Appendix A: Groundwater

Table A 1: Groundwater use as registered in WARMS, (total per GRU) per water use category, per major geological grouping, per GRU)

GRU	Major Geology	Water Use Sector	Number of registrations	Sum of registrations m^3/a
BB-1	Bokkeveld Group	AGRICULTURE	121	15471965
		INDUSTRY	2	72710
		WATER SUPPLY SERVICE	4	65900
	Coastal Cenozoic Deposits	AGRICULTURE	56	3950704
		INDUSTRY	4	11928
		SCHEDULE 1	2	3152
		WATER SUPPLY SERVICE	2	6576
	TMG	AGRICULTURE	93	12618066
		INDUSTRY	4	609225
		SCHEDULE 1	1	1576
		WATER SUPPLY SERVICE	11	73357
			Total	**32885159**
BB-2	Bokkeveld Group	AGRICULTURE	48	3655233
		INDUSTRY	1	17600
		WATER SUPPLY SERVICE	1	26400
	Coastal Cenozoic Deposits	AGRICULTURE	119	14924637.5
		SCHEDULE 1	1	36000
		WATER SUPPLY SERVICE	1	10000
	TMG	AGRICULTURE	37	4044467
		INDUSTRY	2	213720
		SCHEDULE 1	2	15298
		WATER SUPPLY SERVICE	1	5120
			Total	**22948475.5**
BB-3	Basement And Intrusive	AGRICULTURE	29	2235995
		INDUSTRY	1	13600
		WATER SUPPLY SERVICE	4	30152
	Coastal Cenozoic Deposits	AGRICULTURE	205	18389953
		INDUSTRY	5	99883
		WATER SUPPLY SERVICE	4	647080
	TMG	AGRICULTURE	37	2351944
		INDUSTRY	2	317195
		RECREATION	1	192677
			Total	**24277679**
BB-4	Bokkeveld Group	AGRICULTURE	147	1121685
	Coastal Cenozoic Deposits	AGRICULTURE	59	362538
	TMG	AGRICULTURE	28	527406
		INDUSTRY	1	3650

GRU	Major Geology	Water Use Sector	Number of registrations	Sum of registrations m^3/a
			Total	**2015279**
BB-5	Basement And Intrusive	AGRICULTURE	33	2339982
	Coastal Cenozoic Deposits	AGRICULTURE	161	13411099
		INDUSTRY	9	339358
		SCHEDULE 1	4	105742
		WATER SUPPLY SERVICE	2	13676
	TMG	AGRICULTURE	24	2511929
	Uitenhage Group	AGRICULTURE	1	78870
			Total	**18800656**
BB-6	Bokkeveld Group	AGRICULTURE	210	96296216
		INDUSTRY	1	1576
		RECREATION	1	129037
		SCHEDULE 1	2	25800
		WATER SUPPLY SERVICE	2	39200
	Coastal Cenozoic Deposits	AGRICULTURE	32	1567140.32
	TMG	AGRICULTURE	55	2612576
		SCHEDULE 1	1	7884
	Witteberg Group	AGRICULTURE	3	110560
			Total	**14123390**
BB-7	Basement And Intrusive	AGRICULTURE	11	388200
	Bokkeveld Group	AGRICULTURE	21	1362358
		INDUSTRY	2	20720
		URBAN (EXCLUDING INDUSTRIAL &/OR DOMESTIC)	1	10000
	Coastal Cenozoic Deposits	AGRICULTURE	1	6124843
		INDUSTRY	1	217152
		MINING	2	24000
		SCHEDULE 1	5	82152
	TMG	AGRICULTURE	30	701932
		WATER SUPPLY SERVICE	1	8395
	Uitenhage Group	AGRICULTURE	7	86902
			Total	**9027654**
BB-8	Bokkeveld Group	AGRICULTURE	1	100000
	Coastal Cenozoic Deposits	AGRICULTURE	7	591059
		WATER SUPPLY SERVICE	1	1576
	TMG	AGRICULTURE	3	136946
	Witteberg Group	INDUSTRY	1	1576
			Total	**831157**
BO-1	Bokkeveld Group	AGRICULTURE	1	416100
		INDUSTRY	1	20000
		SCHEDULE 1	10	31704
		WATER SUPPLY SERVICE	9	166576

GRU	Major Geology	Water Use Sector	Number of registrations	Sum of registrations m^3/a
	Coastal Cenozoic Deposits	WATER SUPPLY SERVICE	1	110000
	TMG	AGRICULTURE	5	183776
		WATER SUPPLY SERVICE	2	11576
			Total	**939732**
BO-2	Basement And Intrusive	AGRICULTURE	5	83242
		WATER SUPPLY SERVICE	2	1016868
	Bokkeveld Group	AGRICULTURE	1	8760
		AGRICULTURE	47	3256653
		AGRICULTURE	2	60000
		SCHEDULE 1	2	5176
		WATER SUPPLY SERVICE	2	504576
	Coastal Cenozoic Deposits	AGRICULTURE	12	1013747
		AGRICULTURE	3	140000
		INDUSTRY	3	336455
		RECREATION	1	3000
		SCHEDULE 1	1	7622
		WATER SUPPLY SERVICE	5	2153333
	TMG	AGRICULTURE	17	901380
		INDUSTRY	1	1576
		RECREATION	1	100000
		WATER SUPPLY SERVICE	6	1957559
			Total	**11549947**
BO-3	Basement And Intrusive	AGRICULTURE	10	1217829
		SCHEDULE 1	1	3000
		WATER SUPPLY SERVICE	2	135332
	Bokkeveld Group	AGRICULTURE	11	1269776
		RECREATION	2	14400
		WATER SUPPLY SERVICE	3	481300
	Coastal Cenozoic Deposits	AGRICULTURE	11	446946
		WATER SUPPLY SERVICE	13	648102
	TMG	AGRICULTURE	20	1203570
		SCHEDULE 1	5	312796
		WATER SUPPLY SERVICE	2	66557
			Total	**5799608**
BR-1	Basement And Intrusive	AGRICULTURE	2	26426
		SCHEDULE 1	1	36000
	Bokkeveld Group	AGRICULTURE	31	2269854
		INDUSTRY	1	8400
		WATER SUPPLY SERVICE	1	60000
	Coastal Cenozoic Deposits	AGRICULTURE	8	481456
		INDUSTRY	1	1576
		SCHEDULE 1	1	40000

GRU	Major Geology	Water Use Sector	Number of registrations	Sum of registrations m^3/a
	TMG	AGRICULTURE	14	392956
		WATER SUPPLY SERVICE	5	380576
			Total	**3697244**
BR-2	Basement And Intrusive	AGRICULTURE	1	356910
	Bokkeveld Group	AGRICULTURE	5	209052
		WATER SUPPLY SERVICE	1	285120
	Coastal Cenozoic Deposits	WATER SUPPLY SERVICE	1	2744
	TMG	AGRICULTURE	5	330530
		MINING	1	11088
			Total	**1195444**
GC-1	Basement And Intrusive	AGRICULTURE	54	1665537
		INDUSTRY	13	488559
		WATER SUPPLY SERVICE	1	64018
	Coastal Cenozoic Deposits	AGRICULTURE	1	58304
	TMG	AGRICULTURE	5	252488
	Uitenhage Group	AGRICULTURE	1	99450
			Total	**2628386**
GC-2	Basement And Intrusive	AGRICULTURE	1	7050
		WATER SUPPLY SERVICE	2	9060
		AGRICULTURE	2	12973
		SCHEDULE 1	1	9670
	Coastal Cenozoic Deposits	AGRICULTURE	18	701069
		AGRICULTURE	3	9576
		INDUSTRY	2	317607
		SCHEDULE 1	3	15175
		WATER SUPPLY SERVICE	14	1858050
	TMG	AGRICULTURE	1	626548
		INDUSTRY	2	11200
		SCHEDULE 1	2	47201
		WATER SUPPLY SERVICE	5	716576
	Uitenhage Group	AGRICULTURE	4	68981
		INDUSTRY	3	223532
		MINING	1	18000
		WATER SUPPLY SERVICE	3	54000
			Total	**4696692**
GC-3	Coastal Cenozoic Deposits	AGRICULTURE	1	30000
	TMG	AGRICULTURE	6	317203
		INDUSTRY	2	35576
		SCHEDULE 1	1	46672
			Total	**429451**
GGa-1	Karoo	AGRICULTURE	27	1029100
		INDUSTRY	1	54400

GRU	Major Geology	Water Use Sector	Number of registrations	Sum of registrations m^3/a
		WATER SUPPLY SERVICE	1	37400
			Total	**1120900**
GGa-2a, 2b and 2c	Basement And Intrusive	AGRICULTURE	1	15000
	Coastal Cenozoic Deposits	AGRICULTURE	37	2979882
		MINING	1	1576
		WATER SUPPLY SERVICE	15	2225958.5
	Karoo	AGRICULTURE	62	2880197
		INDUSTRY	2	66800
		SCHEDULE 1	4	44647
		WATER SUPPLY SERVICE	19	1224572.5
			Total	**9438633**
GGa-3	Basement And Intrusive	AGRICULTURE	1	5300
	Bokkeveld Group	AGRICULTURE	6	205000
	Coastal Cenozoic Deposits	AGRICULTURE	3	65680
	TMG	AGRICULTURE	2	3152
	Uitenhage Group	AGRICULTURE	8	262406
		INDUSTRY	3	93000
			Total	**634538**
GGa-4	Coastal Cenozoic Deposits	AGRICULTURE	13	1396580
	Karoo	AGRICULTURE	1	528700
	TMG	AGRICULTURE	3	128600
	Witteberg Group	AGRICULTURE	2	85220
		WATER SUPPLY SERVICE	1	229000
			Total	**2368100**
GGa-5	Bokkeveld Group	AGRICULTURE	1	20800
	TMG	AGRICULTURE	3	66600
			Total	**87400**
GGo-1	Bokkeveld Group	AGRICULTURE	10	1014093
		INDUSTRY	1	97774
		WATER SUPPLY SERVICE	1	67160
	Coastal Cenozoic Deposits	AGRICULTURE	18	938659
		INDUSTRY	8	624479
		SCHEDULE 1	1	1576
		WATER SUPPLY SERVICE	4	221145.07
	TMG	AGRICULTURE	5	334096
		WATER SUPPLY SERVICE	1	31536
	Uitenhage Group	AGRICULTURE	3	196772
		WATER SUPPLY SERVICE	2	16576
			Total	**3543866.07**
GGo-2a and 2b	Bokkeveld Group	AGRICULTURE	24	1539012

GRU	Major Geology	Water Use Sector	Number of registrations	Sum of registrations m^3/a
	Coastal Cenozoic Deposits	AGRICULTURE	47	2792458
		INDUSTRY	2	1389500
		WATER SUPPLY SERVICE	6	550894
	TMG	AGRICULTURE	12	455475
		INDUSTRY	1	203614
	Uitenhage Group	AGRICULTURE	26	662985
		INDUSTRY	2	152280
			Total	**7738298**
GGr-1	Bokkeveld Group	AGRICULTURE	26	1424202
		SCHEDULE 1	1	1576
	Coastal Cenozoic Deposits	AGRICULTURE	21	2406435
		SCHEDULE 1	1	1825
	Karoo	AGRICULTURE	3	4728
	Witteberg Group	AGRICULTURE	16	896684
			Total	**4735450**
GGr-2	Bokkeveld Group	AGRICULTURE	10	319368
		SCHEDULE 1	1	1576
	Coastal Cenozoic Deposits	AGRICULTURE	4	365909
	TMG	AGRICULTURE	7	127852
	Witteberg Group	SCHEDULE 1	1	1576
			Total	**816281**
GGr-3	Coastal Cenozoic Deposits	AGRICULTURE	8	561815
		WATER SUPPLY SERVICE	8	773701
	Karoo	AGRICULTURE	49	1530516
		INDUSTRY	1	8000
		WATER SUPPLY SERVICE	6	565190
	Witteberg Group	AGRICULTURE	2	56000
			Total	**3495222**
GGr-4	Bokkeveld Group	AGRICULTURE	44	2035901
	Coastal Cenozoic Deposits	AGRICULTURE	8	694473
	TMG	AGRICULTURE	14	653090
	Witteberg Group	AGRICULTURE	16	894033
			Total	**4277497.2**
GGr-5	Bokkeveld Group	AGRICULTURE	56	1525579
		INDUSTRY	1	22000
		SCHEDULE 1	1	1576
		WATER SUPPLY SERVICE	1	6600
	Coastal Cenozoic Deposits	AGRICULTURE	7	412852
	TMG	AGRICULTURE	3	15000
		INDUSTRY	2	21576
		WATER SUPPLY SERVICE	1	48600

GRU	Major Geology	Water Use Sector	Number of registrations	Sum of registrations m^3/a
	Witteberg Group	AGRICULTURE	1	1576
			Total	**2055359**
GO-1	Bokkeveld Group	AGRICULTURE	5	242280
	Coastal Cenozoic Deposits	AGRICULTURE	3	154000
	Karoo	AGRICULTURE	16	700720
	Witteberg Group	AGRICULTURE	4	54400
			Total	**1151400**
GO-2	Bokkeveld Group	AGRICULTURE	24	627252
	Coastal Cenozoic Deposits	AGRICULTURE	14	399602
	TMG	AGRICULTURE	15	703186
	Uitenhage Group	AGRICULTURE	9	201676
			Total	**1931716**
GO-3	Bokkeveld Group	AGRICULTURE	6	945000
		WATER SUPPLY SERVICE	1	30000
	TMG	AGRICULTURE	36	1588549
		WATER SUPPLY SERVICE	1	39420
			Total	**2602969**
GO-4	Basement And Intrusive	AGRICULTURE	18	1166738
	Bokkeveld Group	AGRICULTURE	42	1452946
	Coastal Cenozoic Deposits	AGRICULTURE	28	1806565
	TMG	AGRICULTURE	62	2065547
		WATER SUPPLY SERVICE	1	40000
	Uitenhage Group	AGRICULTURE	10	1814508
		WATER SUPPLY SERVICE	2	54360
			Total	**8400664**

Table A 2: Recharge total (GRAII, DWAF 2006) per major geological grouping, per GRU

GRU Name	Major geologic unit	Recharge sum million m3/A
BB-1	Bokkeveld Group	22.84
	Coastal Cenozoic Deposits	6.08
	TMG	32.70
	Witteberg Group	1.68
	Total	**63.48**
BB-2	Bokkeveld Group	3.03
	Coastal Cenozoic Deposits	4.62
	TMG	47.05
	Witteberg Group	0.24
	Total	**55.11**
BB-3	Basement And Intrusive	16.02
	Coastal Cenozoic Deposits	38.51
	TMG	177.94
	Total	**232.47**
BB-4	Bokkeveld Group	5.57
	Coastal Cenozoic Deposits	0.29
	TMG	12.55
	Total	**18.42**
BB-5	Basement And Intrusive	4.07
	Coastal Cenozoic Deposits	10.04
	Karoo	0.23
	TMG	30.40
	Uitenhage Group	0.22
	Witteberg Group	0.13
	Total	**45.43**
BB-6	Bokkeveld Group	18.78
	Coastal Cenozoic Deposits	1.44
	Karoo	0.05
	TMG	19.11
	Witteberg Group	3.57
	Total	**42.94**
BB-7	Basement And Intrusive	5.78
	Bokkeveld Group	6.45
	Coastal Cenozoic Deposits	5.61
	Karoo	0.80
	TMG	28.75
	Uitenhage Group	0.81
	Witteberg Group	2.15
	Total	**50.47**
BB-8	Basement And Intrusive	1.04
	Bokkeveld Group	26.25
	Coastal Cenozoic Deposits	25.03
	TMG	64.87
	Uitenhage Group	3.19
	Witteberg Group	7.26

GRU Name	Major geologic unit	Recharge sum million m3/A
	Total	**128.05**
BO-1	Basement And Intrusive	0.84
	Bokkeveld Group	19.45
	Coastal Cenozoic Deposits	7.60
	TMG	115.47
	Witteberg Group	0.90
	Total	**146.34**
BO-2	Basement And Intrusive	2.01
	Bokkeveld Group	24.49
	Coastal Cenozoic Deposits	14.16
	TMG	23.61
	Witteberg Group	0.40
	Total	**66.62**
BO-3	Basement And Intrusive	3.34
	Bokkeveld Group	20.21
	Coastal Cenozoic Deposits	36.13
	TMG	17.15
	Uitenhage Group	0.51
	Total	**78.11**
BR-1	Basement And Intrusive	3.73
	Bokkeveld Group	18.80
	Coastal Cenozoic Deposits	11.54
	TMG	125.78
	Witteberg Group	2.21
	Total	**168.20**
BR-2	Basement And Intrusive	1.80
	Bokkeveld Group	16.08
	Coastal Cenozoic Deposits	5.18
	Karoo	0.14
	TMG	23.22
	Witteberg Group	3.26
	Total	**49.85**
GC-1	Basement And Intrusive	80.23
	Coastal Cenozoic Deposits	4.76
	TMG	78.11
	Uitenhage Group	1.63
	Total	**167.80**
GC-2	Basement And Intrusive	19.78
	Bokkeveld Group	1.57
	Coastal Cenozoic Deposits	40.65
	TMG	138.77
	Uitenhage Group	8.46
	Total	**216.59**
GC-3	Bokkeveld Group	4.58
	Coastal Cenozoic Deposits	0.42
	TMG	87.26

