualand Complex)	10	58-160	B-D
36	Halali						
	Klein Halali	-19,05000	16,49000	Calcrete (Kalahari)	10	20-70	C
	Renosterkom	-19,09800	16,52000	Dolomite (Damara)	80	67-87	B
37	Henties Bay	-22,09000	14,29000	Alluvium (Omaruru Delta)	35	32-35	A
38	Hochfeld	-21,49000	17,85000	Damara Sequence	10	46-66	A
39	Kahenge	-17,68000	18,67000	Kalahari	26	38-40	A
40	Kalkfeld	-20,89000	16,19000	Meta-sediments, granite (Damara)	50	19-183	A-B
41	Kalkrand	-24,25000	17,26000	Basalt (Karoo)	100	65-77	B
42	Kamanjab						
	Town & Airport	-19,62000	14,84000	Intrusives, metased. (Huab Complex)	34	60-100	B-D
	Kalkrand	-19,64000	14,98000	Huab covered 10 m calcrete (Tertiary)	29	100-120	B
43	Karasburg	-28,00000	18,68000	Shale, dolerite (Karoo)	300	27-78	B
44	Karibib						
	Hä lbichsbrunn	-21,96000	15,90000	Marble (Damara)	130	80-120	B-C
	Spes Bona	-21,78000	15,94000	Alluvium (Khan), limestone, shale (Damara)	0	31-76	
45	Karstland			Dolomite (Otavi Group, Damara)	10		B
46	Kayengona	-17,89000	19,88000	Kalahari	140	50-60	A
47	Khorixas	-20,38000	14,96000	Calcrete, dolomite (Damara)	700-1.6	31-150	B
48	Koes	-25,93000	19,12000	Sandstone (Ecca Group, Karoo)	70	43-70	B
49	Koichab	-26,20000	15,87000	Sand, gravel, clay (Tertiary)	600-1.0	59-107	A
50	Kosis	-26,71000	17,32000	Sandstone, shale, limestone (Nama Gr.)	45	60-70	A-B
51	Kriess	-25,00000	18,16000	Sandstone (Karoo)	10	80-90	A
52	Kuseb	-23,19000	14,66000	Alluvium (Kuseb River)	5,500	15-50	A-B
	Dorop						
	Rooibank						
	Swartbank						

No	Scheme name	Lat	Long	Geology	Production (Tm ³ /a)	Depth (m)	Quality class
53	Kwakwas	-23,21000	16,90000	Quartzite, schist (Rehoboth Sequence)	No info	79-104	A-B
54	Leonardville	-23,50300	18,79000	Sandstone, shale (Karoo)	60	188-280	A-B
55	Maltahöhe	-24,81000	16,99000	Quartzite (Nama Group)	200	31-46	C
56	Mangetti Duin	-19,52000	19,73000	Kalahari	40	180-197	A
57	Maroelaboom	-19,25000	18,80000	Kalahari	4	147	B
58	M'Kata	-19,50000	19,63000	Kalahari	9	170	A
59	Mpunguwei	-17,67000	18,23000	Kalahari	20	86-90	D
60	Mupini	-17,86000	19,63000	Kalahari	5	50-57	C
61	Namutoni	-18,80000	17,04000	Kalahari	150	39-43	B
62	Nei Neis	-21,47000	15,04000	Alluvium (Omaruru River)	330	12-28	A-C
63	Nkurenkuru	-17,63000	18,62000	Kalahari	20	40-60	
64	Nyangana	-18,02000	20,68000	Kalahari	80		
65	Oamites	-22,98000	17,07000	Marble (Damara)	250	100-150	No info
66	Okaukuejo	-19,18000	15,92000	Kalahari (calcrete)	250	10-80	B
67	Okombahe	-21,35000	15,40000	Alluvium (Omaruru River)	380	25-26	A
68	Okondjatu	-20,98000	18,23000	Damara under Kalahari	70	98-100	B
69	Omatoko	-19,44000	19,22000	Kalahari	20	161-184	B
70	Omatoko Dam	-21,14000	17,17000	Sandstone, shale (Karoo)	4	55-90	B-D
71	Ombika	-19,33000	15,94000	Dolomite, limestone (Otavi, Damara)	12	20-130	B
72	Omdel	-22,09000	14,29000	Alluvium (Omaruru Delta)	5.500	50-100	B
73	Omega	-17,89000	22,15000	Kalahari	115	70-90	B
74	Ondekaremba	-22,48000	17,42000	Khomas schist (Damara)	4	96-125	B
75	Onderombapa	-23,15000	19,56000	Sandstone, shale (Karoo)	4	93-96	A
76	Opuwo	-18,06000	13,85000				
	SE wellfield	-18,15000	13,95000	Otavi Group, Damara	25	90-120	B
	NW wellfield	-18,04000	13,82000	Karoo (Dwyka) / calcrete	780	56-110	C-D
77	Oshivelo	-18,62000	17,17000	Kalahari (sand, shale)	300	68-74	B
78	Osire	-21,08000	17,37000	Omingonde Fm (Karoo)	55	57-77	A-B
79	Otavi	-19,64000	17,35000	Limestone, dolomite (Otavi, Damara)	500	60-61	A-B
80	Otjimbingwe	-22,35200	16,13600	Alluvium (Swakop River)	280	12	A-C
81	Otjinene	-21,14000	18,79000	Damara under Kalahari	150	63-125	A-C
82	Otjiwarongo	-20,46000	16,64000	Marble (Damara)	1.800	66-185	B
	Otjituuo	-19,44800	18,21000	Dolomite (Berg Aukas formasië)	900	85-100	A
83	Otjovasandu	-19,25000	14,51000	Metamorphosed lava (Khoabendus)	10	61	B-C
84	Ovitoto	-21,91000	17,10000	Damara Sequence	40	32-38	B
85	Plessisplaas	-21,71000	19,04000	Kalahari, Gamsberg granite	10	56-82	A
86	Rietfontein	-21,90400	20,91800	Kamtsas Fm (Damara)	140	48-109	C
87	Rooidaghek	-19,25000	19,27000	Kalahari	10	180	
88	Runduhek	-18,78700	18,94200	Kalahari	30	250	
89	Rupara	-17,84000	19,08000	Kalahari	10	77-82	A
90	Sambiu	-17,91000	20,03000	Kalahari	30	60-70	A
91	Schlip	-24,04300	17,13100	Limestone, dolomite, shale (Nama)	230	43-104	B
92	Seeis	-22,45000	17,62000	Alluvium (Seeis River)	30	12-15	No info
93	Sesfontein	-19,12000	13,61000	Dolomite, phyllite (Damara)	20	36-51	A-B
94	Spitzkoppe	-21,85000	15,20000	Granite, schist (Damara)	13	60-92	C-D
95	Stampriet	-24,34200	18,40900	Sandstone, shale (Karoo)	60	84-101	A
96	Terrace Bay	-20,18900	13,20100	Alluvium (Uniab River)	17	10-20	A-D
97	Tondoro	-17,77000	18,79000	Kalahari	70	65-68	A
98	Tses						
	Old scheme	-25,89000	18,11000	Shale (Dwyka, Nama Group)	30	47-109	A-C
	New boreholes	-25,92000	17,94000	Shale (Dwyka, Nama Group)	0	57-100	B-C
99	Tsintsabis	-18,78000	17,96000	Kalahari	30	31-93	B
100	Tsumkwe	-19,59000	20,50000	Kalahari	55	20-35	A-C
101	Tubussis	-21,54800	15,46200	Schist, quartzite (Damara)	20	13-110	B-C
102	Usakos	-21,99200	15,60100		285	15-100	A-B
	Khan River			Alluvium (Khan River)			
	Aroab River			Calcrete & Onguati marble			
103	Warmbad	-28,44100	18,74200	Namaqualand granite-gneiss complex	25	107-110	C-D
104	Witvlei	-22,41000	18,50000	Quartzite, limestone (Damara)	140	31-38	B-D
Municipal schemes							
105	Windhoek	-22,59000	17,08000	Auas quartzites	2.000	77-305	A
106	Omaruru	-21,41000	15,95000	Alluvium (Omaruru River)	1.000	12-16	A
107	Tsumeb	-19,25000	17,71000	Dolomite	2.000	130-200	A
108	Outjo	-20,11000	16,16000	Dolomite	800	90-100	A
109	Grootfontein	-19,56000	18,11000	Dolomite	2.000	50-70	A