GRU Name	Major geologic unit	Recharge sum million m3/A
	Uitenhage Group	0.14
	Total	**92.45**
GGa-1	Basement And Intrusive	0.21
	Coastal Cenozoic Deposits	0.06
	Karoo	3.84
	Witteberg Group	0.02
	Total	**4.12**
GGa-2a, 2b and 2c	Basement And Intrusive	4.09
	Coastal Cenozoic Deposits	2.23
	Karoo	20.09
	Total	**26.42**
GGa-3	Basement And Intrusive	2.54
	Bokkeveld Group	1.55
	Coastal Cenozoic Deposits	0.69
	Karoo	0.01
	TMG	10.03
	Uitenhage Group	0.26
	Witteberg Group	1.33
	Total	**16.41**
GGa-4	Bokkeveld Group	0.93
	Coastal Cenozoic Deposits	0.63
	Karoo	0.84
	TMG	6.99
	Witteberg Group	1.23
	Total	**10.61**
GGa-5	Bokkeveld Group	4.24
	Coastal Cenozoic Deposits	0.83
	TMG	14.36
	Total	**19.43**
GGo-1	Basement And Intrusive	0.03
	Bokkeveld Group	10.08
	Coastal Cenozoic Deposits	15.14
	TMG	14.07
	Uitenhage Group	5.25
	Total	**44.73**
GGo-2a and 2b	Bokkeveld Group	23.97
	Coastal Cenozoic Deposits	47.38
	TMG	62.98
	Uitenhage Group	10.41
	Witteberg Group	0.24
	Total	**145.13**
GGr-1	Bokkeveld Group	3.44
	Coastal Cenozoic Deposits	3.20
	Karoo	0.33
	TMG	1.76

GRU Name	Major geologic unit	Recharge sum million m3/A
	Witteberg Group	5.75
	Total	**14.50**
GGr-2	Bokkeveld Group	4.44
	Coastal Cenozoic Deposits	4.05
	Karoo	0.07
	TMG	5.51
	Witteberg Group	6.08
	Total	**20.15**
GGr-3	Coastal Cenozoic Deposits	0.06
	Karoo	12.63
	Witteberg Group	0.17
	Total	**12.87**
GGr-4	Bokkeveld Group	3.92
	Coastal Cenozoic Deposits	0.62
	Karoo	0.00
	TMG	6.94
	Witteberg Group	3.40
	Total	**14.88**
GGr-5	Bokkeveld Group	13.97
	Coastal Cenozoic Deposits	1.09
	TMG	14.24
	Witteberg Group	0.43
	Total	**29.72**
GO-1	Basement And Intrusive	0.28
	Bokkeveld Group	3.65
	Coastal Cenozoic Deposits	0.22
	Karoo	0.12
	TMG	6.28
	Witteberg Group	0.79
	Total	**11.35**
GO-2	Basement And Intrusive	0.86
	Bokkeveld Group	9.01
	Coastal Cenozoic Deposits	1.97
	TMG	19.46
	Uitenhage Group	2.55
	Total	**33.90**
GO-3	Bokkeveld Group	4.68
	Coastal Cenozoic Deposits	1.23
	TMG	21.56
	Total	**27.48**
GO-4	Basement And Intrusive	16.61
	Bokkeveld Group	5.62
	Coastal Cenozoic Deposits	7.48
	TMG	40.77
	Uitenhage Group	5.38
	Total	**75.86**

Table A 3: Average water quality parameters for major geological groupings per GRU, compared to DWAF Drinking Water Quality Limits[1]

GRU	Geology	Number of locations	pH Value at 25^{0}C	Conductivity at 25^{0}C	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Fluoride (F)	Chloride (Cl)	Sulphate (SO_4)	Total Alkalinity ($CaCO_3$)	NO_3 -N
			mg/l	mS/m	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
		Drinking Water Quality Limits - DWAF, 1996; DWAF, DOH and WRC, 1998*										
		Class 1	*5-6 or 9-9.5*	*70-150*	*100-200*	*80-150*	*30-70*	*0.7-1*	*100-200*	*200-400*		*6-10*
		Class 2	*4-5 or 9.5-10*	*150-370*	*200-600*	*150-300*	*70-100*	*1-1.5*	*200-600*	*400-600*		*10-20*
		Class 3	*3.5-4 or 10-10.5*	*370-520*	*600-1200*	*>300*	*100-200*	*1.5-3.5*	*600-1200*	*600-1000*		*20-40*
BB-1	Bokkeveld Group	28.00	7.46	99.20	110.34	48.29	35.11	0.25	224.31	94.51	93.70	0.31
	Coastal Cenozoic Deposits	11.00	7.25	107.63	116.19	50.97	35.88	0.25	221.74	99.38	111.43	1.67
	TMG	10.00	7.21	109.84	130.80	42.17	35.86	0.24	215.62	167.71	60.05	3.03
BB-2	Bokkeveld Group	24.00	7.04	136.98	119.02	96.80	52.52	0.33	231.13	264.71	121.95	0.51
	Coastal Cenozoic Deposits	380.00	6.89	50.61	46.81	34.71	12.37	0.13	70.81	82.25	47.06	2.95
	TMG	46.00	6.33	40.00	34.23	26.69	11.70	0.12	52.05	75.77	35.84	1.79
BB-3	Basement	4.00	6.74	22.54	19.73	11.58	6.36	0.15	39.36	2.87	45.50	0.37
	Coastal Cenozoic Deposits	62.00	6.68	29.54	25.27	11.25	8.67	0.22	52.39	7.67	52.55	1.81
	TMG	13.00	6.35	9.71	8.86	3.61	1.99	0.22	16.03	5.17	11.99	1.16
	Witteberg Group	1.00	6.30	48.80	63.20	7.50	10.10	0.75	129.00	11.00	4.80	1.65
BB-4	Bokkeveld Group	6.00	7.96	92.62	71.91	70.67	31.95	0.39	99.47	168.42	143.80	0.09
	Coastal Cenozoic Deposits	1.00	8.73	84.40	85.60	53.40	20.90	0.40	98.40	81.10	171.80	0.02

[1] Note: mean averages are presented. Medians are preferable for analysis of water quality however due to the large datasets automated averaging was necessary which does not accommodate medians. The values should be considered maximums as a mean can be significantly skewed by outliers.

GRU	Geology	Number of locations	pH Value at 25^{0}C	Conductivity at 25^{0}C	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Fluoride (F)	Chloride (Cl)	Sulphate (SO_4)	Total Alkalinity ($CaCO_3$)	NO_3 -N
BB-5	Basement	5.00	7.45	208.83	138.50	109.16	145.89	0.58	389.82	515.74	136.28	1.34
	Bokkeveld Group	1.00	7.92	305.10	351.00	115.00	113.00	0.59	561.00	528.00	141.90	0.02
	Coastal Cenozoic Deposits	62.00	6.66	143.16	208.45	24.30	48.47	0.73	392.74	85.82	78.45	2.07
	TMG	9.00	6.31	28.28	24.73	16.11	7.82	0.15	39.95	23.61	46.23	1.13
	Witteberg Group	2.00	5.14	32.00	19.95	18.20	12.75	0.05	34.95	63.45	3.95	13.12
BB-6	Bokkeveld Group	19.00	7.99	206.98	265.99	73.88	73.22	0.46	481.49	171.74	230.18	0.04
	Coastal Cenozoic Deposits	6.00	8.17	164.13	221.13	70.33	38.67	0.55	314.72	139.67	237.33	0.03
	TMG	13.00	7.60	87.94	89.81	55.85	24.27	0.38	166.73	114.94	86.42	0.21
BB-7	Basement	4.00	8.29	110.43	102.20	76.23	26.98	0.53	181.88	86.05	180.78	0.69
	Bokkeveld Group	9.00	7.93	401.68	659.21	90.16	115.10	0.70	1200.68	197.86	261.88	0.04
	Coastal Cenozoic Deposits	31.00	7.14	124.13	186.44	28.23	32.34	0.33	307.74	77.88	96.73	2.47
	Karoo Supergroup	5.00	6.91	130.30	194.06	53.08	42.20	0.14	436.64	53.44	60.20	4.39
	TMG	3.00	7.47	19.27	25.07	2.70	4.77	0.24	48.83	6.93	14.87	0.03
	Witteberg Group	1.00	8.16	245.00	425.00	29.00	72.00	0.60	630.00	193.00	191.10	0.02
BB-8	Bokkeveld Group	14.00	8.21	1056.19	2014.68	142.07	246.05	2.00	3453.19	427.34	461.01	0.78
	Coastal Cenozoic Deposits	5.00	7.70	332.70	506.36	109.18	83.66	0.38	1058.97	84.35	133.82	3.53
	TMG	10.00	6.85	76.44	118.41	13.33	15.65	0.21	204.96	28.46	18.20	0.04
BO-1	Coastal Cenozoic Deposits	1.00	6.08	53.10	82.00	5.90	9.60	0.05	148.60	17.40	13.20	0.02
	TMG	5.00	6.66	21.04	24.39	7.48	4.26	0.20	47.26	8.86	20.16	0.12
BO-2	Bokkeveld Group	1.00	6.87	32.68	37.64	9.87	4.23	0.12	75.00	7.25	14.15	2.94

GRU	Geology	Number of locations	pH Value at 25^{0}C	Conductivity at 25^{0}C	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Fluoride (F)	Chloride (Cl)	Sulphate (SO_4)	Total Alkalinity ($CaCO_3$)	NO_3 -N
	Coastal Cenozoic Deposits	7.00	7.51	84.17	107.33	49.39	12.09	0.11	175.76	26.48	127.58	1.07
	TMG	2.00	6.81	23.26	26.72	5.58	3.64	0.24	44.63	5.26	22.87	0.10
BO-3	Bokkeveld Group	18.00	5.91	1668.97	1225.11	89.20	136.46	0.80	2100.46	264.06	194.10	50.26
	Coastal Cenozoic Deposits	15.00	7.76	191.95	249.39	104.01	29.07	0.23	485.06	49.50	200.65	0.73
	TMG	1.00	7.19	85.20	126.50	6.60	16.50	0.12	235.40	25.30	9.60	0.48
BR-1	Bokkeveld Group	3.00	5.73	235.10	368.68	27.55	50.22	0.27	696.75	74.43	37.00	0.06
	Coastal Cenozoic Deposits	2.00	6.37	15.52	13.07	7.01	3.01	0.17	20.76	17.94	16.32	0.09
	TMG	8.00	6.82	4.95	3.13	1.62	0.78	0.18	3.70	1.65	7.48	0.16
BR-2	Bokkeveld Group	3.00	8.15	568.00	1027.00	101.43	158.40	1.03	1840.37	196.33	353.23	0.13
	Karoo Supergroup	1.00	7.64	88.79	66.41	86.71	13.96	0.13	115.11	25.70	234.73	0.03
GC-1	Basement	25.00	7.91	278.95	438.58	65.51	56.28	0.64	785.92	83.18	156.30	1.14
	Coastal Cenozoic Deposits	3.00	7.51	121.97	152.91	40.64	25.44	0.19	256.49	46.26	134.95	1.54
	TMG	7.00	5.99	23.59	26.62	2.42	3.99	0.13	50.32	10.08	4.30	0.21
	Uitenhage Group	1.00	8.31	484.00	846.00	50.60	70.50	1.84	1161.70	146.10	505.10	16.52
GC-2	Basement	7.00	8.09	505.63	896.20	111.86	92.46	0.43	1580.31	155.55	169.92	0.24
	Coastal Cenozoic Deposits	29.00	7.81	115.67	124.00	68.41	20.28	0.17	215.68	43.97	170.83	5.22
	TMG	20.00	5.99	60.43	96.70	9.37	9.19	0.16	175.58	15.90	13.71	0.51
	Uitenhage Group	2.00	7.32	51.80	68.05	11.00	6.30	0.05	125.60	9.41	27.83	0.48
GC-3	Coastal Cenozoic Deposits	5.00	7.73	181.24	231.44	91.22	29.50	0.66	411.48	54.16	241.12	0.31
	TMG	7.00	6.06	21.96	30.20	2.67	3.57	0.13	51.43	10.59	8.94	0.08

GRU	Geology	Number of locations	pH Value at 25^{0}C	Conductivity at 25^{0}C	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Fluoride (F)	Chloride (Cl)	Sulphate (SO_4)	Total Alkalinity ($CaCO_3$)	NO_3 -N
	Uitenhage Group	1.00	7.85	209.90	284.20	97.50	32.80	0.66	409.20	139.10	304.90	0.22
GGa-1	Basement	3.00	7.71	55.00	52.20	42.20	14.53	0.81	40.10	60.77	150.17	1.06
	Coastal Cenozoic Deposits	14.00	7.89	112.49	142.75	64.11	19.95	1.06	137.89	128.82	219.34	4.81
	Karoo Supergroup	473.00	7.75	106.32	117.30	77.94	20.92	0.99	133.14	118.05	217.36	3.16
GGa-2a, 2b and 2c	Basement	15.00	8.06	98.70	86.85	70.19	36.59	0.72	110.05	118.31	207.15	6.43
	Coastal Cenozoic Deposits	173.00	7.64	216.23	168.94	101.59	33.84	0.90	278.13	266.52	184.83	5.31
	Karoo Supergroup	670.00	7.80	121.04	126.10	77.70	24.74	1.01	152.03	170.46	178.64	4.51
GGA-3	Basement	1.00	7.93	795.00	834.20	482.50	306.00	0.78	2430.00	454.80	305.40	0.88
	Bokkeveld Group	12.00	7.17	70.86	70.67	33.94	16.15	0.34	131.57	50.27	83.59	0.35
	Coastal Cenozoic Deposits	9.00	7.45	246.94	349.18	113.99	53.20	0.65	461.11	390.95	217.58	2.24
	Karoo Supergroup	89.00	8.00	171.08	227.04	125.94	55.44	0.85	345.96	159.58	247.92	1.69
	TMG	8.00	6.95	126.07	191.75	37.98	27.54	0.28	327.19	85.50	75.58	0.03
	Witteberg Group	1.00	8.20	298.00	400.30	136.10	74.80	0.84	587.00	392.00	309.00	0.10
GGa-4	Bokkeveld Group	2.00	8.32	60.20	59.65	38.75	15.50	0.69	56.80	51.75	150.65	0.15
	Coastal Cenozoic Deposits	13.00	8.17	144.75	169.47	83.90	39.17	0.63	233.29	154.02	254.28	1.11
	Karoo Supergroup	56.00	7.87	189.52	196.26	140.84	50.38	0.78	298.76	262.60	301.62	2.17
	TMG	2.00	7.32	10.35	5.45	6.90	3.05	0.45	9.55	10.15	26.10	0.02
	Witteberg Group	6.00	7.94	51.15	49.36	28.61	17.59	0.31	42.84	103.19	85.69	0.11
GGa-5	Bokkeveld Group	1.00	6.49	357.00	507.80	96.20	68.30	0.39	857.30	371.10	90.60	0.10
	TMG	1.00	7.24	372.00	641.60	50.80	46.90	0.50	851.80	320.50	232.50	0.05

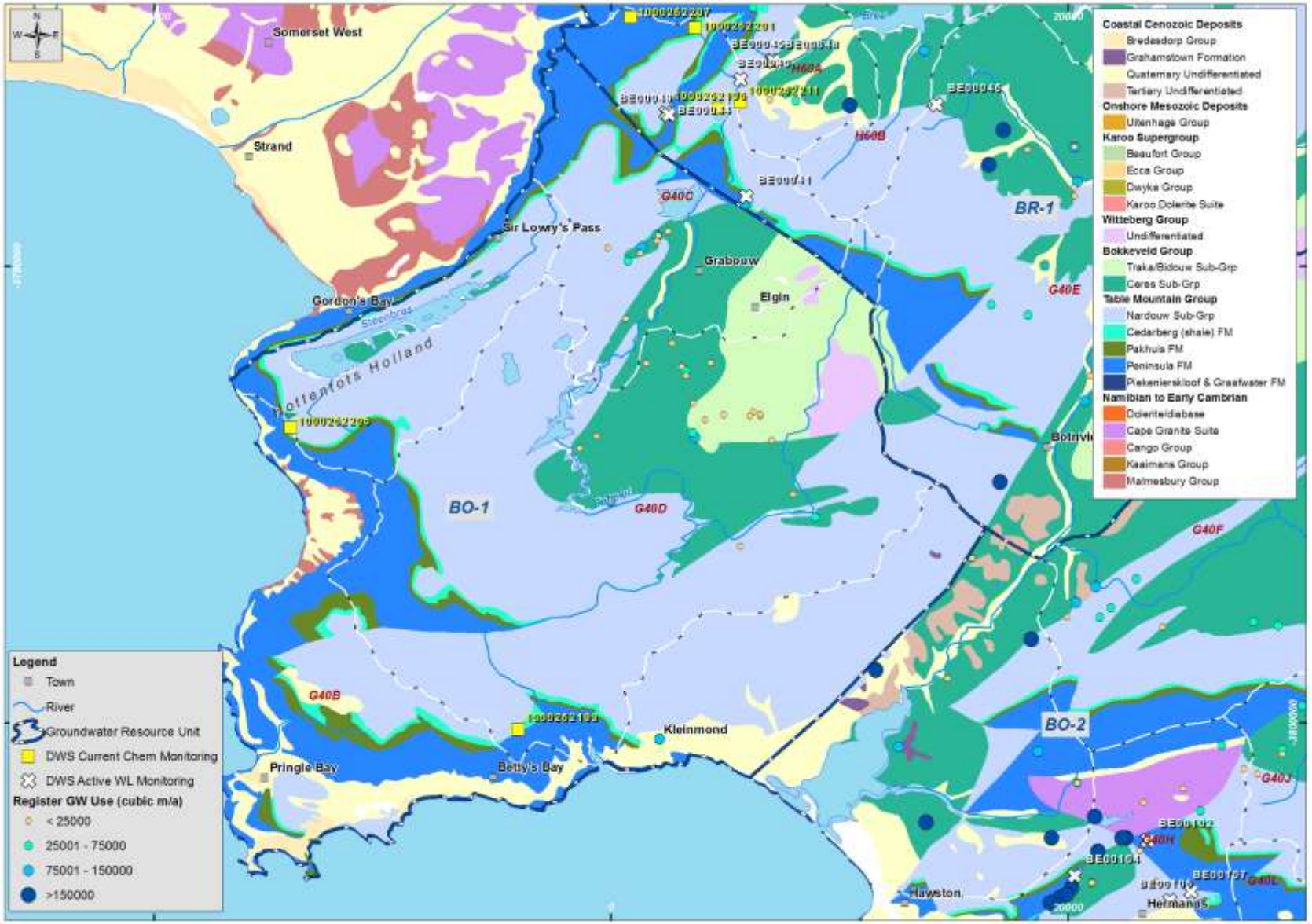
GRU	Geology	Number of locations	pH Value at 25^{0}C	Conductivity at 25^{0}C	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Fluoride (F)	Chloride (Cl)	Sulphate (SO_4)	Total Alkalinity ($CaCO_3$)	NO_3 -N
GGo-1	Bokkeveld Group	10.00	7.00	265.20	412.81	46.95	59.23	0.43	740.76	163.92	103.33	0.94
	Coastal Cenozoic Deposits	103.00	7.58	271.93	426.96	59.72	53.70	0.30	759.67	103.46	130.80	0.86
	TMG	19.00	7.56	355.84	594.31	68.07	81.48	0.44	1079.35	145.39	123.05	3.28
	Uitenhage Group	14.00	7.03	223.50	336.58	39.18	36.20	0.48	618.16	82.88	80.23	0.14
GGo-2a and 2b	Bokkeveld Group	19.00	7.71	195.28	267.39	80.41	32.68	0.15	506.54	113.66	153.57	4.23
	Coastal Cenozoic Deposits	93.00	7.80	177.66	254.20	71.16	33.06	0.22	458.67	63.32	178.54	2.36
	TMG	10.00	6.79	12.74	14.03	1.94	2.57	0.10	26.77	16.68	6.72	0.12
	Uitenhage Group	1.00	7.50	20.70	24.37	1.73	3.26	0.13	47.34	8.70	4.00	0.08
GGr-1	Bokkeveld Group	14.00	7.70	289.61	326.76	125.54	119.41	0.54	611.66	392.31	236.71	0.82
	Coastal Cenozoic Deposits	13.00	7.89	274.98	358.65	71.99	85.42	0.71	688.55	158.87	186.18	0.93
	Karoo Supergroup	1.00	8.41	169.00	181.50	74.20	50.10	0.73	325.30	80.60	266.80	0.64
	TMG	3.00	7.91	301.73	441.00	78.73	84.30	0.90	779.93	187.60	148.27	0.31
	Witteberg Group	13.00	7.31	171.17	176.72	62.65	57.88	0.40	442.27	58.90	103.87	0.31
GGr-2	Bokkeveld Group	11.00	8.10	326.06	437.26	113.10	91.35	0.66	743.87	276.25	313.77	0.02
	Coastal Cenozoic Deposits	12.00	8.12	325.15	457.35	93.73	95.43	0.67	850.56	183.45	266.46	0.21
	TMG	6.00	7.60	99.22	97.73	62.02	18.98	0.29	192.85	118.90	70.83	0.02
	Witteberg Group	8.00	7.97	221.74	224.30	117.80	73.86	0.51	562.36	95.95	211.23	0.17
GGr-4	Bokkeveld Group	38.00	7.49	208.09	216.92	84.19	55.73	0.57	345.90	184.40	238.83	0.40
	Coastal Cenozoic Deposits	7.00	7.00	141.47	217.59	43.17	30.97	0.45	270.01	143.90	157.52	1.47

GRU	Geology	Number of locations	pH Value at 25^{0}C	Conductivity at 25^{0}C	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Fluoride (F)	Chloride (Cl)	Sulphate (SO_4)	Total Alkalinity ($CaCO_3$)	NO_3 -N
	TMG	10.00	6.84	25.57	27.06	36.30	4.24	0.32	31.49	50.01	54.50	0.11
	Witteberg Group	5.00	7.54	303.66	331.36	116.75	138.74	0.28	860.61	175.32	229.86	0.26
GGr-5	Bokkeveld Group	62.00	7.49	438.27	647.66	151.41	119.67	0.69	1161.55	404.62	236.41	1.10
	Coastal Cenozoic Deposits	8.00	7.42	475.83	734.40	169.36	132.50	1.00	1282.23	447.21	293.63	0.17
	TMG	3.00	6.16	71.17	89.57	27.83	11.00	0.31	142.73	35.43	84.50	0.20
GO-1	Bokkeveld Group	1.00	8.12	333.00	410.80	196.20	115.20	0.55	772.60	320.90	440.00	0.02
	Coastal Cenozoic Deposits	2.00	8.05	134.50	192.65	72.55	25.90	0.78	180.20	91.25	351.40	5.07
	Karoo Supergroup	65.00	7.86	163.58	184.52	97.50	44.13	1.02	252.23	185.43	280.05	3.13
	TMG	2.00	7.45	20.05	6.90	30.65	2.90	0.13	8.05	3.05	86.80	0.16
	Witteberg Group	2.00	8.43	203.00	277.05	80.15	67.70	0.86	408.10	209.50	248.30	3.58
GO-2	Bokkeveld Group	9.00	7.27	380.69	524.74	189.62	122.12	0.57	894.40	585.73	275.73	0.25
	Coastal Cenozoic Deposits	3.00	7.84	308.33	523.33	104.73	43.63	1.03	663.07	361.90	263.47	2.78
	TMG	8.00	6.93	26.68	23.26	9.34	4.97	0.26	42.30	10.69	36.02	0.10
	Uitenhage Group	3.00	7.05	17.98	11.39	8.70	3.47	0.32	24.17	6.79	28.03	0.03
GO-3	Bokkeveld Group	7.00	7.32	169.26	208.74	69.04	50.17	0.76	340.51	81.49	265.34	0.53
	Coastal Cenozoic Deposits	2.00	6.89	30.30	11.30	22.95	7.85	0.37	14.00	85.75	29.45	0.45
	TMG	34.00	6.26	72.18	97.70	23.89	15.36	0.27	171.54	56.95	48.67	0.56
GO-4	Basement	21.00	7.91	93.75	92.27	68.46	28.58	0.43	159.21	44.65	214.81	1.63
	Bokkeveld Group	17.00	7.55	242.76	333.12	87.24	59.36	0.71	529.47	225.05	219.58	0.07
	Coastal Cenozoic Deposits	95.00	7.60	179.26	276.04	74.88	37.38	0.59	361.96	209.89	221.29	0.94

GRU	Geology	Number of locations	pH Value at 25^0C	Conductivity at 25^0C	Sodium (Na)	Calcium (Ca)	Magnesium (Mg)	Fluoride (F)	Chloride (Cl)	Sulphate (SO_4)	Total Alkalinity ($CaCO_3$)	NO_3 -N
	TMG	93.00	6.46	23.86	24.97	7.38	4.83	0.13	43.89	18.84	16.19	0.31
	Uitenhage Group	12.00	7.28	55.40	68.15	18.45	13.10	0.27	88.12	34.54	99.26	1.05

Table A 4. Detailed Status Quo assessment per Groundwater Resource Unit

Please refer to the following maps:


Somerset West
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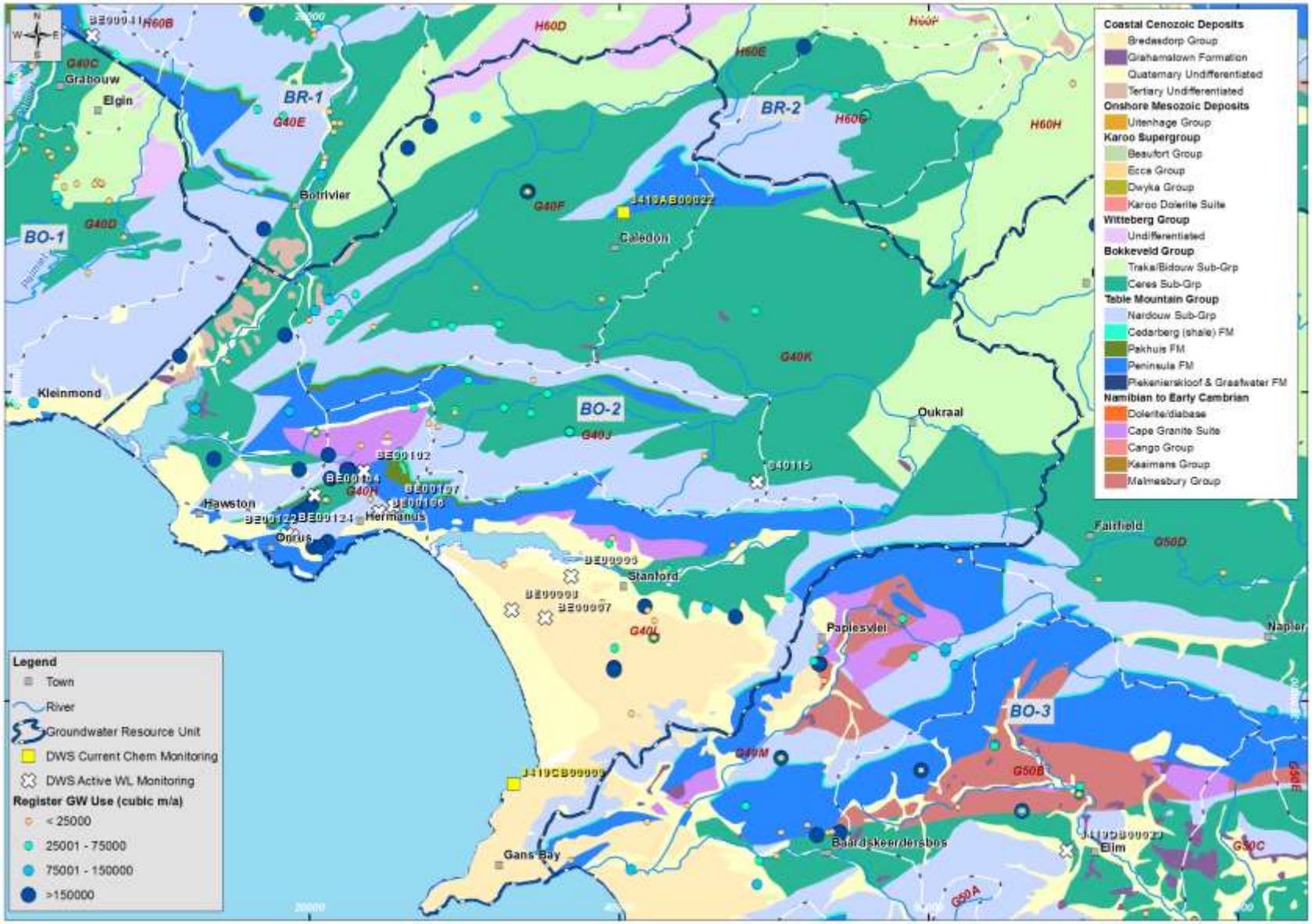
Sir Lowry's Pass
Grabouw
Elgin
Gordon's Bay
Hottentots Holland
BO-1
BO-2
BR-1
G40B
G40C
G40D
G40E
G40F
G40J
G40H
G40L
H60A
H60B
Kleinmond
Pringle Bay
Betty's Bay
Hawston
Hermanus
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Map for BO-1


Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
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Traka/Bidouw Sub-Grp
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Cape Granite Suite
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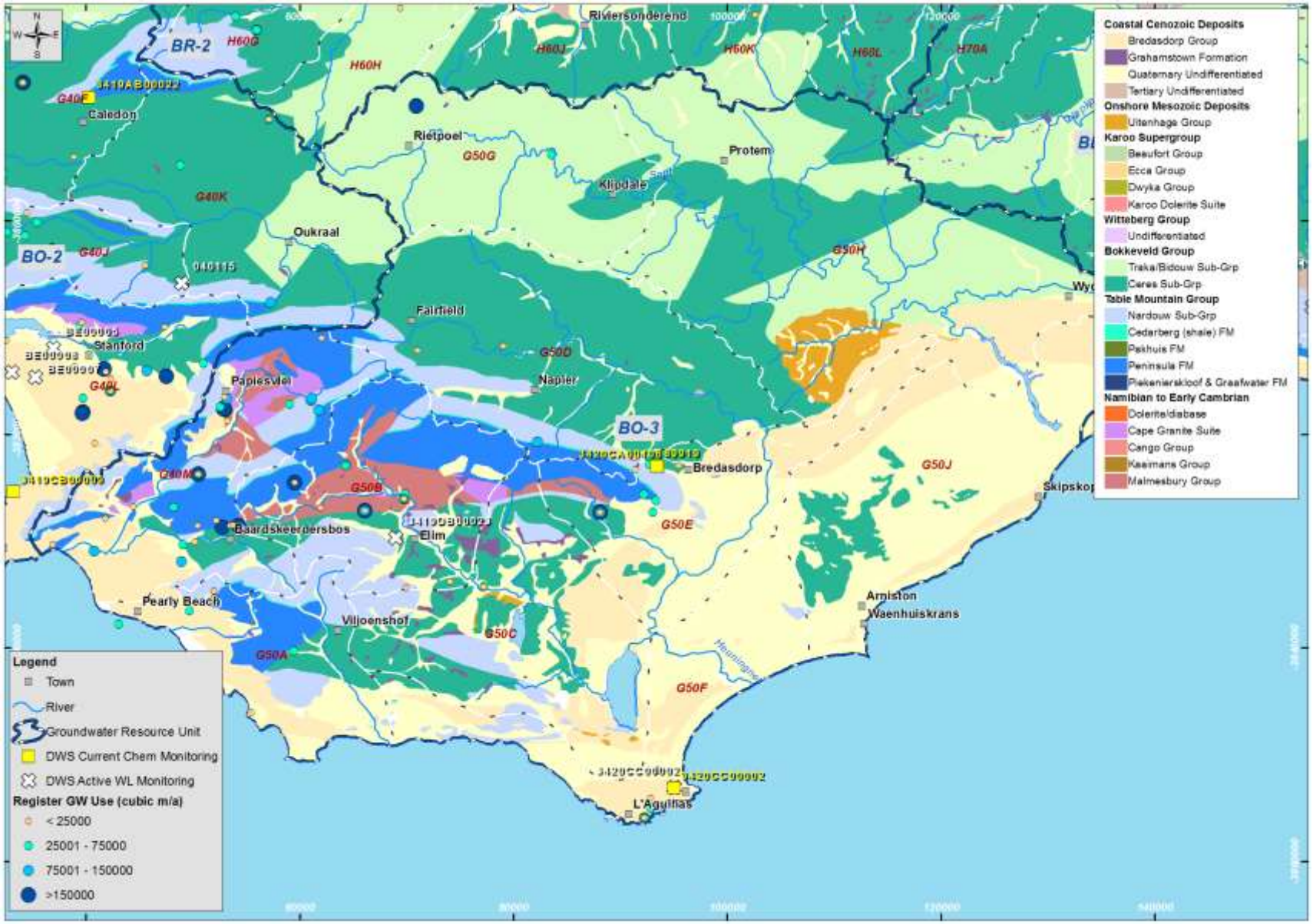
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
BR-1
BR-2
BO-1
BO-2
BO-3
Grabouw
Elgin
Botrivier
Caledon
Kleinmond
Hawston
Hermanus
Onrus
Stanford
Oukraal
Fairfield
Napier
Papiesvlei
Baardskeerdersbos
Elim
Gans Bay
Map for BO-2