Annex 2: Selected representative boreholes

Latitude	Longitude	WW no	Depth [m]	Water level [m bgl]	Yield [m ³ /h]	Water quality	Aquifer host rock
-17.50013	24.35257	37113	49	6	22	C	Kalahari
-17.50590	12.79480	33962	39	8	4	A	Quartzite
-17.56111	16.35397	37070	259	20	18	C	Kalahari (Very Deep Aquifer)
-17.60965	12.94160	36681	74	-	0	-	Gneiss
-17.64612	24.16922	36622	70	14	19	C	Kalahari
-17.68162	24.46502	37111	39	4	22	C	Kalahari
-17.69023	23.42113	36479	68	24	19	A	Kalahari
-17.70410	12.75600	33963	59	17	1	A	Gneiss
-17.70710	24.03052	36451	69	23	11	B	Kalahari
-17.78010	16.84440	36867	200	55	13	A	Kalahari
-17.82223	23.39272	36502	61	31	9	A	Kalahari
-17.85707	23.71302	36543	73	16	10	B	Kalahari
-17.88680	15.95620	9124	668	-	10	-	Kalahari, Karoo
-17.88735	24.19542	36575	27	9	-	B	Kalahari
-17.89303	18.28392	39962	101	-	1	-	Kalahari
-17.95050	23.47782	36529	76	29	-	B	Kalahari
-17.97130	13.85610	33969	70	16	3	B	Shale
-17.97300	14.02870	33964	71	40	-	A	Dolomite
-17.98600	13.81840	33958	104	-	0	-	Shale
-17.99600	13.65900	33959	108	23	3	A	Shale
-18.06190	12.76660	33972	103	-	0	-	Quartzite, shale
-18.08562	23.37620	36540	59	7	-	B	Kalahari
-18.20398	19.48798	39964	72	-	22	-	Kalahari
-18.24922	21.03687	39961	81	-	13	-	Kalahari
-18.26565	19.92525	39966	70	-	13	-	Kalahari
-18.34710	16.56610	8191	101	15	10	D	Kalahari
-18.35210	13.89570	33966	70	38	7	A	Dolomite
-18.36967	19.10807	39965	120	-	4	-	Kalahari
-18.43290	13.93950	33967	100	62	1	A	Siltstone
-18.52083	16.77250	2731	244	Artesian	100	D	Kalahari (Oshivelo Artesian Aquifer)
-18.58667	14.25833	36680	121	3	4	A	Calcrete, mudstone, sandstone
-18.77930	12.94510	33975	15	7	26	-	Gneiss
-18.97460	14.15555	35489	56	31	7	A	Calcrete, clay
-18.97460	14.15555	35490	154	32	15	A	Calcrete, clay, shale
-18.99536	17.60146	39980	398	11	2	B	Shale, mudstone (Karoo sequence)
-18.99643	16.40460	9581	32	Artesian	8	D	Dolomite (Tsumeb Subgroup)
-19.01942	14.47157	35827	101	13	150	B	Dolomite (Abenab Subgroup)
-19.08487	14.04905	35491	183	56	11	A	Calcrete, clay, shale
-19.10972	15.21255	37229	63	11	-	B	Kalahari (Limestone of Unconfined Kalahari Aquifer)
-19.21389	16.05861	3617	46	15	-	C	Kalahari (Limestone of Unconfined Kalahari Aquifer)
-19.30245	18.07460	40000	400	66	25	B	Dolomite, limestone (Abenab subgroup)
-19.33841	17.18271	39984	335	12	12	B	Quartzite, shale (Mulden group)
-19.38713	14.57475	37180	63	32	-	B	Khoabendus Formation
-19.41740	17.61896	39991	140	53	1	B	Quartzite (Nosib formation)
-19.41843	17.88354	39972	85	37	2	B	Gneiss (Grootfontein basement complex)
-19.52147	14.36407	4245	49	37	3	D	Gneiss
-19.99097	19.73580	39967	117	-	23	-	Kalahari
-20.02960	18.19470	37741	462	33	33	B	Kalahari
-20.13264	20.14354	39913	225	138	0	-	Kalahari
-20.15293	20.79700	39909	201	7	1	B	Dolomite
-20.15900	16.89290	30643	78	5	144	A	Marble
-20.16322	14.85734	7647	31	5	8	C	Gneiss

Latitude	Longitude	WW no	Depth [m]	Water level [m bgl]	Yield [m ³ /h]	Water quality	Aquifer host rock
-20.21846	14.07537	20020	58	6	2	B	Basalt
-20.25040	16.76110	29494	102	36	36	A	Marble
-20.34668	14.46168	39938	34	23	-	D	Gneiss
-20.36964	15.11598	30815	95	11	0	C	Schist
-20.46185	20.78952	39912	157	120	5	B	Calcrete, dolomite
-20.53340	17.36987	39910	171	-	0	-	Clay, siltstone, mudstone, schist
-20.54140	14.49924	6393	33	22	5	D	Granite
-20.67605	20.81943	39907	165	144	1	-	Kalahari
-20.87434	19.13697	39979	201	-	0	-	Sandstone, marble
-20.94361	17.43833	34684	120	75	2	A	Sandstone
-21.79917	18.87472	35206	102	1	100	A	Kalahari, quartzite (Eskadron)
-21.82020	15.56140	22159	27	7	8	A	Alluvium of Khan River with bedrock of granite, schist
-21.83023	20.47874	39906	201	-	0	A	Quartzite
-21.91410	14.46020	22194	100	28	70	A	Alluvium of Omaruru Delta
-22.08480	19.89810	39905	177	-	0	A	Kalahari
-22.14333	19.07555	35224	120	23	34	A	Kalahari, quartzite
-22.15358	17.11150	39908	99	6	1	C	Schist
-22.19138	19.04306	35229	102	24	82	A	Kalahari, quartzite
-22.28778	19.22778	35203	108	26	68	A	Quartzite
-22.36806	19.05222	35215	102	22	39	A	Quartzite
-23.25415	18.98668	39839	256	58	8	-	Sandstone (Auob member)
-23.34070	14.77480	20146	33	10	74	A	Alluvium of Kuiseb River
-23.40049	19.62557	39846	204	59	20	C	Sandstone (Auob member)
-23.40098	19.62489	39845	53	45	0	-	Basalt (Kalkrand basalt)
-23.40105	19.62621	39847	356	10	12	-	Sandstone (Nossob member)
-23.64747	18.38873	39840	131	17	3	A	Sandstone (Auob member)
-23.64808	18.38871	39841	209	7	3	-	Sandstone (Nossob member)
-23.88778	18.03833	34572	39	13	34	A	Basalt
-23.92722	18.04667	34534	54	3	6	A	Basalt
-23.96917	18.03944	34569	44	6	8	A	Basalt
-24.00194	18.21500	39857	141	2	45	A	Sandstone (Auob member)
-24.04592	18.79340	39842	102	19	2	-	Calcrete (Rietmond formation)
-24.04792	18.79312	39843	253	16	20	A	Sandstone (Auob member)
-24.04858	18.79614	39844	409	Artesian	0	A	Sandstone (Nossob member)
-24.32842	18.39794	39848	187	Artesian	1	-	Sandstone (Nossob member)
-24.79963	19.33457	39851	385	Artesian	-	-	Sandstone (Nossob member)
-24.80009	19.33483	39849	169	102	3	-	Kalahari
-24.80059	19.33520	39850	273	104	4	B	Sandstone (Auob member)
-25.00056	17.85667	33749	50	2	10	D	Carbonaceous shale
-25.09250	17.50889	34260	90	45	6	A	Sandstone
-25.19530	17.35000	33761	154	130	1	B	Sandstone
-25.29117	18.41650	39853	250	22	0	-	Sandstone (Nossob member)
-25.29163	18.41678	39852	55	10	7	-	Kalahari
-25.34940	17.68970	33784	86	12	4	A	Sandstone
-25.45174	19.43373	39855	250	172	-	D	Sandstone (Auob member)
-25.46028	19.42444	39854	129	60	0	C	Kalahari
-25.46148	19.43324	39856	346	20	-	D	Sandstone (Nossob member)
-25.48000	17.48972	34692	50	16	-	A	Sandstone
-25.51722	17.53556	34695	93	37	1	B	Sandstone
-25.73417	17.39611	33739	250	192	1	B	Sandstone
-26.21889	18.81250	34682	44	9	9	A	Sandstone
-26.33420	17.44670	33742	250	209	1	B	Sandstone

Annex 3: Irrigation schemes using groundwater

Scheme Name	Latitude	Longitude	Cons./Ha (m ³ /a)	1999 (Mm ³ /a)	Basin	Main crops
Aalborg	-19.15	17.85	15000	0.0450	Cuvelai	Vegetables
Abenab	-19.29	18.09	9000	0.1800	Cuvelai	Maize
Adrianople	-24.32	19.39	15000	0.0900	Nossob	
A'hingas	-25.39	18.63	18000	0.0000	Auob	
Ai-ais	-23.10	18.68	15000	0.0300	Nossob	
Areams	-23.86	19.05	17908	0.0537	Nossob	Lucerne
Awadoab	-24.00	18.95	15000	0.0450	Nossob	
Badenhorst	-23.36	18.70	15000	0.0600	Nossob	
Berg Aukas	-19.51	18.26	15000	0.1200	Omatako	Vegetables
Bernafay	-24.61	18.55	20000	0.2000	Auob	Vegetables, citrus
Blakeway	-22.64	14.67	20000	0.0200	Swakop	
Boomplaas	-24.56	18.53	15000	0.1500	Auob	Maize, lucerne
Cleopatra	-24.09	19.07	14086	0.0563	Nossob	Lucerne
Dawn	-19.50	18.10	15000	0.0150	Omatako	Vegetables
De Duinen	-24.59	18.45	15000	0.0750	Auob	
De Jager	-23.21	18.74	15000	0.0450	Nossob	
Die Vlakte	-19.47	14.89	10000	0.0300	Huab	Vegetables
Dobbin	-24.29	18.50	27138	0.5428	Auob	Vegetables, melons
Donnersberg	-23.19	18.65	25629	0.0769	Nossob	Lucerne
Drimiopsis	-22.09	19.06	10000	0.0400	Nossob	Vegetables
Eahero	-21.45	17.95	10000	0.1000	Omatako	Vegetables
Eendrag	-21.27	17.82	10000	0.0900	Omatako	Maize, vegetables
Eersbegin	-20.14	14.52	12000	0.3600	Huab	Dates
Eerstbegin	-24.36	18.58	20299	0.0609	Auob	Vegetables, prickly pears
Eirup	-24.22	18.41	22260	0.1336	Auob	Citrus, lucerne
Excelsior	-19.01	17.94	10000	0.0700	Cuvelai	Vegetables, maize
Fricourt	-24.55	18.66	14858	0.2972	Auob	Lucerne, table grapes
Friedrichsruhe	-19.16	17.81	7603	0.2281	Cuvelai	Maize
Gabis	-28.28	18.57	18000	0.0180	Orange	Fodder, vegetables
Gainatseb	-20.29	15.23	15000	0.0750	Huab	Citrus
Galenbeck	-24.16	18.13	18000	0.0000	Auob	
Galton	-23.32	18.68	15000	0.0450	Nossob	
Geinkous	-23.40	18.71	15000	0.0450	Nossob	
Georgia	-23.29	18.66	24000	0.0240	Nossob	Lucerne
Glave	-24.18	18.65	28290	0.4244	Auob	Table grapes
Goanikontes no 28/b	-22.67	14.84	9840	0.0492	Swakop	Dates, lucerne, fodder
Goanikontes Oos no 59	-22.67	14.82	8000	0.0240	Swakop	Dates, lucerne, prickly pears, asparagus, fodder
Gross Nabas	-24.50	18.55	29531	0.1772	Auob	Vegetables, melons
Guinas (Henning Farm)	-19.25	17.39	15000	0.4500	Cuvelai	Maize, wheat, cotton
Guinas vlei (Erasmus Farm)	-19.24	17.23	15000	0.0300	Cuvelai	Vegetables
Gunchab	-24.15	18.56	13200	0.0792	Auob	
Hartebeesteich Noord	-21.38	17.86	10000	0.0150	Omatako	Vegetables
Hartebeesteich Suid	-21.43	17.87	12000	0.0600	Omatako	Olives
Hartebeestloop	-24.36	18.75	7577	0.0379	Auob	
Heidelberg	-19.09	17.75	10754	0.1613	Cuvelai	
Hiebis Ost	-19.09	17.81	15000	0.0900	Cuvelai	Vegetables, citrus
Hoagosgeis	-23.79	18.95	15000	0.0450	Nossob	Lucerne
Hoogenhout	-24.37	18.36	24000	0.0960	Auob	Lucerne, table grapes
Huttenhof	-19.48	17.19	8073	0.2826	Cuvelai	Maize
Imkerhof	-21.23	17.74	10000	0.1000	Omatako	Cotton
Kameelboom	-24.25	18.73	12108	0.0726	Auob	Maize
Kameelpoort	-23.29	18.79	15000	0.0450	Nossob	
Klein Birkenfels	-22.64	14.75	18000	0.0000	Swakop	
Klein Hutte	-24.59	18.69	18000	0.0180	Auob	Lucerne, oats, seet potatoes
Klein Nabas West	-24.55	18.49	18000	0.2880	Auob	Lucerne, maize
Kombat	-19.76	17.68	15000	1.5000	Ugab	Maize, wheat
Kosis	-25.01	17.34	18000	0.0063	Fish	Fodder, vegetables
Kowarib	-19.26	13.75	4778	0.0860	Hoanib	Wheat, maize, tobacco, citrus
Kristall	-21.45	16.01	20000	0.1000	Omaruru	Vineyard, asparagus
Langverwacht	-25.02	18.52	15000	0.0450	Auob	
Lidfontein	-24.07	18.25	18000	0.0000	Auob	
Ludwigshaven	-19.15	17.78	20000	2.4000	Cuvelai	Maize, vegetables, citrus
Maitland	-21.31	17.75	10000	0.0500	Omatako	Vegetables
Mangetti Dune (Tsumkwe)	-18.50	17.66	10000	0.0500	Cuvelai	Vegetables