BR-2
BO-2
BO-3
Caledon
Riviersonderend
Rietpoel
Protem
Klipdale
Oukraal
Fairfield
Stanford
Napier
Papiesvlei
Bredasdorp
Baardskeerdersbos
Elim
Pearly Beach
Viljoenshof
Arniston
Waenhuiskrans
L'Agulhas
Skipskop
Coastal Cenozoic Deposits
Bredasdorp Group
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Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
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Cedarberg (shale) FM
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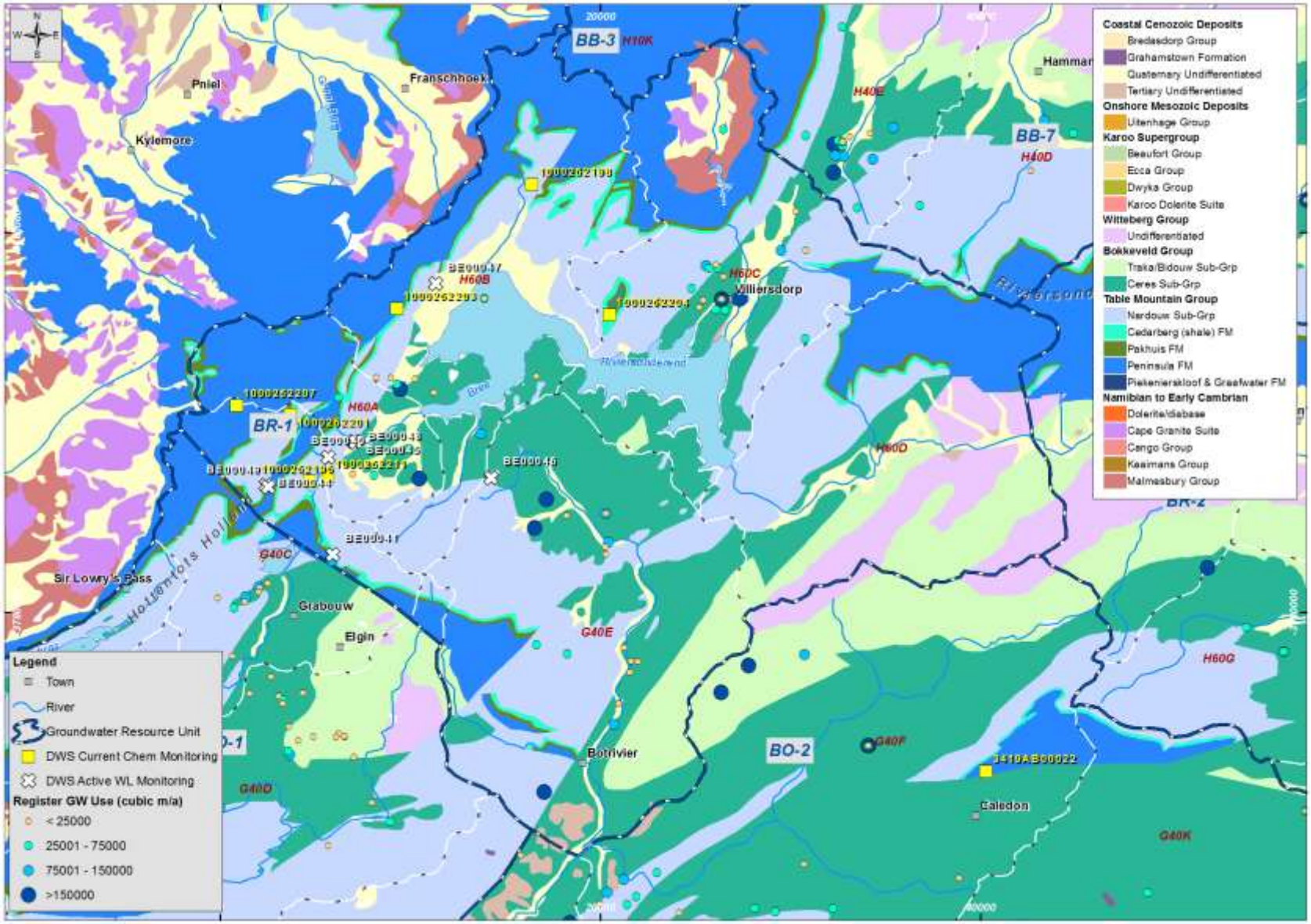
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Map for BO-3


Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
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Traka/Bidouw Sub-Grp
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Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
BB-3
H10K
BB-7
H40D
H40E
BR-1
BR-2
BO-2
H60A
H60B
H60C
H60D
H60G
G40C
G40D
G40E
G40F
G40K
Pniel
Kylemore
Franschhoek
Villiersdorp
Sir Lowry's Pass
Grabouw
Elgin
Botrivier
Caledon
Hottentots Holland
Riviersonderend
1000262293
1000262294
1000262297
1000262201
1000262211
1000262196
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BE000.11
BE000.43
BE000.44
BE000.46
20000
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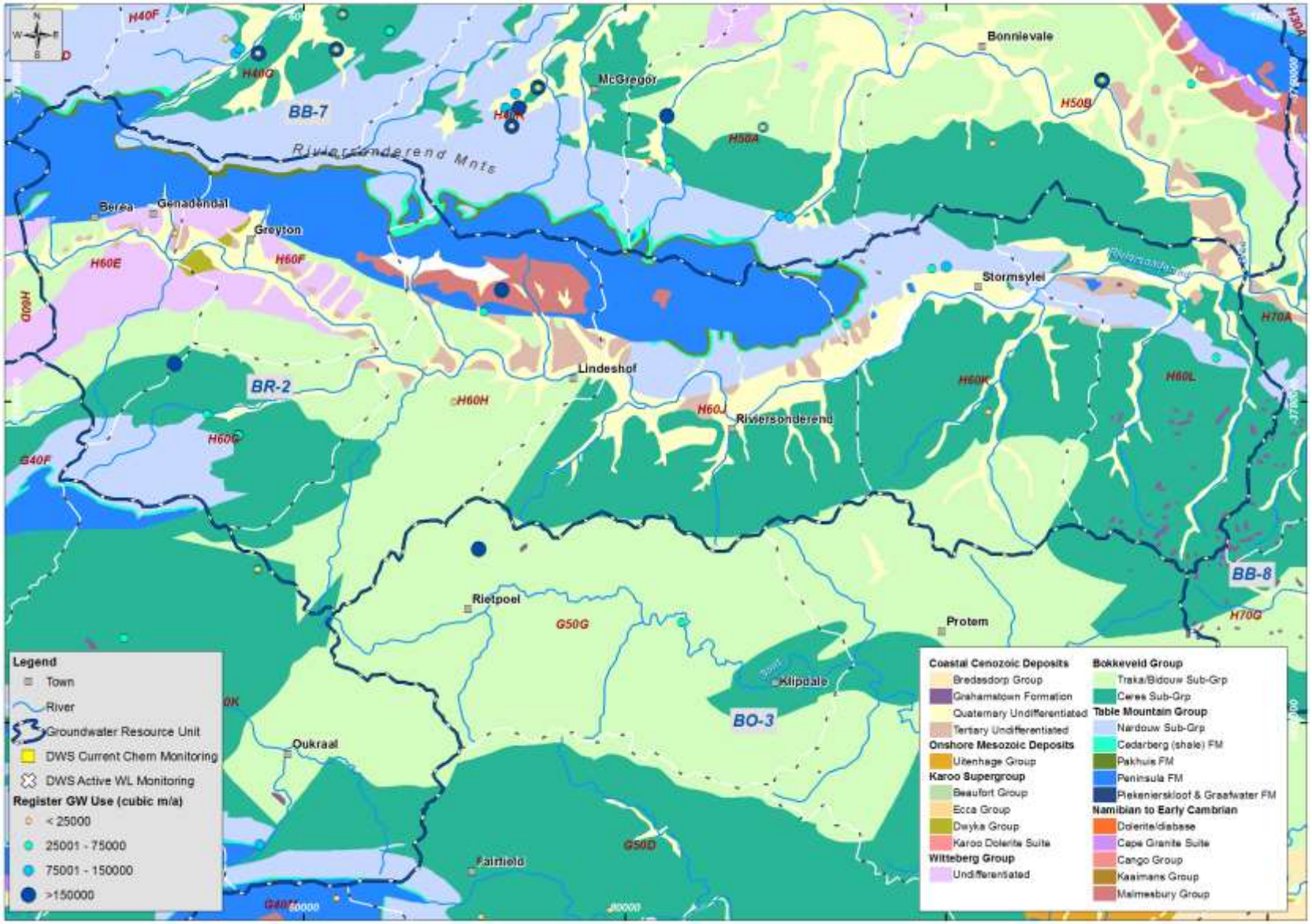
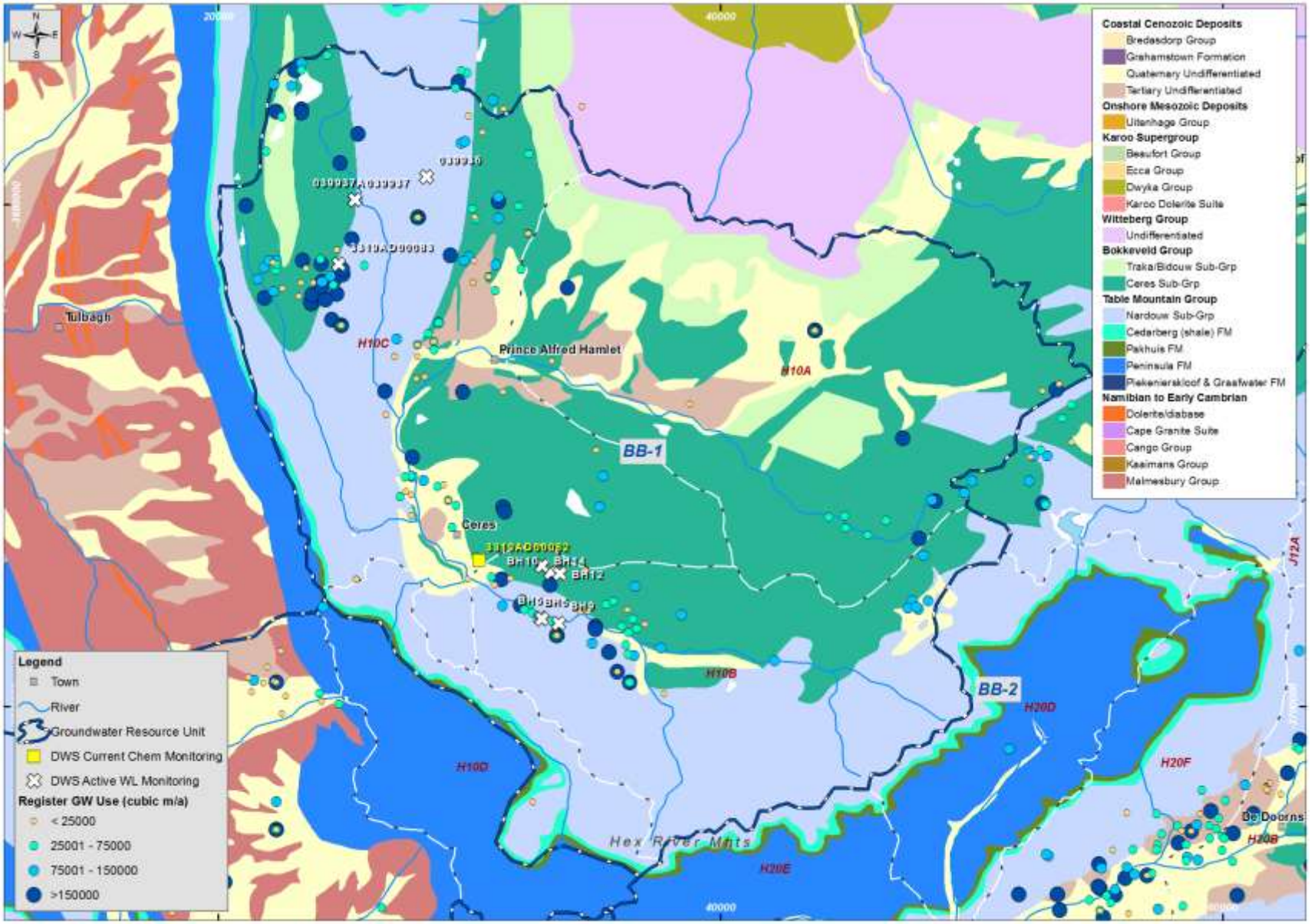
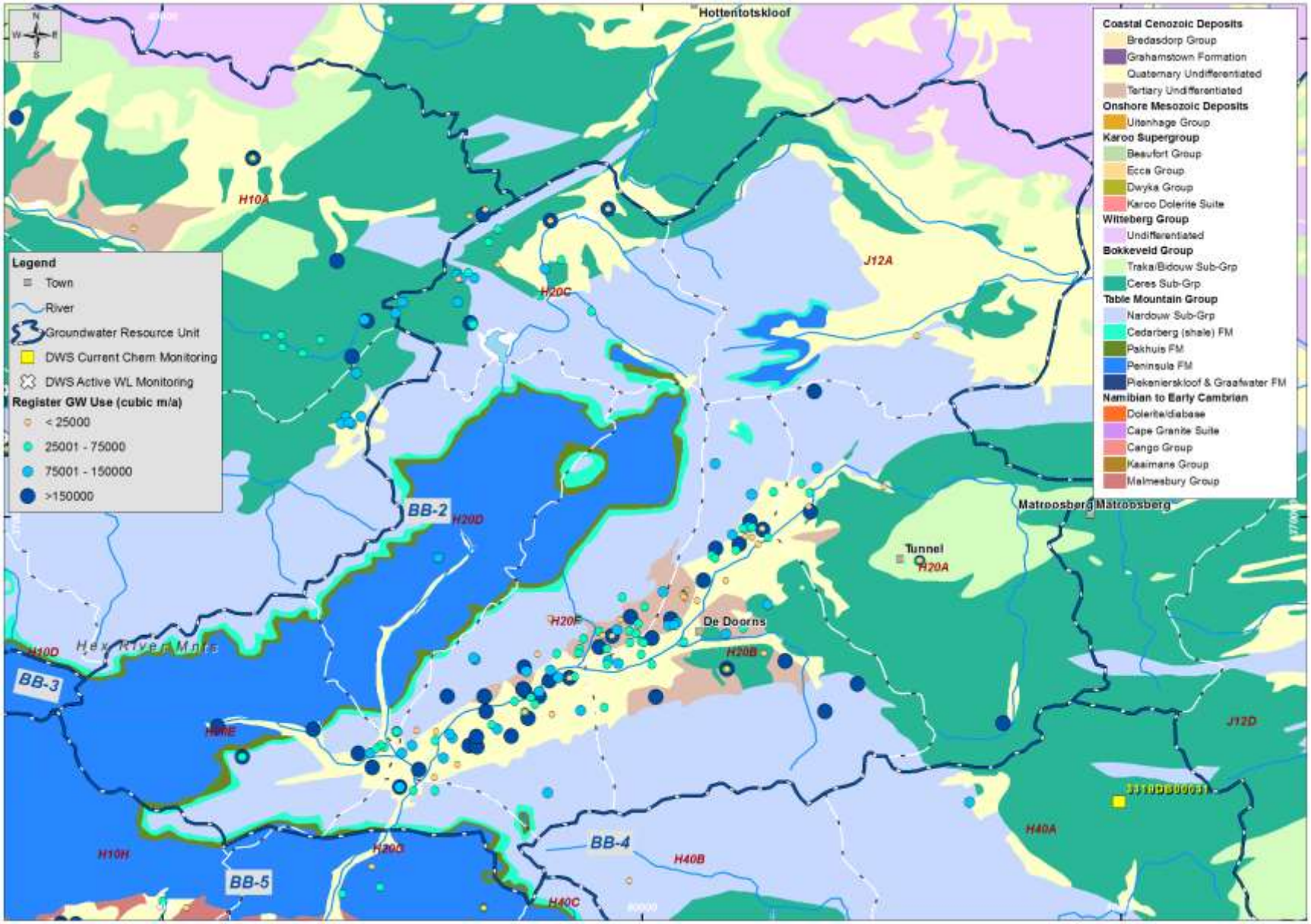
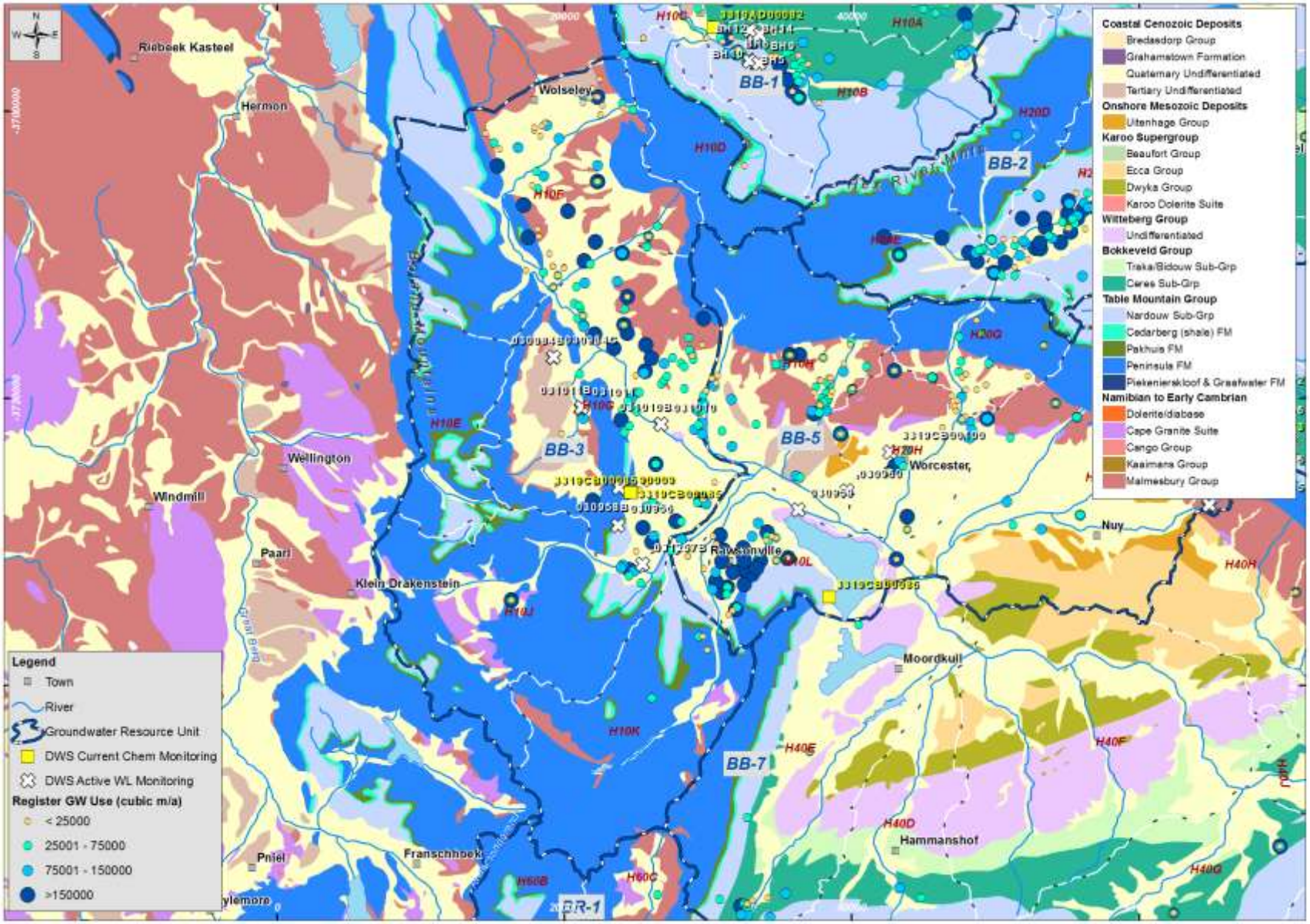
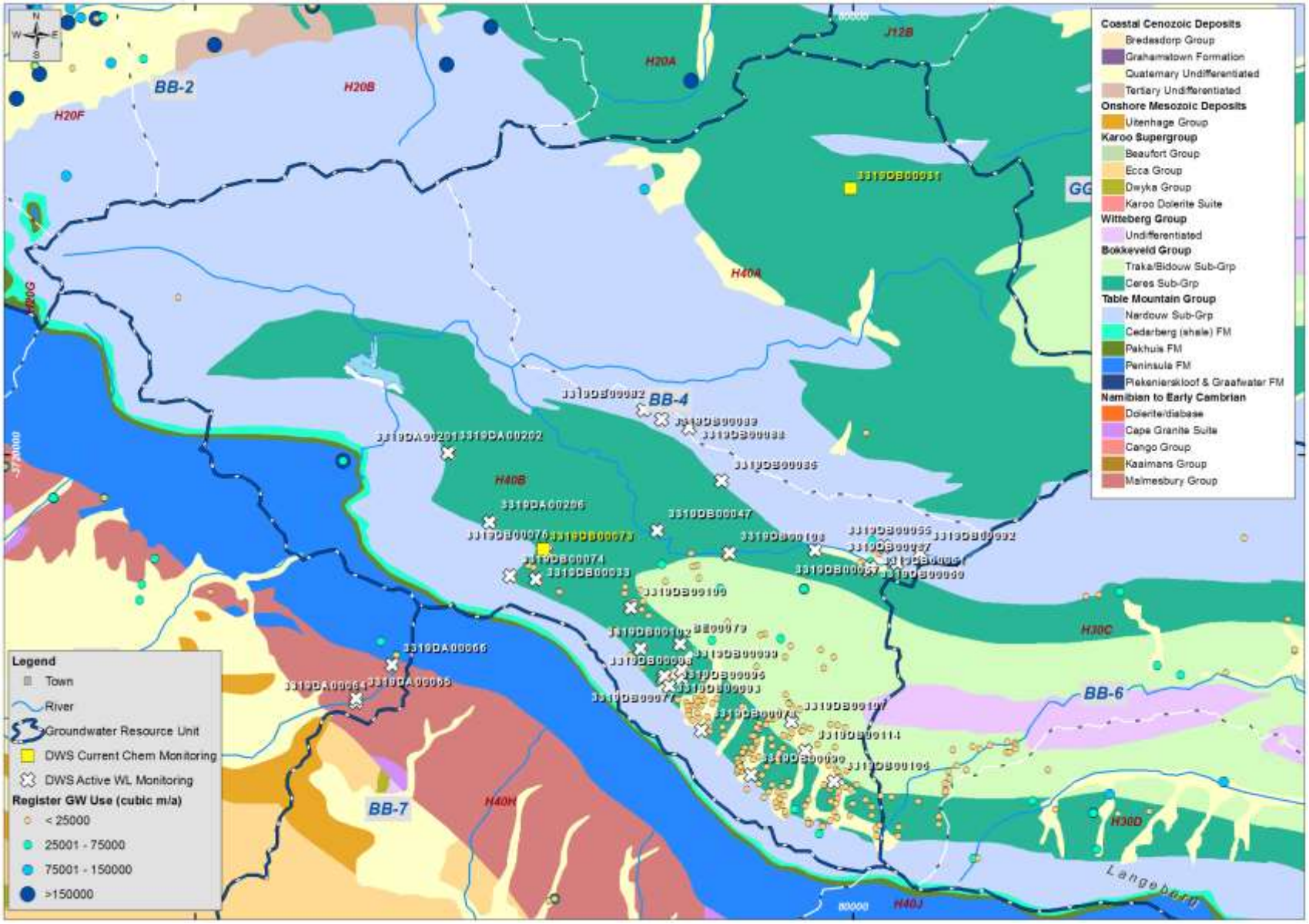
Map for BR-1