Scheme Name	Latitude	Longitude	Cons./Ha (m ³ /a)	1999 (Mm ³ /a)	Basin	Main crops
Mannheim farms and plots	-19.15	17.74	20000	3.0000	Cuvelai	Maize, wheat, lucerne, citrus, vegetables
Mara (Halifax)	-24.81	16.69	10000	0.0500	Fish	Vegetables
Middelplaats	-24.34	18.67	24529	0.5396	Auob	Vegetables, maize, melons
Nabas Ost	-24.50	18.66	24000	0.4800	Auob	Lucerne
Nadine	-22.65	14.70	18000	0.0000	Swakop	
Namatanga	-18.31	14.44	10000	0.0500	Cuvelai	Vegetables
Noasanabis	-23.46	18.82	18000	0.0180	Nossob	Lucerne, vegetables
Nunib	-24.20	18.57	11024	0.1764	Auob	Maize, wheat
Nuwe Coenbritz	-23.87	18.88	7256	0.0218	Nossob	Lucerne, vegetables
Nuwe Manie	-23.83	19.00	18487	0.0555	Nossob	Lucerne
Oanob river plots (Rehoboth)	-23.33	17.11			Oanob	
Okamahapu	-21.53	17.71	10000	0.1000	Omatako	Vegetables
Okaokasjoti	-21.40	16.03	10000	0.1200	Omaruru	Vegetables
Okongeama	-21.56	17.94	12000	0.0240	Omatako	Olives
Okoronyama	-21.32	16.09	10000	0.0200	Omaruru	Fodder
Olifants fontein	-19.45	18.02	20000	0.0000	Omatako	Vegetables, citrus
Omatako Dam (Mcloud)	-21.05	16.95	24000	0.4800	Omatako	Lucerne
Omupanda	-21.49	17.96	22000	0.0220	Omatako	Citrus
Orab	-24.74	17.91	15000	0.0750	Fish	
Osterode Nord	-24.40	18.42	24025	0.3604	Auob	Lucerne, maize, vegetables, melon
Osterode Sud	-24.42	18.47	21782	0.2178	Auob	Lucerne, vegetables
Otavi Farm	-19.68	17.39	12000	0.3600	Ugab	Maize, wheat
Otavi Fontein	-19.67	17.43	10160	0.2032	Ugab	Vegetables, citrus
Orjozondu Oos	-21.26	17.89	10000	0.0100	Omatako	Vegetables
Outjo farms	-20.14	16.25	15000	0.6900	Ugab	Vegetables
Palmenhorst	-22.69	14.90	18000	0.0000	Swakop	
Portion 11 of Omburo	-21.27	16.20	9550	0.0955	Omaruru	Fodder
Portion 3 of Omburo	-21.29	16.17	12000	0.0720	Omaruru	
Portion 6 & 9 Okoronyama	-21.32	16.11	12512	0.3754	Omaruru	Lucerne, citrus
Portion c of Kakombo	-21.36	15.98	11740	0.0117	Omaruru	Citrus, vegetables
RC Mission Aminuis	-23.69	19.44	10000	0.0300	Nossob	
RC Mission Waldfrieden	-21.39	16.10	18000	0.0360	Omaruru	Vegetables, lucerne
Remainder of Omburo	-21.24	16.24	20675	0.0827	Omaruru	Lucerne
Richthoven	-22.64	14.71	15000	0.0450	Swakop	Asparagus
Rietfontein Farm	-19.79	17.78	20000	1.6600	Omatako	Maize, lucerne
Rössing Uranium	-22.51	15.06	24781	0.2974	Swakop	Asparagus, vegetables
Ruhleben	-22.64	14.69	20333	0.0610	Swakop	
Schifloodage	-24.63	18.71	15000	0.0150	Auob	Lucerne, prickley pears, vegetables
Schurfpenz	-24.21	18.27	18000	0.0000	Auob	
Scott	-19.09	17.87	15000	0.1800	Cuvelai	Vegetables, citrus
Sesfontein	-19.15	13.59	12000	0.3600	Hoanib	Wheat, maize, tobacco, citrus
Skoonheid	-21.54	19.15	10000	0.0200	Okavango Delta	Vegetables
Sommerville	-23.73	18.94	10000	0.0500	Nossob	Maize, vegetables
Spes Bona	-21.35	18.13	22000	0.0880	Omatako	Citrus
Sponholz	-24.65	18.53	23270	0.1164	Auob	Lucerne
Stampriet	-24.32	18.42	25000	2.0000	Auob	Table grapes, vegetables, lucerne, melons
Swakopau	-22.64	14.63	9200	0.0046	Swakop	
Swartmodder	-24.31	18.19	18000	0.0000	Auob	
Tannenhof	-22.64	14.72	18000	0.0000	Swakop	
Three Sisters	-22.65	14.69	24000	0.1200	Swakop	Lucerne
Toekoms	-24.02	18.88	18000	0.0180	Nossob	Lucerne, prickley pears, vegetables
Tsumeb town and townlands	-19.26	17.71	24000	4.8000	Cuvelai	Lucerne
Uitkomst no 78 (Floodeischnann)	-22.64	14.65	24000	0.1920	Swakop	Lucerne
Urikuribus	-24.73	18.80	18000	0.0000	Auob	
Vaalbank	-23.93	18.87	18000	0.0000	Nossob	
Virginia	-23.24	18.65	24000	0.0240	Nossob	Lucerne
Walroda	-19.39	17.47	15000	0.0300	Ugab	Vegetables
Warmquelle/Ongongo	-19.17	13.81	12000	0.1920	Hoanib	Wheat, maize, tobacco, citrus
Welgevonde	-23.97	18.88	6080	0.0304	Nossob	Lucerne, vegetables
Westfalen	-23.66	18.02	20000	0.1600	Auob	Citrus, vegetables
Witkranz	-24.44	18.53	8000	0.0560	Auob	Lucerne, vegetables, cotton, maize
Wolfputz	-23.91	18.12	18000	0.0000	Auob	

Annex 4: Comparison of selected guideline values for drinking water quality

Parameter and Expression of the results			WHO Guidelines for Drinking-Water Quality 2nd edition 1993	Proposed Council Directive of 28 April 1995 (95/C/13-1/03) EEC	Council Directive of 15 July 1980 relating to the quality intended for human consumption 80/778/EEC		U.S. EPA Drinking Water Standards and Health Advisories Table December 1995	Namibia, Department of Water Affairs Guidelines for the evaluation of drinking-water for human consumption with reference to chemical, physical and bacteriological quality July 1991				
			Guideline Value (GV)	Proposed Parameter Value	Guide Level (GL)	Maximum Admissible Concentration (MAC)	Maximum Contaminant Level (MCL)	Group A Excellent Quality	Group B Good Quality	Group C Low Health Risk	Group D Unsuitable	
Temperature	t	° C	-	-	12	25	-	-	-	-	-	-
Hydrogen ion concentration	pH, 25° C	-	R < 8.0	6.5 to 9.5	6.5 to 8.5	10	-	6.0 to 9.0	5.5 to 9.5	4.0 to 11.0	< 4.0 to > 11.0	
Electronic conductivity	EC, 25° C	mS/m	-	280	45	-	-	150	300	400	> 400	
Total dissolved solids	TDS	mg/l	R 1000	-	-	1500	-	-	-	-	-	
Total Hardness	CaCO ₃	mg/l	-	-	-	-	-	300	650	1300	> 1300	
Aluminium	Al	µg/l	R 200	200	50	200	S 50-200	150	500	1000	> 1000	
Ammonia	NH ₄ ⁺	mg/l	R 1.5	0.5	0.05	0.5	-	1.5	2.5	5.0	> 5.0	
	N	mg/l	1,0	-	0.04	0.4	-	1.0	2.0	4.0	> 4.0	
Antimony	Sb	µg/l	P 5	3	-	10	C 6	50	100	200	> 200	
Arsenic	As	µg/l	P 10	10	-	50	C 50	100	300	600	> 600	
Barium	Ba	µg/l	700	-	100	-	C 2000	500	1000	2000	> 2000	
Beryllium	Be	µg/l	-	-	-	-	C 4	2	5	10	> 10	
Bismuth	Bi	µg/l	-	-	-	-	-	250	500	1000	> 1000	
Boron	B	µg/l	300	300	1000	-	-	500	2000	4000	> 4000	
Bromate	BrO ₃ ⁻	µg/l	-	10	-	-	P 10	-	-	-	-	
Bromine	Br	µg/l	-	-	-	-	-	1000	3000	6000	> 6000	
Cadmium	Cd	µg/l	3	5	-	5	C 5	10	20	40	> 40	
Calcium	Ca	mg/l	-	-	100	-	-	150	200	400	> 400	
	CaCO ₃	mg/l	-	-	250	-	-	375	500	1000	> 1000	
Cerium	Ce	µg/l	-	-	-	-	-	1000	2000	4000	> 4000	
Chloride	Cl ⁻	mg/l	R 250	-	25	-	S 250	250	600	1200	> 1200	
Chromium	Cr	µg/l	P 50	50	-	50	C 100	100	200	400	> 400	
Cobalt	Co	µg/l	-	-	-	-	-	250	500	1000	> 1000	
Copper after 12 hours in pipe ¹	Cu	µg/l	P 2000	2	100	-	C TT##	500	1000	2000	> 2000	
		µg/l	-	-	3000 ¹	-	S 1000	-	-	-	-	
Cyanide	CN ⁻	µg/l	70	50	-	50	C 200	200	300	600	> 600	
Fluoride	F ⁻	mg/l	1.5	1.5	-	at 8 to 12 ° C: 1.5	C 4	1.5	2.0	3.0	> 3.0	
		mg/l	-	-	-	at 25 to 30 ° C: 0.7	P, S 2	-	-	-	-	
Gold	Au	µg/l	-	-	-	-	-	2	5	10	> 10	
Hydrogen sulphide	H ₂ S	µg/l	R 50	-	-	undetectable organoleptically	-	100	300	600	> 600	
Iodine	I	µg/l	-	-	-	-	-	500	1000	2000	> 2000	
			P: Provisional R: May give reason to complaints from consumers				C: Current; P: Proposed; S: Secondary; T#: Treatment technique in lieu of numeric MCL; TT##: Treatment technique triggered at action level of 1300 µg/l					

Parameter and Expression of the results			WHO Guidelines for Drinking-Water Quality 2nd edition 1993		Proposed Council Directive of 28 April 1995 (95/C/13-1/03) EEC		Council Directive of 15 July 1980 relating to the quality intended for human consumption 80/778/EEC		U.S. EPA Drinking Water Standards and Health Advisories Table December 1995		Namibia, Department of Water Affairs Guidelines for the evaluation of drinking-water for human consumption with reference to chemical, physical and bacteriological quality July 1991			
			Guideline Value (GV)	Proposed Parameter Value	Guide Level (GL)	Maximum Admissible Concentration (MAC)	Maximum Contaminant Level (MCL)	Group A Excellent Quality	Group B Good Quality	Group C Low Health Risk	Group D Unsuitable			
Iron	Fe	µg/l	R 300	200	50	200	S	300	100	1000	2000	> 2000		
Lead	Pb	µg/l	10	10	-	50	C	TT#	50	100	200	> 200		
Lithium	Li	µg/l	-	-	-	-		-	2500	5000	10000	> 10000		
Magnesium	Mg	mg/l	-	-	30	50		-	70	100	200	> 200		
	CaCO ₃	mg/l	-	-	7	12		-	290	420	840	> 840		
Manganese	Mn	µg/l	P 500	50	20	50	S	50	50	1000	2000	> 2000		
Mercury	Hg	µg/l	1	1	-	1	C	2	5	10	20	> 20		
Molybdenum	Mo	µg/l	70	-	-	-		-	50	100	200	> 200		
Nickel	Ni	µg/l	20	20	-	50		-	250	500	1000	> 1000		
Nitrate *	NO ₃ ⁻	mg/l	50	50	25	50		45	45	90	180	> 180		
	N	mg/l	-	-	5	11	C	10	10	20	40	> 40		
Nitrite *	NO ₂ ⁻	mg/l	P 3	0,1	-	0,1		3	-	-	-	-		
	N	mg/l	-	-	-	-	C	1	-	-	-	-		
Oxygen, dissolved	O ₂	% sat.	-	50	-	-		-	-	-	-	-		
Phosphorus	P ₂ O ₅	µg/l	-	-	400	5000		-	-	-	-	-		
	PO ₄ ³⁻	µg/l	-	-	300	3350		-	-	-	-	-		
Potassium	K	mg/l	-	-	10	12		-	200	400	800	> 800		
Selenium	Se	µg/l	10	10	-	10	C	50	20	50	100	> 100		
Silver	Ag	µg/l	-	-	-	10	S	100	20	50	100	> 100		
Sodium	Na	mg/l	R 200	-	20	175		-	100	400	800	> 800		
Sulphate	SO ₄ ²⁻	mg/l	R 250	250	25	250	S	250	200	600	1200	> 1200		
Tellurium	Te	µg/l	-	-	-	-		-	2	5	10	> 10		
Thallium	Tl	µg/l	-	-	-	-	C	2	5	10	20	> 20		
Tin	Sn	µg/l	-	-	-	-		-	100	200	400	> 400		
Titanium	Ti	µg/l	-	-	-	-		-	100	500	1000	> 1000		
Tungsten	W	µg/l	-	-	-	-		-	100	500	1000	> 1000		
Uranium	U	µg/l	-	-	-	-	P	20	1000	4000	8000	> 8000		
Vanadium	V	µg/l	-	-	-	-		-	250	500	1000	> 1000		
Zinc after 12 hours in pipe	Zn	µg/l	R 3000	-	100	-	S	5000	1000	5000	10000	> 10000		
		µg/l	-	-	5000	-		-	-	-	-	-		
* C _{NO3} / GV _{NO3} + C _{NO2} / GV _{NO2} 1			P: Provisional R: May give reason to complaints from consumers				C: Current; P: Proposed; S: Secondary; T#: Treatment technique in lieu of numeric MCL; TT#: Treatment technique triggered at action level of 1300 µg/l							