Bonnievale
McGregor
BB-7
Riversonderend Mnts
Stormsvlei
Berea
Genadendal
Greyton
Lindeshof
BR-2
Riversonderend
Rietpoel
Protem
Klipdale
BO-3
BB-8
Oukraal
Fairfield
H40F
H40Q
H40K
H50B
H50A
H60E
H60F
H60D
H60H
H60J
H60K
H60L
H70A
H70G
G40F
G50G
G50D
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Map for BR-2

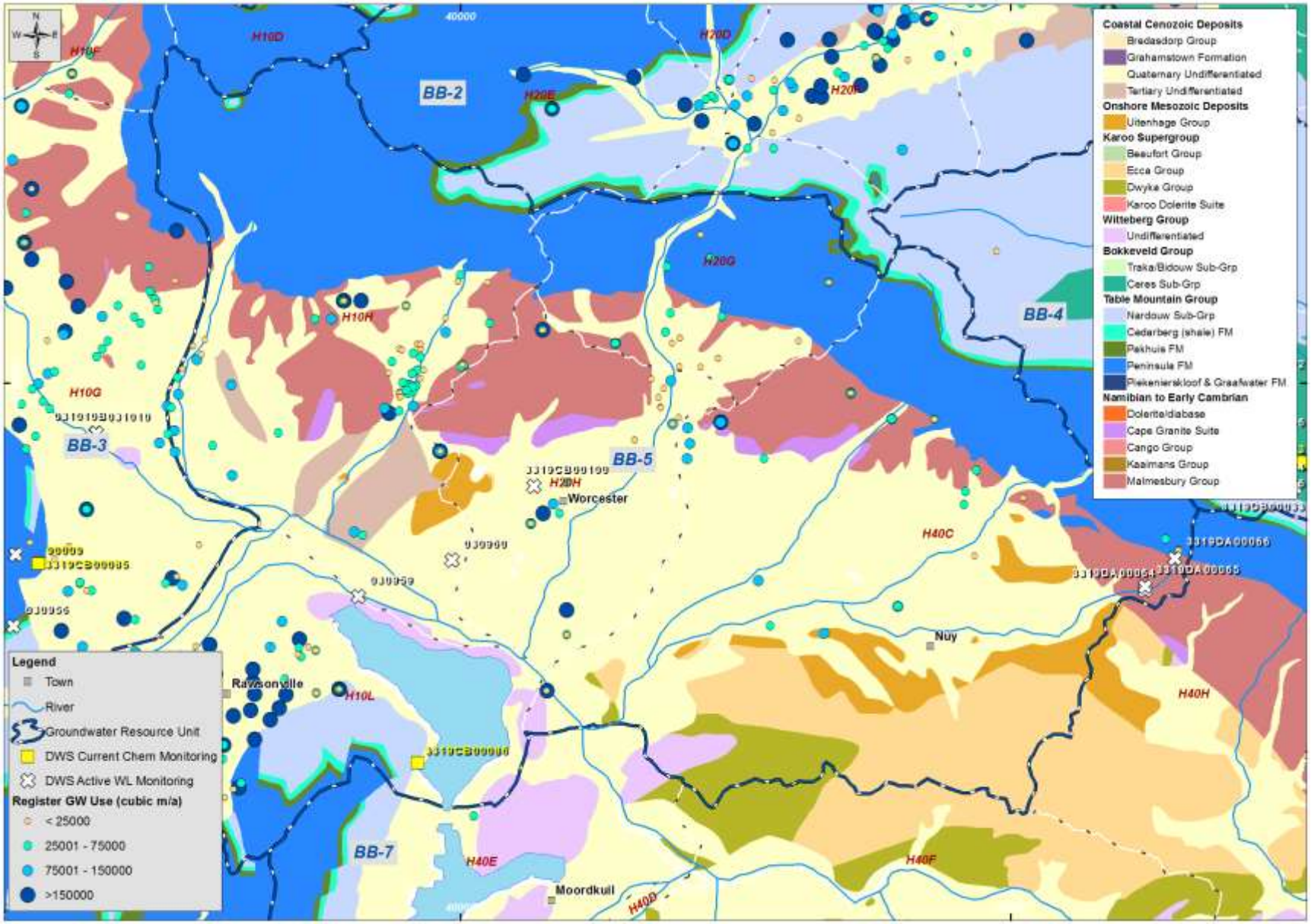

Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Tulbagh
Prince Alfred Hamlet
Ceres
BB-1
BB-2
H10A
H10B
H10C
H10D
H20D
H20E
H20F
H20B
J12A
Hex River Mnts
De Doorns
BH10
BH11
BH12
BH9
20000
40000
Map for BB-1


Hottentotskloof
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
H10A
J12A
H20C
BB-2
H20D
Matroosberg
Tunnel
H20A
H20F
De Doorns
H20B
H10D
Hex River Mnts
BB-3
H20E
J12D
H40A
H10H
H20G
BB-4
H40B
BB-5
H40C
Map for BB-2

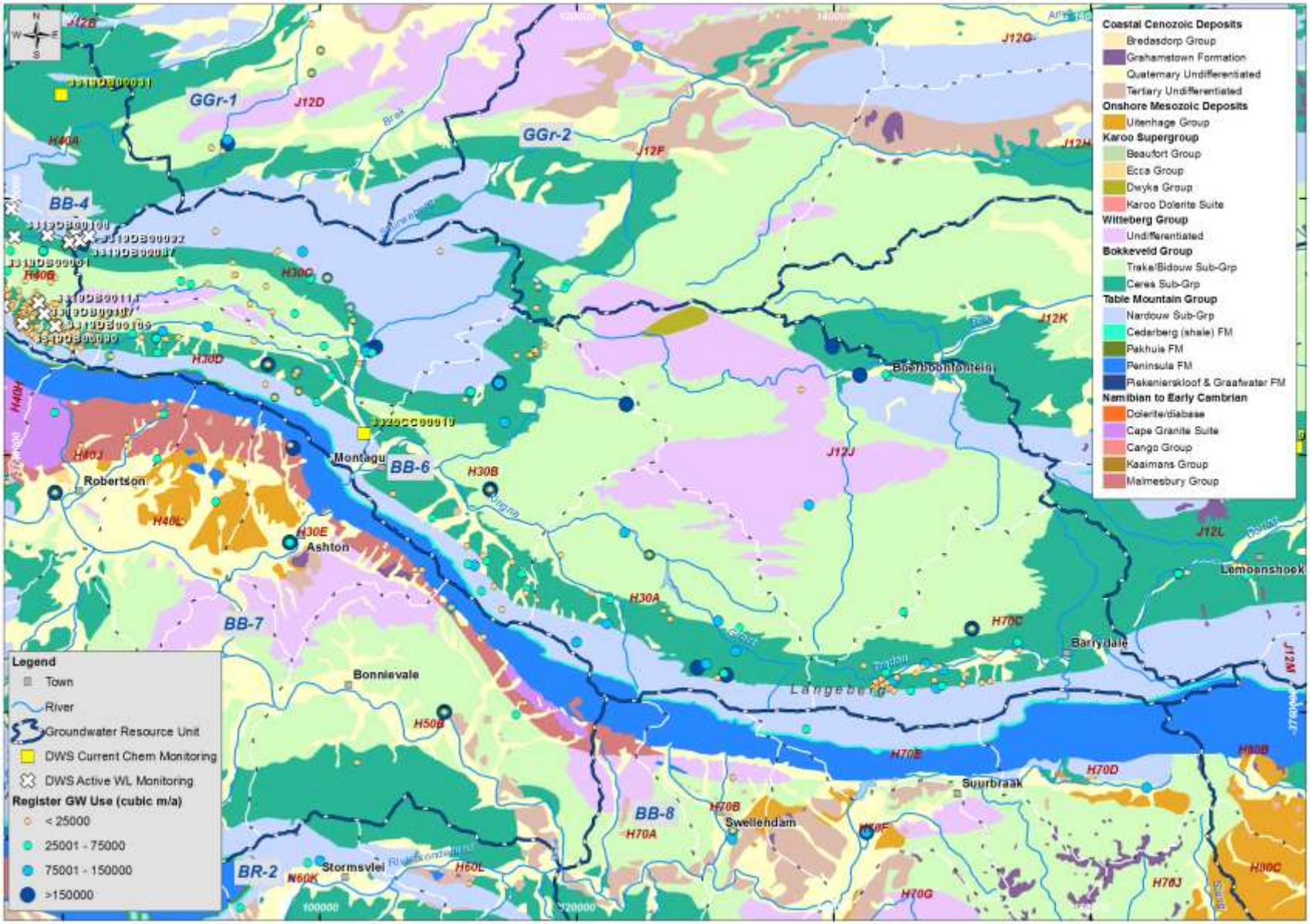

Riebeek Kasteel
Hermon
Wolseley
Wellington
Windmill
Paarl
Klein Drakenstein
Pniel
Franschhoek
Worcester
Rawsonville
Nuy
Moordkuil
Hammanshof
BB-1
BB-2
BB-3
BB-5
BB-7
BR-1
H10A
H10B
H10C
H10D
H10E
H10F
H10G
H10H
H10J
H10K
H10L
H20D
H20G
H20H
H40D
H40E
H40F
H40G
H40H
H60B
H60C
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Map for BB-3