Glossary

- a** Annum (lat.), year.
- a BP** Years before present (= 1950).
- Acrisol** Soil having a B horizon with illuvial accumulation of clay and low base saturation.
- aeolian** Pertinent to the action of wind.
- Ag** Silver.
- Al** Aluminium.
- Alluvium** Sediments deposited by flowing rivers. Depending on the location in the floodplain in the river, different sized sediments are deposited.
- Amphibolite** High grade metamorphic rock.
- AN** Andoni Formation.
- Anion exchange** Ion exchange process in which anions in solution are exchanged for other anions from an ion exchanger.
- Aquiclude** A geologic formation, group of formations, or part of a formation through which virtually no water moves.
- Aquifer** Rock or sediment in a formation, group of formations, or part of a formation that is saturated and sufficiently permeable to transmit economic quantities of water to boreholes or springs.
- Aquifer, confined** An aquifer that is overlain by a confining bed. The confining bed has a significantly lower hydraulic conductivity than the aquifer.
- Aquifer, perched** Aquifer containing isolated bodies of groundwater suspended above water table.
- Aquifer, semi-confined** An aquifer confined by a low permeability layer that permits water to flow slowly through it. During pumping of the aquifer, recharge to the aquifer can occur across the confining layer. Also known as a leaky artesian or leaky confined aquifer.
- Aquifer, unconfined** Aquifer where the water table is exposed to the atmosphere through openings in the overlying materials.
- Aquifer test** A test involving the withdrawal of measured quantities of water from or the addition to, a well and the measurement of the resulting changes in head in the aquifer both during and after the period of discharge or addition.
- Aquitard** A saturated, but poorly permeable bed, formation, or group of formations that does not yield water freely to a well or spring. However, an aquitard may transmit appreciable water to and from adjacent aquifers.
- Arenosol** Weakly developed, deep sandy soil.
- Argillite, argilliceous** Clayey sediment, compacted.
- Arkose** A sandstone containing 25 % or more of feldspars. Usually derived from disintegrated acid igneous rock of granitoid texture.
- Artesian well** A well deriving its water from an confined aquifer in which the water level stands above the ground surface; synonymous with flowing artesian well.
- Artificial recharge** The process by which water can be injected or added to an aquifer. Dug basins, drilled wells, or simply the spread of water across the surface are all means of artificial recharge.
- As** Arsenic.
- asl** Above sea level.
- Atm** Atmosphere(s).
- Basalt** A general term for dark-coloured iron- and magnesium rich igneous rocks, commonly extrusive, but locally intrusive. It is the principle rock making up the ocean floor.
- Bedrock** A general term for the rock, usually solid, that underlies soil or other unconsolidated material.
- Bentonite** A colloidal clay, largely made up of the mineral sodium montmorillonite, a hydrated aluminium silicate.
- bgl** Below ground level.
- BGR** Bundesanstalt für Geowissenschaften und Rohstoffe / Federal Institute for Geosciences and Natural Resources, Hannover, Germany.
- BMZ** Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung / Federal Ministry for Economic Cooperation and Development, Bonn/Berlin, Germany.
- Borehole development** The process by which a borehole is pumped or surged to remove any fine material that may be blocking the well screen or the aquifer outside the well screen.
- Brackish** 1 000 to 10 000 mg/L TDS or 150 to 1 500 mS/m EC, or Group B to C quality.
- C** Capita.
- °C** Grad Celsius, dimension of temperature.
- Ca** Calcium.
- Calcisol** Soil characterised by calcium carbonate (CaCO₃).
- Calcrete** Carbonates, precipitated from rain water or groundwater (see Box on page 20-21).
- Cambisol** Soil in an early stage of development.
- Carbonate rocks** A rock consisting of chiefly of carbonate minerals, such as limestone and dolomite.
- Casing** A solid piece of pipe, typically steel or PVC plastic, used to keep a well open in either unconsolidated materials or unstable rock.
- Cementing** The operation by which grout is placed between casing and the sides of the well bore to a predetermined height above the bottom of the well. This secures the casing in place and excludes water and other fluids from the well bore.
- Cone of depression** A depression in the groundwater table or the potentiometric surface that has the shape of an inverted cone and develops around a well from which water is withdrawn. It defines the area of influence of a well.
- Conglomerate** A sedimentary rock containing rounded water-worn fragments of rock or pebbles, cemented together by another mineral substance.
- Cl** Chloride.

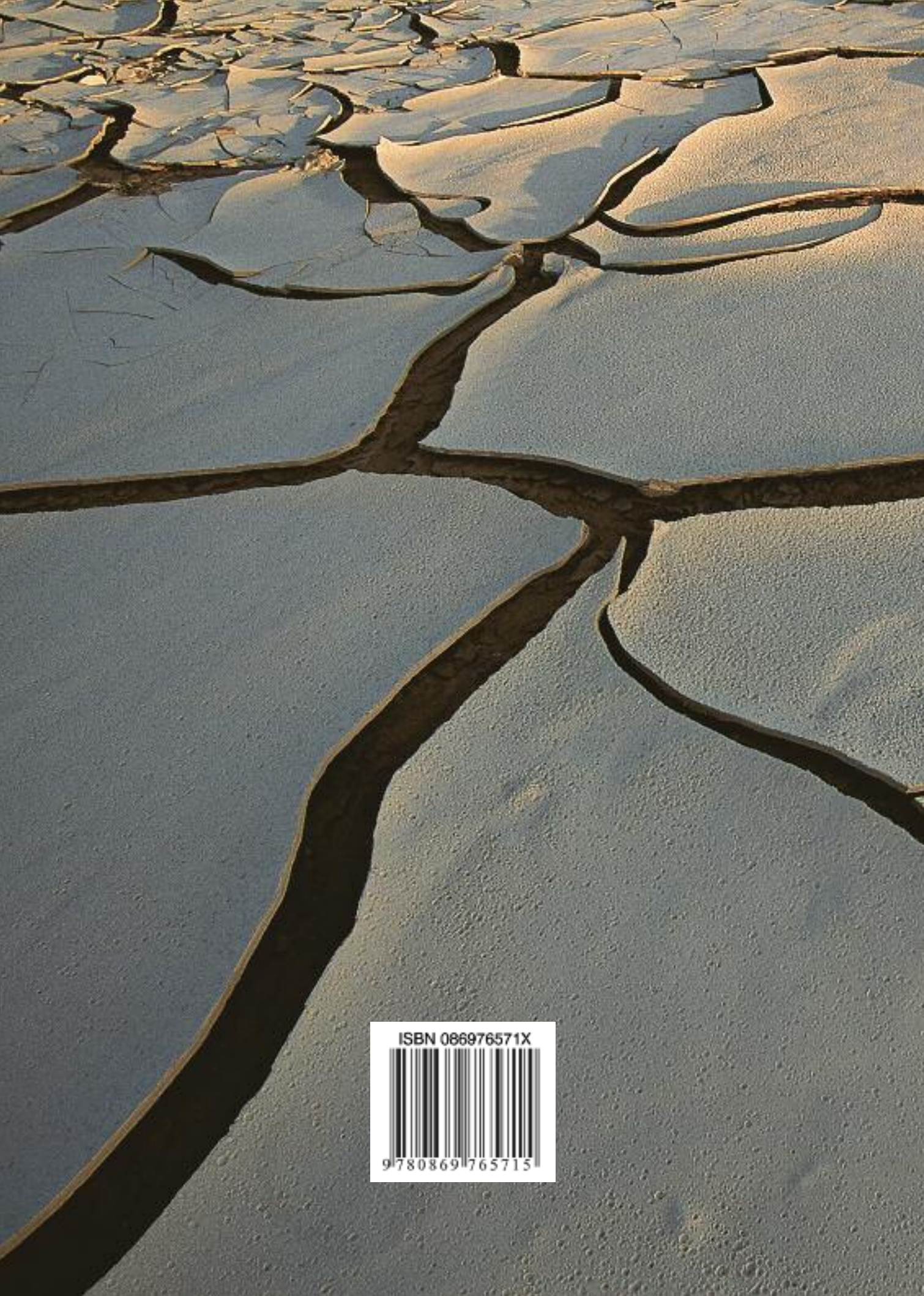
- Contaminant** Any solute or cause of change in physical properties that renders water unfit for a given use.
- CO₂** Carbon dioxide.
- CSIR** The Council for Scientific and Industrial Research, Republic of South Africa.
- Cu** Copper.
- d** Day.
- D** Water saturated thickness in metre.
- Darcy's Law** A derived equation for the flow of fluids on the assumption that flow is laminar and that inertia can be neglected.
- Desalination** To remove salt and other chemicals from sea or saline water.
- Discharge area** An area in which there are upward components of hydraulic head in the aquifer - Groundwater is flowing toward the surface in a discharge area and may escape as a spring, seep, or baseflow or by evaporation and transpiration.
- Drainage basin** The land area from which surface runoff drains into a river system.
- Dolerite** A coarser grained rock of basaltic composition intruding as dykes or sills within the earth's crust.
- Dolocrete** Gravel, sand or desert debris cemented by porous calcium magnesium carbonate.
- Drawdown** The lowering of the water table of unconfined aquifer or the potentiometric surface of a confined aquifer caused by pumping of groundwater from boreholes.
- Dunite** A nonfeldspathic plutonic rock consisting almost entirely of olivine and containing accessory pyroxene and chromite.
- Durisol** Hard crust soil.
- DWA** Department of Water Affairs, Windhoek, Namibia.
- DPA** Discontinuous Perched Aquifer.
- E** East.
- EEC** European Economic Commission, Brussels, Belgium.
- EC** Electrical conductivity of water in $\mu\text{S}/\text{cm}$ or mS/cm at 25°C .
- Effluent** A waste liquid discharge from a manufacturing or treatment process, in its natural state or partially or completely treated, that discharges into the environment.
- e.g.** For example.
- Electrical conductance** A measure of the ease with which a conducting current can be caused to flow through a material under the influence of an applied electric field. It is reciprocal of resistivity and is measured in mhos metre.
- Electrical resistivity** The property of a material which resists the flow of an electric current measured per unit length through a unit cross sectional area.
- ENWC** Eastern National Water Carrier (see Box on page 70-71).
- Equipotential line** A contour line on the water table or the potentiometric surface, a line along which the pressure head of groundwater in an aquifer is the same. Fluid flow is normal to these lines in the direction of decreasing fluid potential.
- Evaporation** The process by which water passes from liquid to vapour state.
- Evapotranspiration** Loss of water from a land area through transpiration of plants and evaporation from the soil.
- Facies** A stratigraphic body as distinguished from other bodies of different appearance and composition.
- Fault** A fracture or a zone of fractures along which there has been displacement of the sides relative to one another parallel to the fracture.
- Fe** Iron.
- Ferralsol** Soil with a high content of iron oxides.
- Filterpack** Sand or gravel that is smooth, uniform, clean, well-rounded and siliceous. It is placed in the annulus of the well between the borehole wall and the well screen to prevent formation material from entering the screen.
- Floodplain** The surface or strip of a relative smooth land adjacent to a river channel, constructed by the present river and covered with water when the river overflows its banks. It is built of alluvium carried by the river during floods and deposited in the sluggish water beyond the influence of the swiftest current.
- fluvial, fluvialite** Pertinent to the action of river water.
- Fm** Formation.
- Fossil water** Interstitial water that was buried the same time as the sediment.
- Foyaitite** Syenitic rocks containing almost equal proportions of feldspathoids and potash feldspars.
- fresh** $<1\,000\text{ mg/L TDS}$ or $<150\text{ mS/m EC}$ or Group A quality.
- Gabbro** Dark-coloured, basic intrusive rock.
- GKA** Grootfontein Karst Aquifer comprising synclines 1 to 3.
- Gleysol** Excessively wet soil with a gley horizon.
- GOC** Grootfontein-Omatako Canal.
- Granite** Quartz-bearing, plutonic rock.
- Groundwater** The water contained in interconnected pores located below the water table in an unconfined aquifer or located in a confined aquifer.
- Groundwater basin** A rather vague designation pertaining to a groundwater reservoir that is more or less separated from neighbouring groundwater reservoirs. A groundwater basin could be separated from adjacent basins by geological boundaries or by hydrological boundaries.
- Groundwater flow** The movement of water through openings in sediment and rock; occurs in the zone of saturation.
- Groundwater table** The surface between the zone of saturation and the zone of aeration; the surface of an unconfined aquifer.