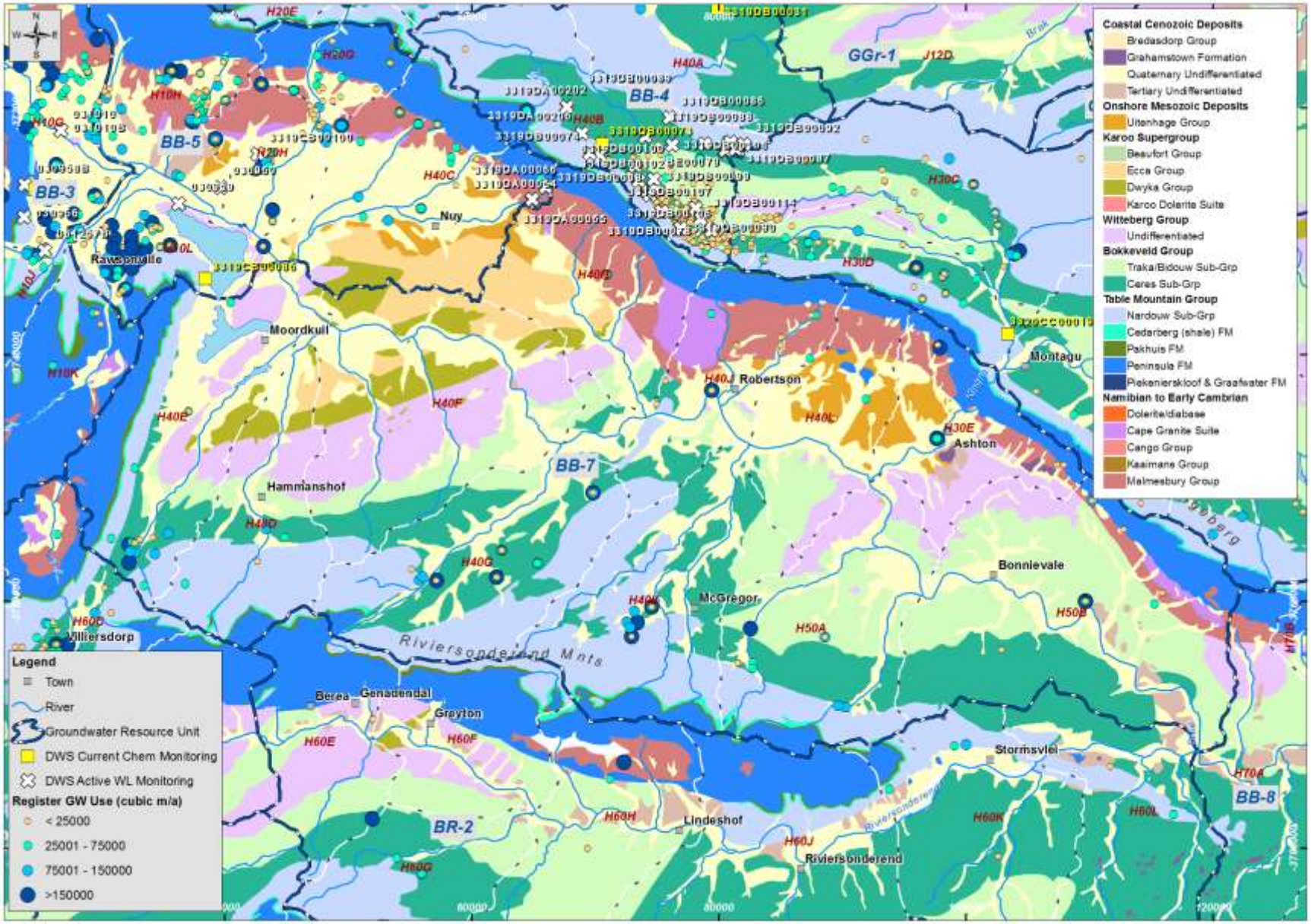

BB-2
BB-4
BB-6
BB-7
H20A
H20B
H20F
H40A
H40B
H40H
H40J
H30C
H30D
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cederberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000

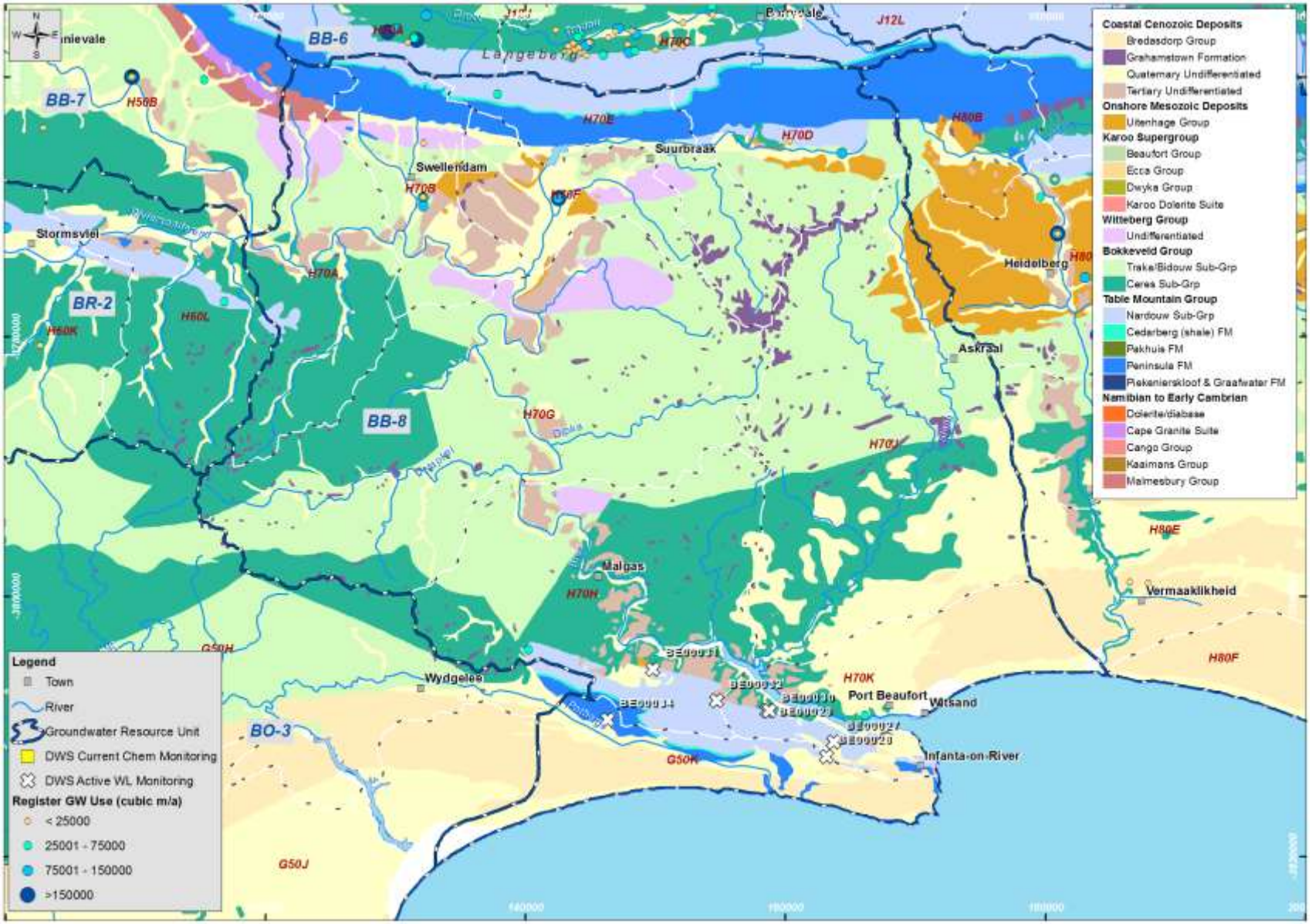
Map for BB-4

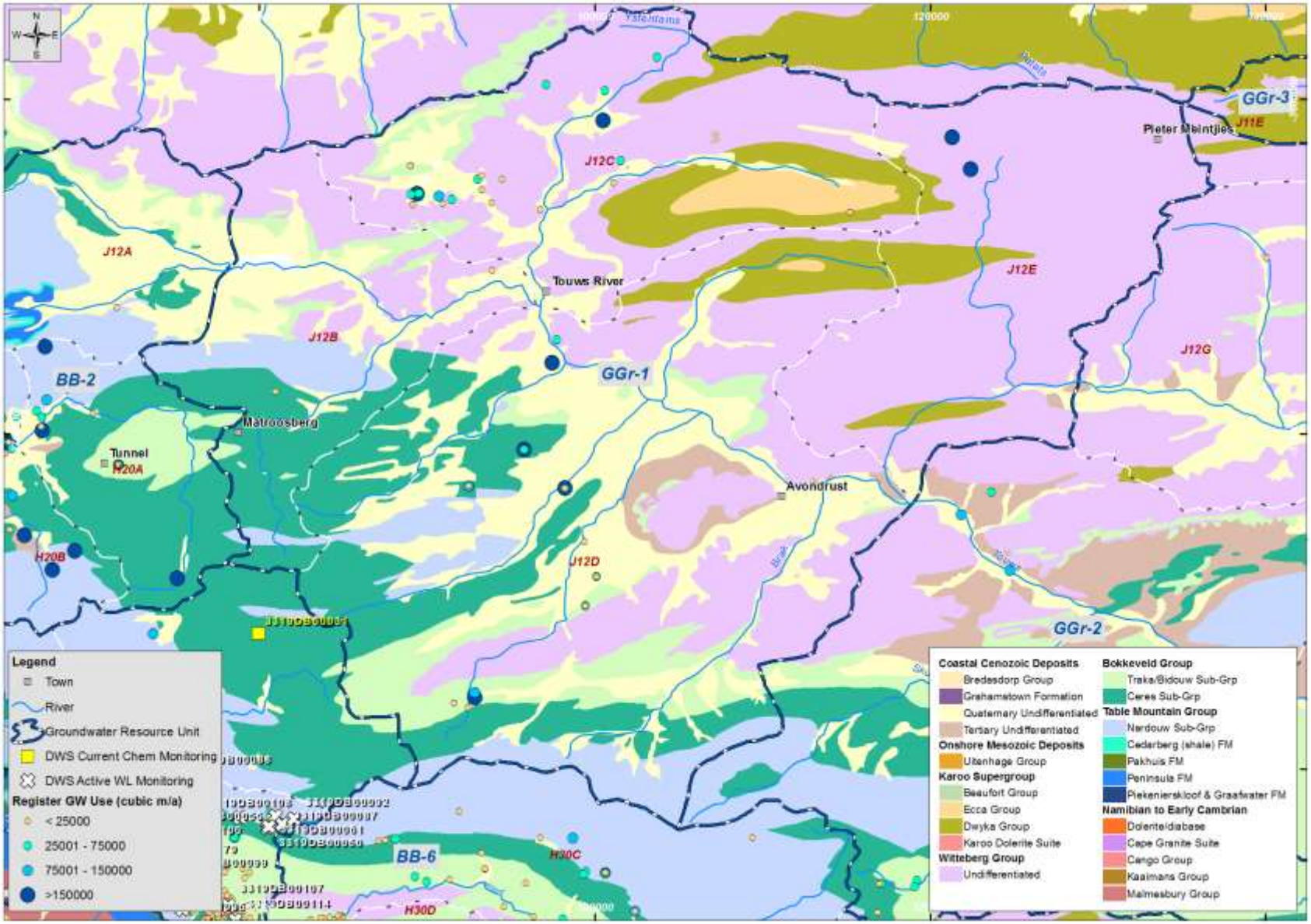

Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
BB-2
BB-3
BB-4
BB-5
BB-7
H10D
H10E
H10G
H10H
H10L
H20D
H20E
H20F
H20G
H40C
H40E
H40F
H40H
Worcester
Ravensville
Moordkuil
Nuy

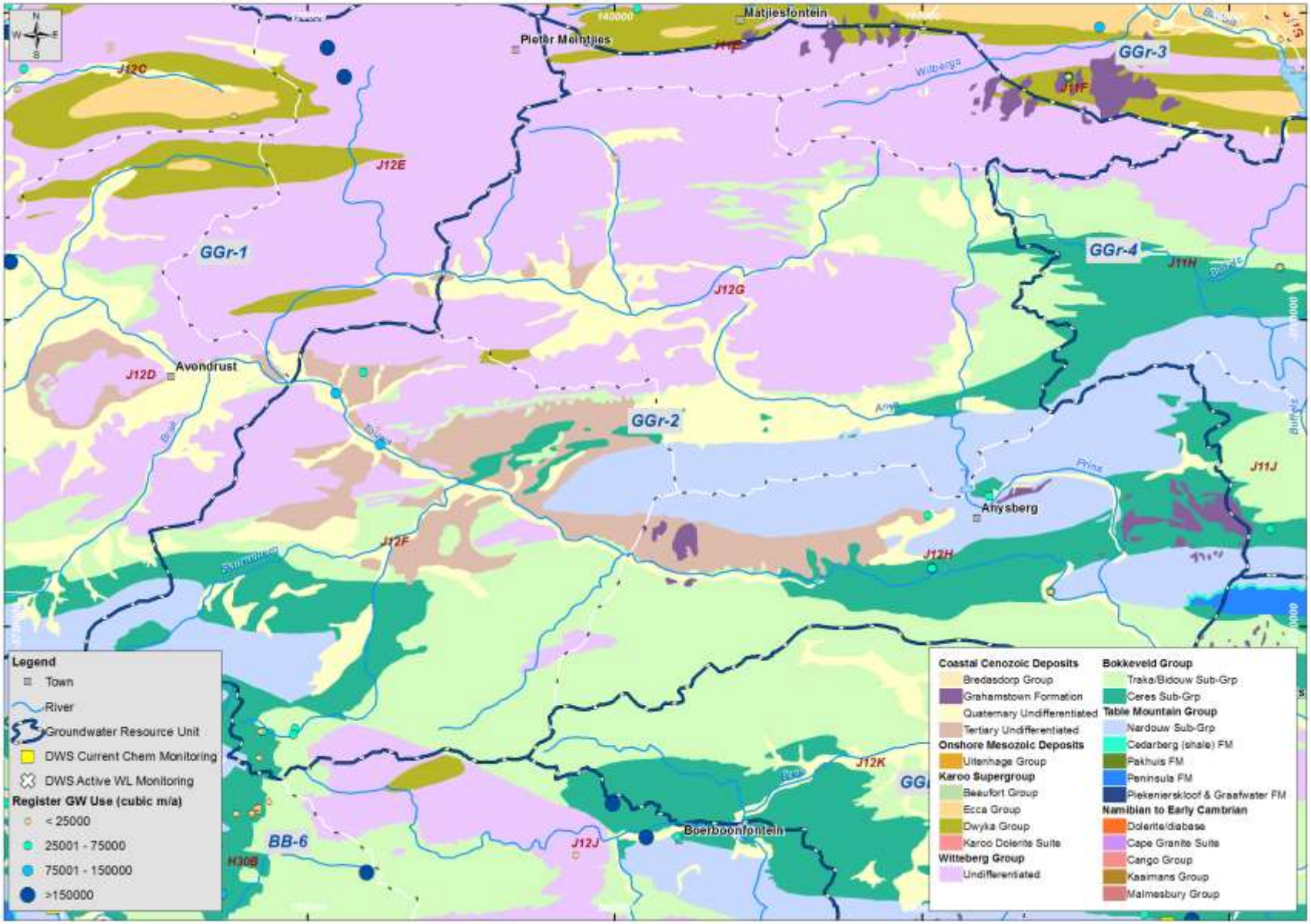
Map for BB-5

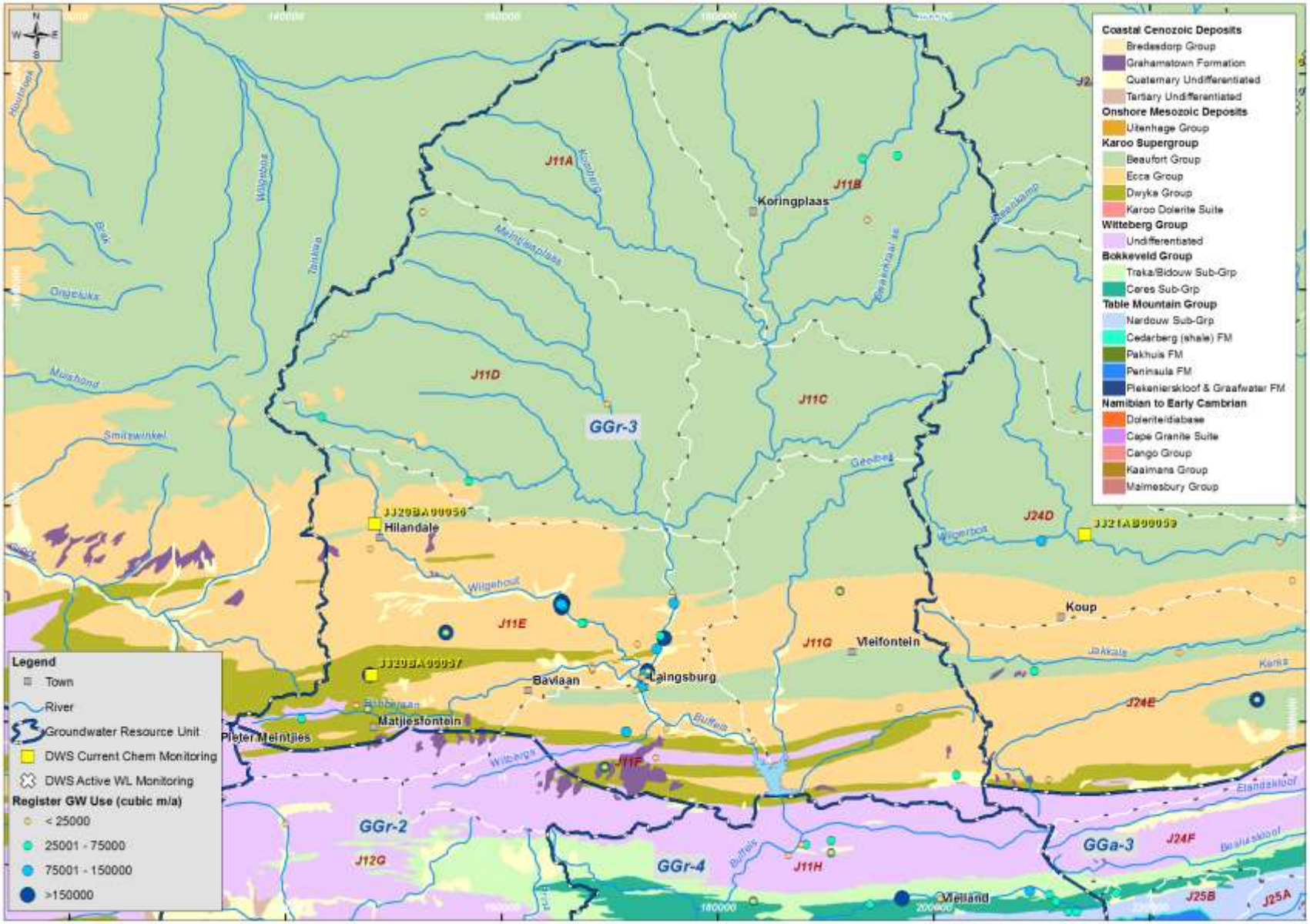

Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
GGr-1
GGr-2
BB-4
BB-6
BB-7
BB-8
BR-2
Montagu
Robertson
Ashton
Bonnievale
Stormsvlei
Boomboontein
Barrydale
Suurbraak
Swellendam
Lemoenshoek
Langeberg
J12B
J12D
J12F
J12G
J12H
J12J
J12K
J12L
J12M
H40A
H40B
H40H
H40J
H40L
H30A
H30B
H30C
H30D
H30E
H50B
H50L
H60K
H70A
H70B
H70C
H70D
H70E
H70G
H76J
Map for BB-6


Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
BB-3
BB-4
BB-5
BB-7
BB-8
BR-2
GGr-1
Nuy
Rawsonville
Moordkuil
Robertson
Montagu
Ashton
Hammanshof
Bonnievale
McGregor
Villiersdorp
Riviersonderend Mnts
Genadendal
Greyton
Stormsvlei
Lindeshof
Riviersonderend
Map for BB-7

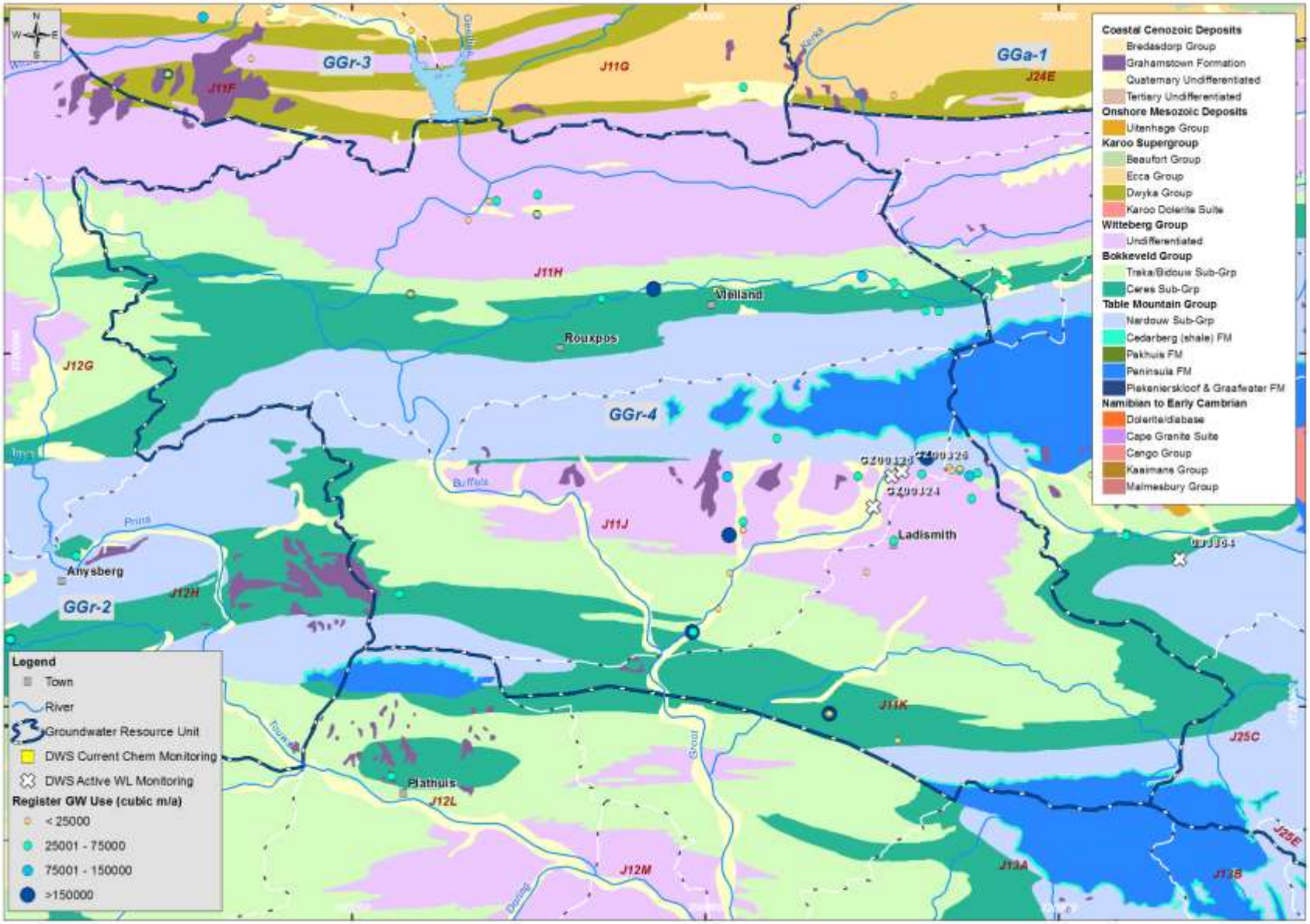

BB-6
BB-7
BB-8
BR-2
BO-3
Swellendam
Suurbraak
Stormsvlei
Heidelberg
Barrydale
Askraal
Malgas
Wydgeles
Port Beaufort
Witsand
Infanta-on-River
Vermaaklikheid
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Map for BB-8


GGr-3
J11E
Pieter Meintjies
J12C
J12A
Touws River
J12E
J12B
GGr-1
J12G
BB-2
Matroosberg
Tunnel
H20A
Avondrust
H20B
J12D
GGr-2
BB-6
H30C
H30D
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Gidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Map for GGr-1

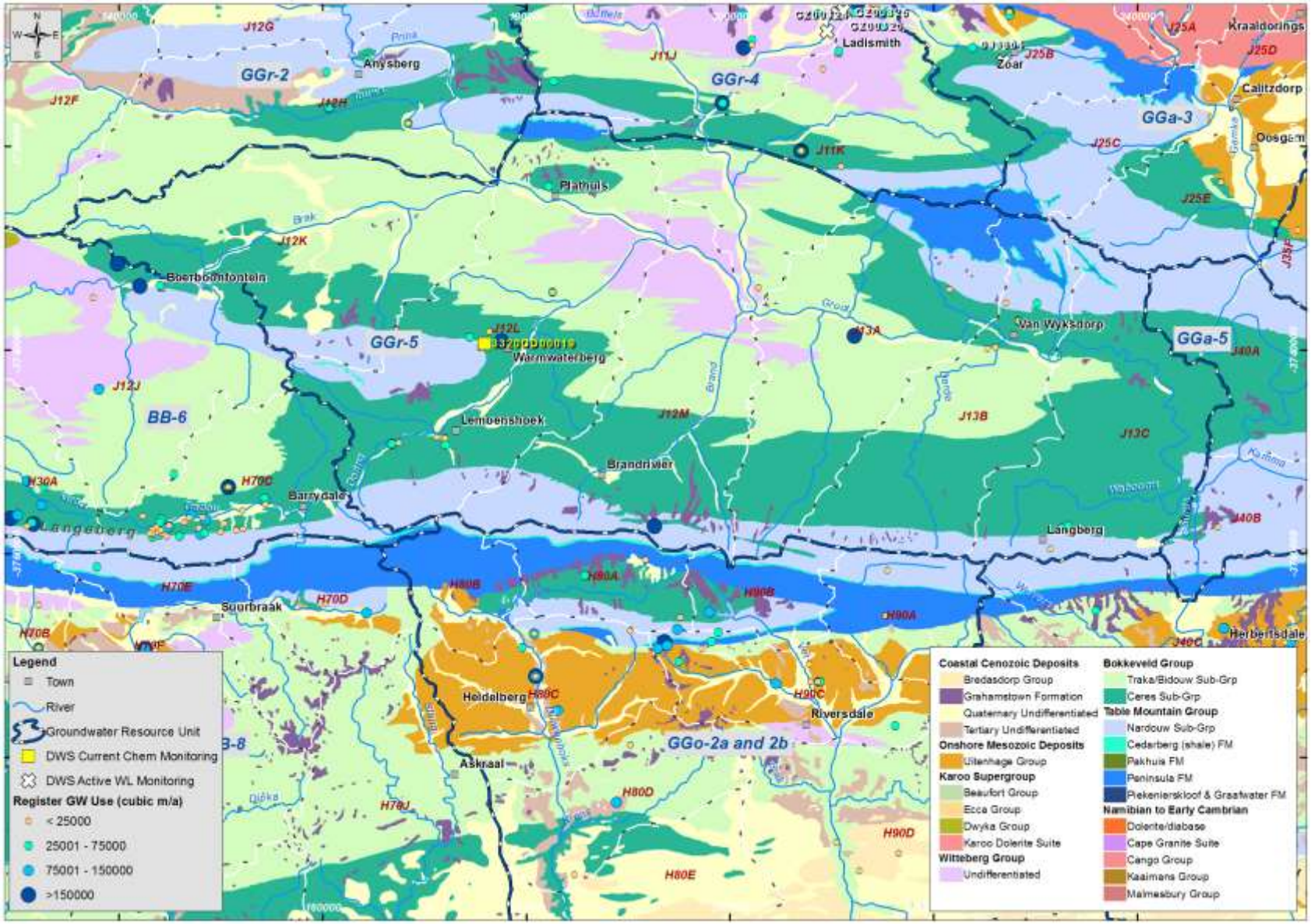

Matjiesfontein
Pietor Meintjies
GGr-3
GGr-1
GGr-4
GGr-2
J12C
J12E
J12G
J12D
Avondrust
J11H
J11J
Ahrysberg
J12F
J12H
J12K
J12J
Boerboonfontein
BB-6
H30B
Witteberg
Buffels
Prins
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Map for GGr-2


Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
GGr-3
GGr-2
GGr-4
GGa-3
J11A
J11B
J11C
J11D
J11E
J11F
J11G
J11H
J12G
J24D
J24E
J24F
J25B
J25A
Koringplaas
Hilandale
Baviaan
Laingsburg
Matjiesfontein
Pieter Meintjies
Vleifontein
Koup
Vleiland
Meintjiesplaas
Geelbek
Wilgehout
Buffels
Elandskloof
Bosluiskloof