- Group A** No risk, excellent water quality.
- Group B** Insignificant risk, good quality water.
- Group C** Low risk.
- Group D** High risk or water unsuitable for human consumption.
- GSN** Geological Survey of Namibia, Windhoek.
- ha** Hectare, (1 ha = 10 000 m²).
- Hardness** A property of the water causing formation of an insoluble residue when water is used with soap. Sum of the ions which can precipitate as "hard particles" from water. Sum of Ca²⁺ and Mg²⁺, and sometimes Fe²⁺. Expressed in mg/L CaCO₃ or in hardness degrees. Temporary hardness is the part of Ca²⁺ and Mg²⁺ concentrations, which are balanced by HCO₃⁻ and can thus precipitate as carbonate. Permanent hardness is the part of Ca²⁺ and Mg²⁺ being in excess HCO₃⁻. Total hardness is the sum of temporary and permanent hardness.
- Hardness ranges** [mg/L CaCO₃] (0-75 = soft; 75-150 = moderately hard; 150-300 = hard; >300 = very hard).
- HCO₃⁻** Bicarbonate.
- Head** Energy contained in a water mass, produced by elevation, pressure, or velocity.
- heterogeneous** Pertaining to a substance having different characteristics in different locations. A synonym for non-uniform.
- homogeneous** Pertaining to a substance having identical characteristics everywhere. A synonym is uniform.
- Hydraulic conductivity** A coefficient of proportionality describing the rate at which water can move through a permeable medium. The density and kinematic viscosity of the water must be considered in determining the hydraulic conductivity.
- Hydraulic gradient** The change in the total head with the change in distance in a given direction. The direction is that which yields a maximum rate of decrease in head.
- Hydraulic parameter** Values (K, T, s) that are determined quantitatively to characterise the aquifer, and are used for modelling.
- Hydrogeology** The study of interrelationships of geologic materials and processes with water, especially groundwater.
- Hydrologic cycle** The circulation of water from oceans through the atmosphere to the land and ultimately back to the ocean.
- Hydrology** The study of the occurrence, distribution and chemistry of all waters of the earth.
- IAEA** International Atomic Energy Agency.
- i.e.** That is.
- Igneous rocks** Rocks that solidified from molten material, that is, a magma.
- Inselberg** Erosion rest of previously wider extended rock cover.
- Intrusive rocks** Those igneous rocks that formed from magma injected beneath the earth's surface. Generally these rocks have large crystals by slow cooling.
- Ion exchange** A process by which an ion in a mineral lattice is replaced by another ion that was present in aqueous solution.
- isostatic** Subject to equal pressure from every side; being in hydrostatic equilibrium.
- Isopach** Contour lines indicating areas of equal depth.
- K** Hydraulic conductivity in m/d or m/s, K = T/D.
- Karst** The type of geologic terrain underlain by carbonate rocks where significant solution of the rock has occurred due to the flowing of groundwater.
- km** Kilometre.
- L** Litre.
- Landfill** A general term indicating a disposal site of refuse, dirt from excavations, and junk.
- lacustrine** In a lake environment.
- Leachate** A liquid that has percolated through solid waste and dissolved soluble components.
- Leptosol** Shallow, stony soil overlying rock.
- Limestone** A sedimentary rock consisting chiefly of calcium carbonate, primarily in the form of the mineral calcite.
- Lithology, lithologic** Rock composition, rock type.
- Luvisol** Soil with prominent illuvial accumulation of clay in the subsoil.
- m** Metre.
- m²** Square metre.
- Ma** Million years.
- MAC** Maximum Admissible Concentration.
- Mantle** Layer of the earth between crust and core.
- MDA** Main Deep Aquifer.
- Mm³** Million cubic metre.
- Mm³/a** Million cubic metre per annum.
- meteoric** Pertaining to recent atmospheric water.
- Metamorphic rocks** Any rock derived from pre-existing rocks by mineralogical, chemical, and/or structural changes, essentially in a solid state, in response to marked changes in temperature, pressure, shearing stress, and chemical environment, generally at depth in the Earth's crust.
- Mg** Magnesium.
- Mg/L** Milligrams per litre of sample.
- Min** Minute.
- mm** Millimetre, e.g. 10 mm rainfall equals 10 L/m².
- mS/m** MilliSiemens/metre, dimension of EC, =10 μS/cm.
- N** North.
- Na** Sodium.
- n/a** Not applicable, not available.

- NamWater** Namibia Water Corporation (Ltd.), Windhoek.
- NO³** Nitrate.
- OAA** Oshivelo Artesian Aquifer.
- Observation well** A well drilled at a selected location for the purpose of observing parameters such as water levels and pressure changes.
- ODA** Otavi Dolomite Aquifer.
- Ol** Olukondo formation.
- OMAP** Omaruru River alluvial plain.
- OMDEL** Omaruru River Delta (see Box on page 83).
- OMPL** Ongopolo.
- Orogeny** The process of forming mountains, particularly by folding and thrusting.
- Pb** Lead.
- pedogenic** Related to soils or soil water.
- Pelite** Fine grained, clayey sediment.
- Permeability** The property or capacity of a porous rock, sediment, or soil transmitting a fluid; it is a measure of the relative ease of fluid flow under unequal pressure.
- petrographic** Concerning the mineralogical composition of rocks.
- pH** A measure of the acidity and alkalinity of a solution, numerically equal to 7 for neutral solutions, increasing with increasing alkalinity and decreasing with increasing acidity. Originally stood for the words potential of hydrogen. It is calculated as $-\log [H^+]$, the log of H^+ activity.
- Phyllite** A metamorphosed clay-bearing rock intermediate in grade between slate and schist.
- piezometric head** Pressure head of groundwater in a well or borehole.
- plutonic rock** An igneous rock formed when magma cools and crystallises within the earth.
- Pollutant** Any solute or cause of change in physical properties that renders water unfit for a given use.
- Pore space** The volume between mineral grains of a porous medium.
- Porosity** The ration of volume of void spaces in a rock or sediment to the total volume of the rock or sediment.
- potentiometric surface** A surface that represents the level o which water will rise in tightly cased boreholes. If the head varies significantly with the depth in the aquifer, then there are may be more than one potentiometric surface. The water table is a particular potentiometric surface for an unconfined aquifer.
- Primary porosity** The porosity that represents the original pore openings when a rock or sediment is formed.
- Pumping test** A test made by pumping a borehole for a period of time and observing the change in the hydraulic head of the aquifer. A pumping test may be used to determine the capacity of the borehole and the hydraulic characteristics of the aquifer. Also called an aquifer test.
- Pyroclastics** A rock consisting of unworked solid material of whatever size explosively or aerially ejected from a volcanic vent.
- Pyroxenite** A medium or coarse-grained rock consisting essentially of pyroxene.
- Q** Pump discharge in m³/h.
- Quartzite** A granulose metamorphic rock consisting essentially of quartz granules.
- Recharge** The addition of water to a zone of saturation; also, the amount of water added.
- Recharge area** An area where there are downward components of hydraulic head in the aquifer. Infiltration moves downward into the deeper parts of an aquifer in the recharge area.
- Recharge basin** A basin or pit excavated to provide means of allowing water to soak into the ground at rates exceeding those that would occur naturally.
- Recharge well** A borehole specifically designed so that water can be pumped into an aquifer in order to recharge the groundwater reservoir.
- Recovery** The rate at which the water level in a well rises after the pump has been shut off. It is the inverse of draw down.
- Regosol** Soil with weak or no development.
- Rhyolite** An extrusive equivalent of a granite.
- River, ephemeral** A river that is mostly dry and only subject to water flow for short periods after heavier rainfall events.
- River, perennial** A river that is subject to flow throughout the year.
- Runoff** The total amount of water flowing in a stream. It includes overland flow, return flow, interflow and baseflow.
- s** Second.
- s** Storage coefficient.
- S** South.
- Safe yield** The amount of naturally occurring groundwater that can be economically and legally withdrawn from an aquifer on a sustained basis without impairing the native groundwater quality or creating an undesirable effect such as environment damage. It cannot exceed the increase or leakage from adjacent strata plus the reduction in discharge, in which due to the decline in head caused by pumping.
- Saline** > 10 000 mg/L TDS or >1500 mS/m EC or Group D quality.
- Salinity ranges** Classification: TDS [mg/L] / EC [mS/m] (fresh = < 1000 / <150; brackish = 1000 to 10 000 / 150 to 1500; saline = >10 000 / >1500).
- Sandstone** A sedimentary rock composed of abundant rounded or angular fragments of sand set in a fine grained matrix (silt or clay) and more or less firmly united by cementing material.
- Sapropelite** A fluid organic slime originating in swamps as

- a product of putrefaction. Often contains hydrocarbons. Substance becomes tough when dry.
- saturated zone** The zone in which the voids in the rock or soil are filled with water at a pressure greater than atmospheric. The water table is the top of the saturated zone in an unconfined aquifer.
- Schist** A medium or coarse-grained metamorphic rock with sub-parallel orientation of the micaceous minerals which dominate its composition.
- secondary porosity** The porosity that has been caused by fractures or weathering in a rock or sediment after it has been formed.
- sedimentary rock** A rock formed from sediments through a process known as diagenesis or formed by the chemical precipitation of water.
- Shale** A fine-grained sedimentary rock, formed by the consolidation of clay, silt and mud. It is characterised by finely laminated structure and it is sufficiently indurated so that it will not fall apart on wetting.
- Siltstone** A very fine-grained consolidated clastic rock composed predominantly of particles of silt grade.
- SO₄** Sulphate.
- Solonetz** Soil with B horizon rich in sodium and/or magnesium.
- Solonchak** Soil having a high salinity and no well-developed subsurface horizons.
- static water level** The level of water in a well that is not being affected by withdrawal of water.
- Storativity, storage coefficient** The volume of water an aquifer releases from or takes into storage per unit surface area of an aquifer per unit change in hydraulic head. It is equal to the product of specific storage and the aquifer thickness. In an unconfined aquifer the storativity is equivalent to the specific yield. Also called storage coefficient.
- Stratigraphy** A study of rock strata, especially in their distribution, deposition and age.
- Surface water** Water found in ponds, lakes, inland seas, streams and rivers.
- Syenite** A plutonic igneous rock consisting principally of alkalic feldspar usually with one or more mafic minerals such as hornblende or biotite.
- T** Temperature in °C.
- T** Transmissivity.
- TCL** Tsumeb Corporation Ltd. (Member of Gold Fields Namibia Ltd.).
- TDS** Total dissolved solids in mg/L; (sum of cations and anions); (in DWA analytical reports TDS is calculated: TDS = 6.6 x EC).
- TKA** Tsumeb Karst Aquifer comprising the Abenab-Tsumeb Synklinorium.
- TH** Total hardness, refer to "Hardness".
- Transmissivity** The rate at which water of a prevailing density and viscosity is transmitted through a unit width of an aquifer or confining bed under a unit hydraulic gradient. It is a function of the properties of the liquid, the porous media and the thickness of the porous media.
- Transpiration** The process by which water absorbed by plants, usually through the roots, is evaporated into the atmosphere from the plant surface.
- Travertine** Calcium carbonate, of light colour and usually concretionary and compact, deposited from solution in ground and surface waters.
- Tufa** A chemical sedimentary rock composed of calcium carbonate or of silica, deposited from solution in the water of a spring or lake or from percolating ground water.
- UKA** Unconfined Kalahari Aquifer.
- US-EPA** United States Environmental Protection Agency, Washington, D.C.
- V** Vanadium.
- VDA** Very Deep Aquifer.
- Vertisol** Soil topped with clay which crack when dry.
- Vlei** A small swamp, usually open and containing a pond.
- Volcanic rock** An igneous rock formed when molten rock called lava cools on the earth's surface.
- W** West.
- Water budget** An evaluation of all the sources of supply and the corresponding discharges with respect to an aquifer or drainage basin.
- Water table** The surface in an unconfined aquifer or confining bed at which the pore water pressure is atmospheric. It can be measured by installing shallow wells extending a few metres into the zone of saturation and then measuring the water level in those wells.
- Water type** Ions with a relative concentration (fraction) ≥ 20 meq % are name-giving, e.g. Ca-Mg-HCO₃.
- Well screen** Filtering device used to keep sediment from entering well.
- Well yield** The volume of water discharged from a well in cubic metres per hour or cubic metres per day.
- Weir** A device placed across a stream and used to measure the discharge by having water flow over a specifically designed spillway.
- WHO** World Health Organisation, Geneva, Switzerland.
- WL** Water level in metres below ground level (bgl).
- Zn** Zinc.





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