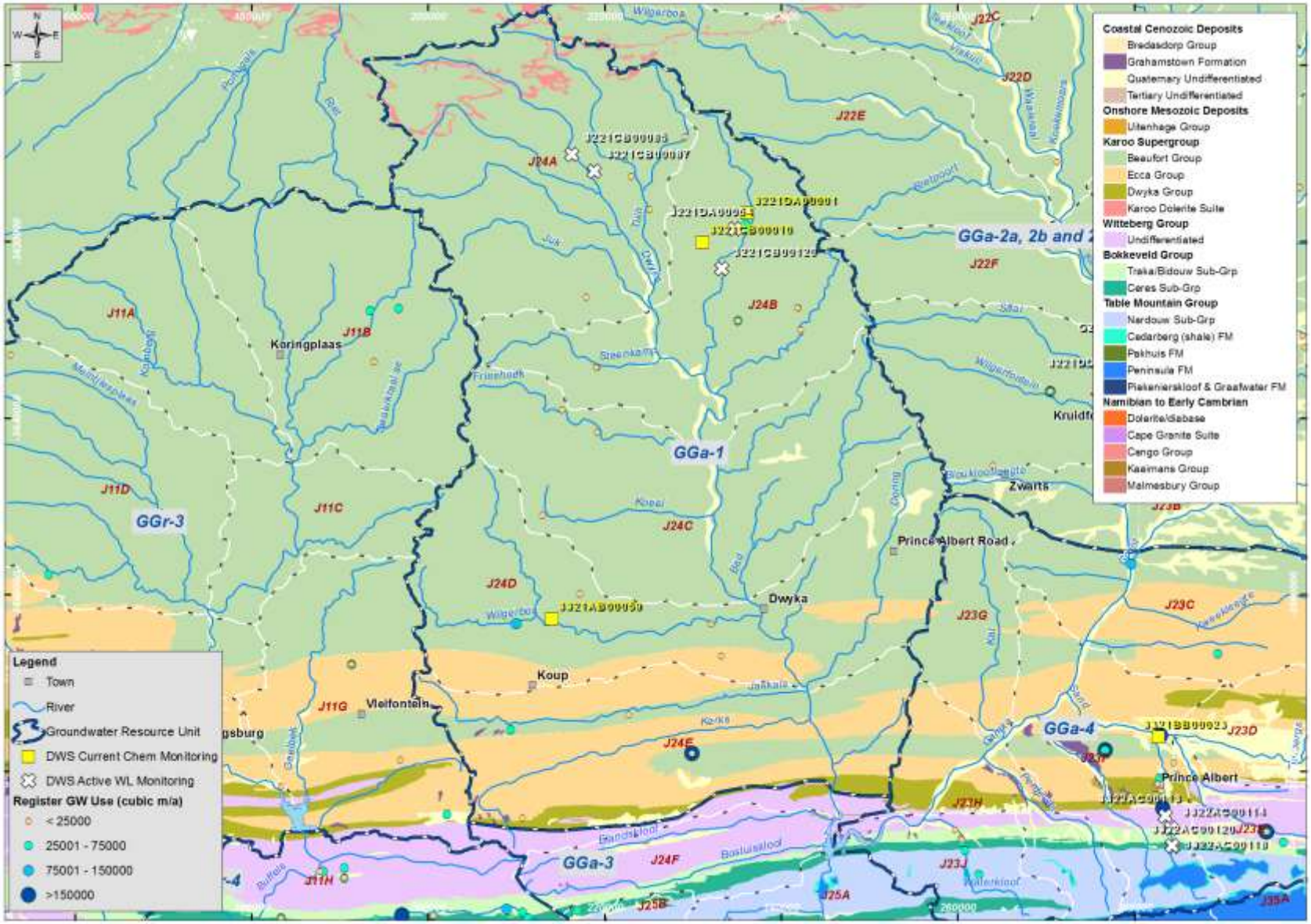
Map for GGr-3

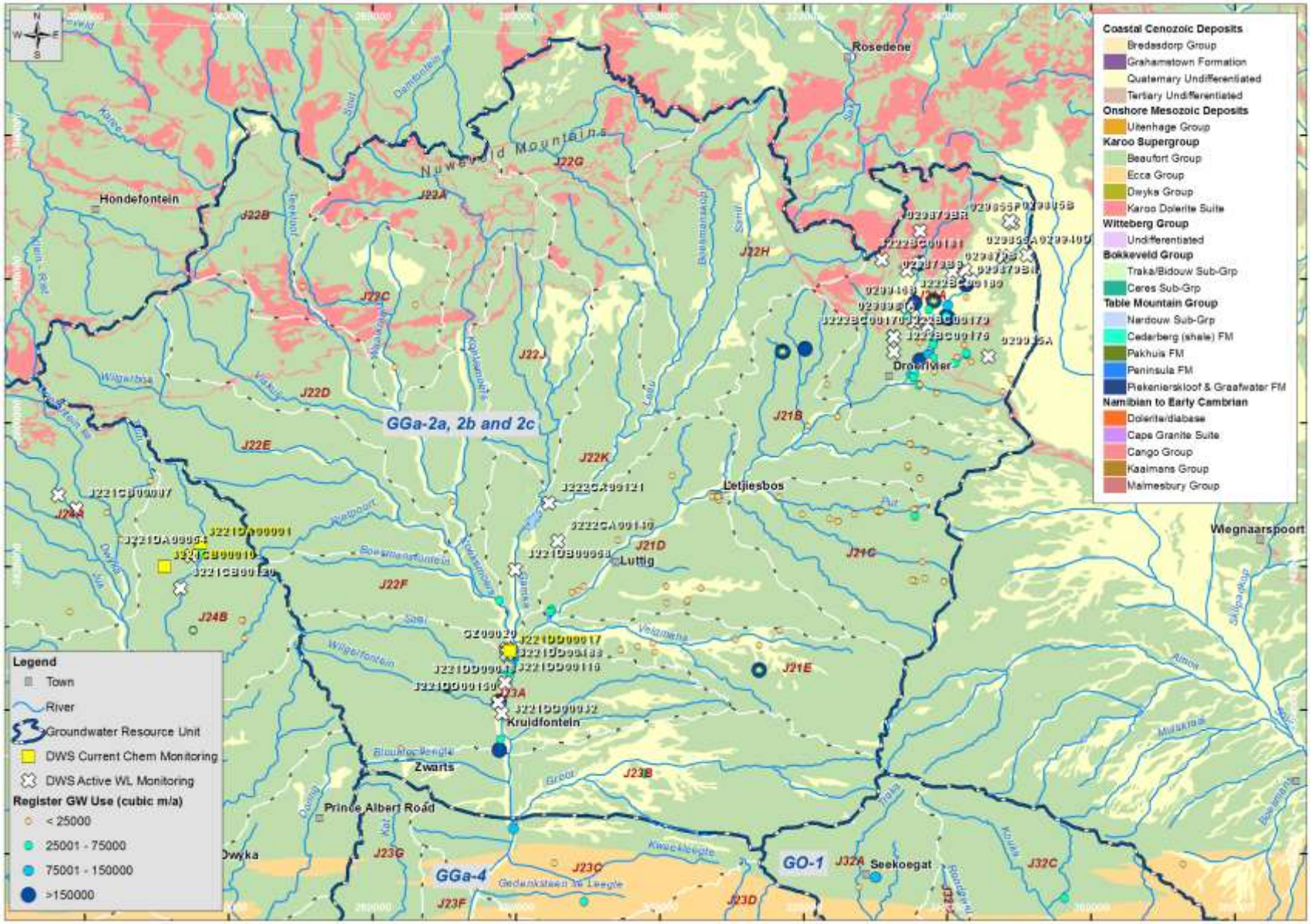

GGr-3
GGa-1
GGr-4
GGr-2
J11F
J11G
J24E
J11H
J12G
J11J
J11K
J12H
J12L
J12M
J25C
J25E
J13A
J13B
Vioolland
Rouxpos
Ladismith
Anysberg
Plathuis
Buffels
Prins
Touws
Groot
Doring
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group

Map for GGr-4

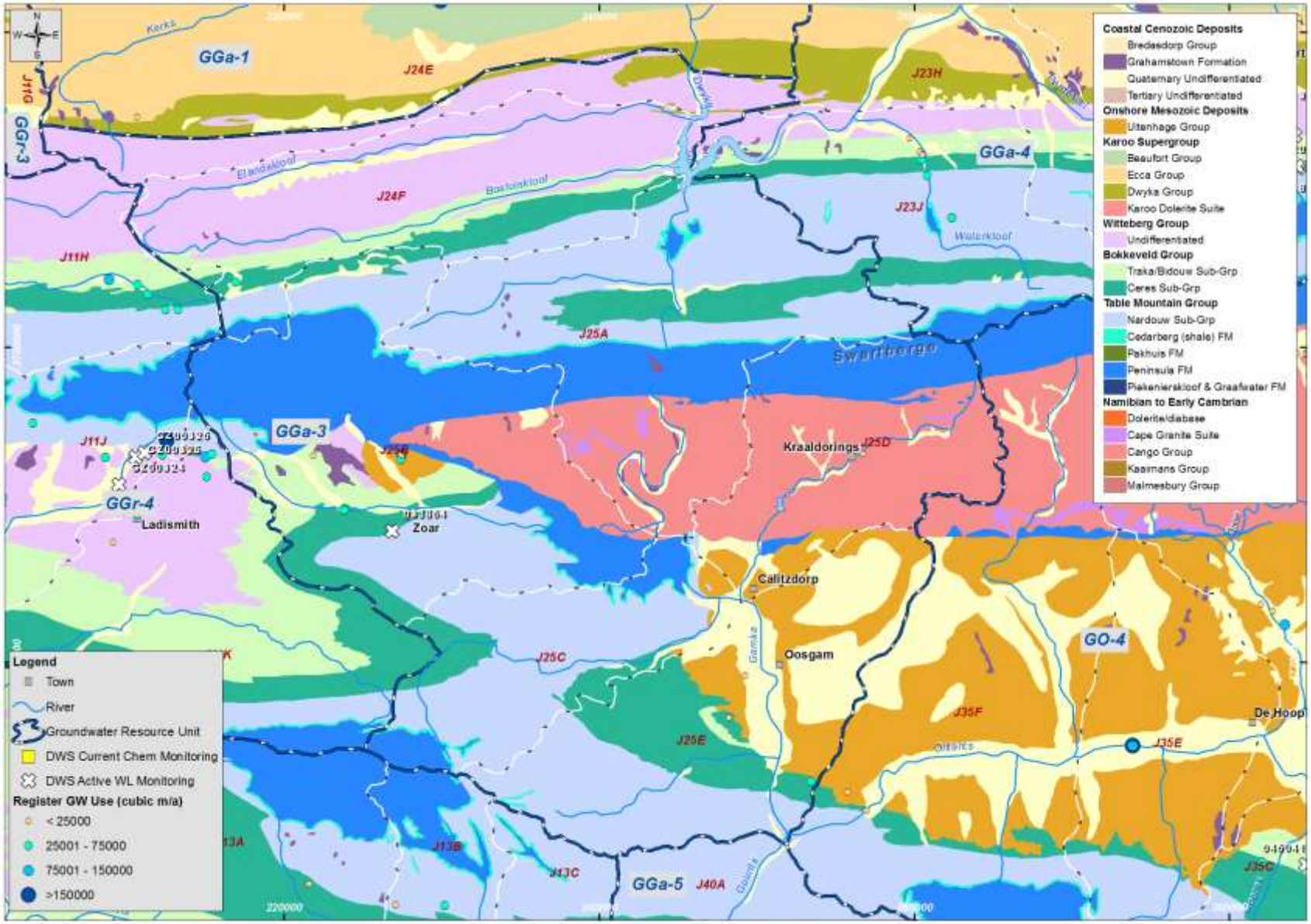

GGr-2
GGr-4
GGr-5
GGa-3
GGa-5
BB-6
GGo-2a and 2b
Ladismith
Zoar
Kraaldorings
Calitzdorp
Oosgem
Anysberg
Plathuis
Boerboomfontein
Warmwaterberg
Van Wyksdorp
Lemoenshoek
Brandriver
Barrydale
Langeberg
Suurbraak
Heidelberg
Riversdale
Askraal
Herbertsdale
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group

Map for GGr-5


Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
GGa-1
GGa-2a, 2b and
GGa-3
GGa-4
GGr-3
Koringplaas
Koup
Vleifontein
Dwyka
Prince Albert Road
Prince Albert
Zwarts
J11A
J11B
J11C
J11D
J11G
J11H
J22C
J22D
J22E
J22F
J23B
J23C
J23D
J23G
J23H
J23J
J24A
J24B
J24C
J24D
J24E
J24F
J25A
J25B
J35A
Map for GGa-1



Map for GGa-2a, 2b and 2c


GGa-1
GGa-3
GGa-4
GGr-4
GO-4
GGa-5
J24E
J23H
J24F
J23J
J11H
J25A
J11J
J25D
J25C
J35F
J35E
J13B
J13C
J40A
Swartberge
Kraaldorings
Calitzdorp
Oosgam
De Hoop
Ladismith
Zoar
Waterkloof
Baskaasklool
Elandsklool
Dwyka
Gamka
Olifants
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
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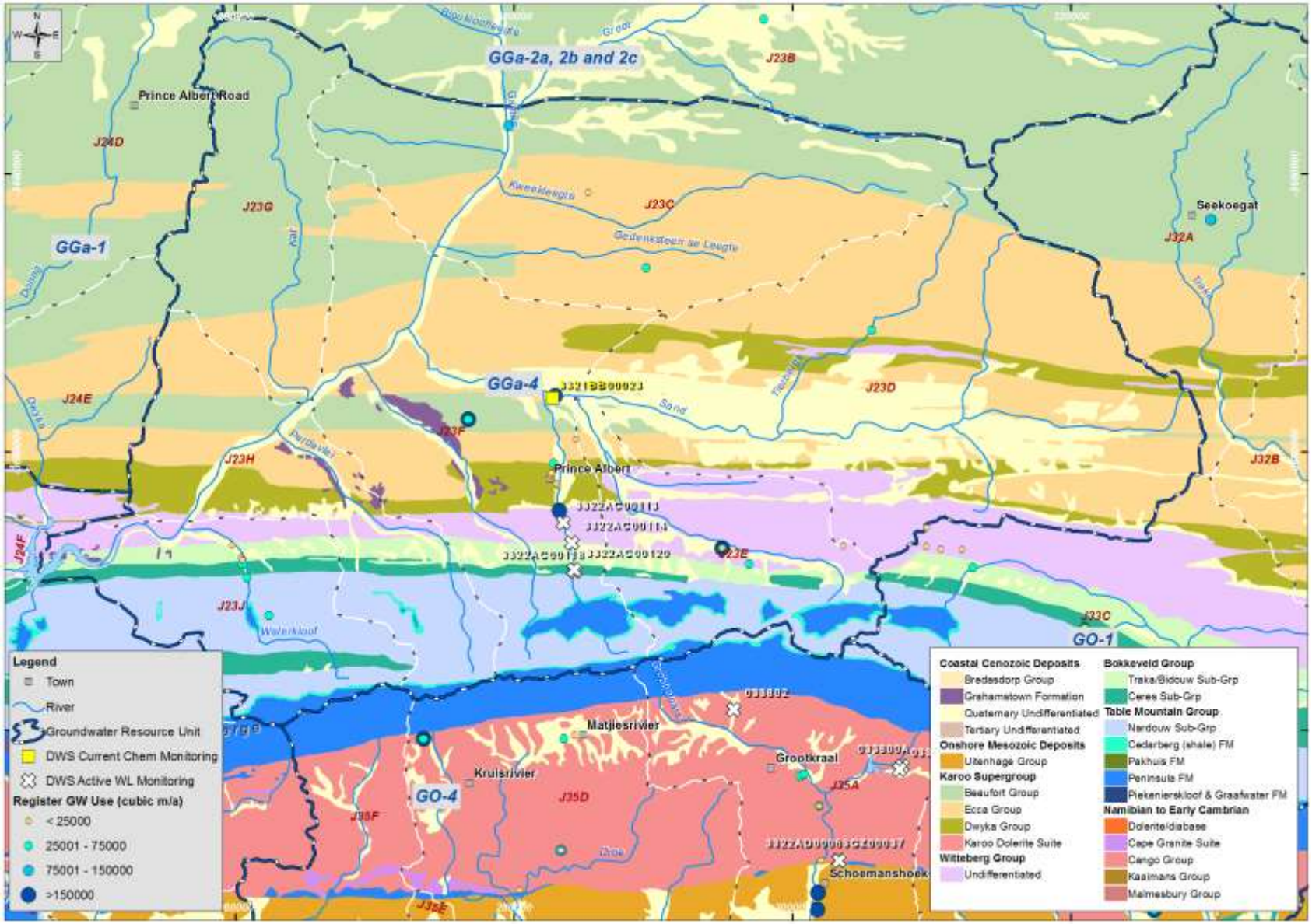
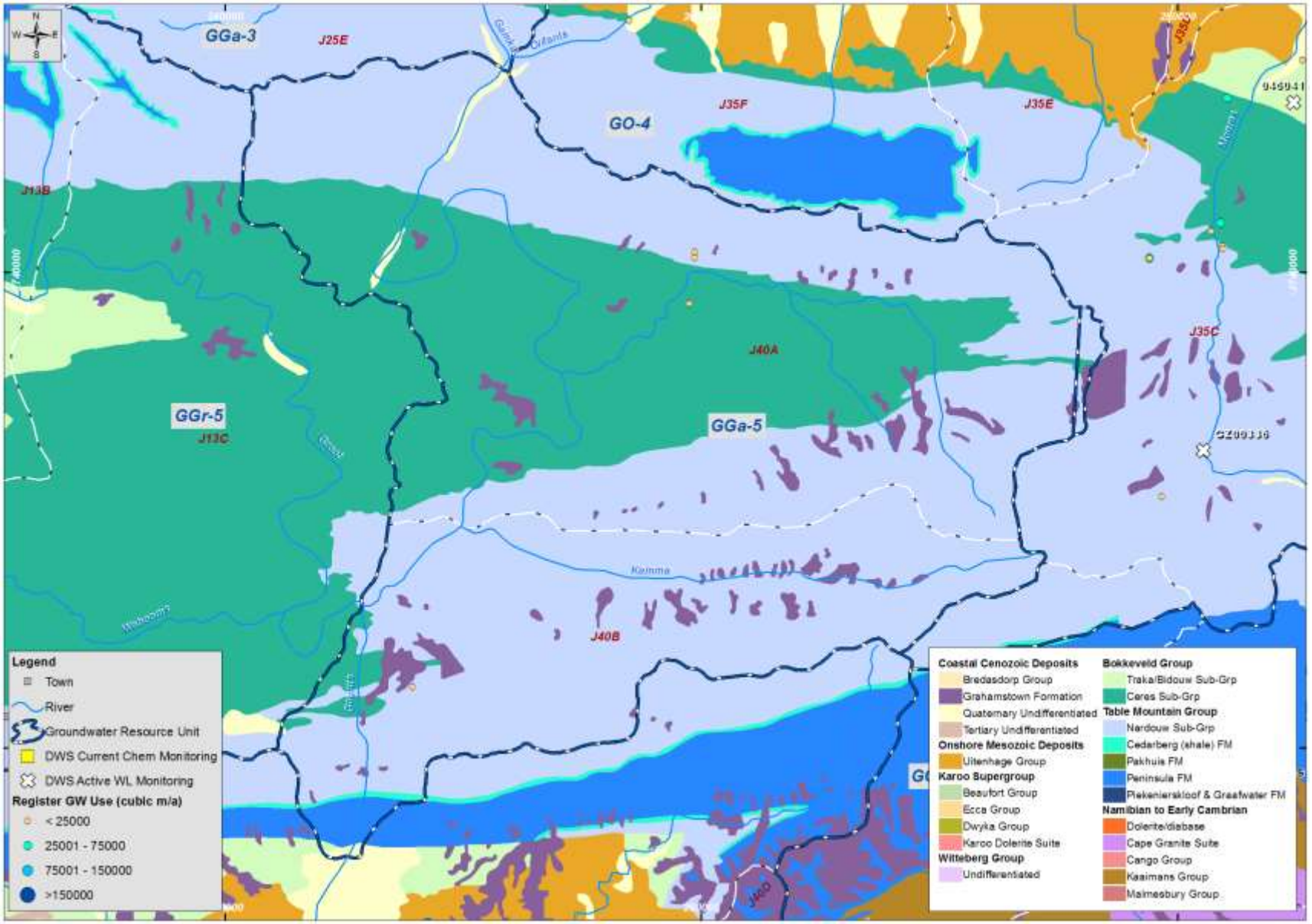
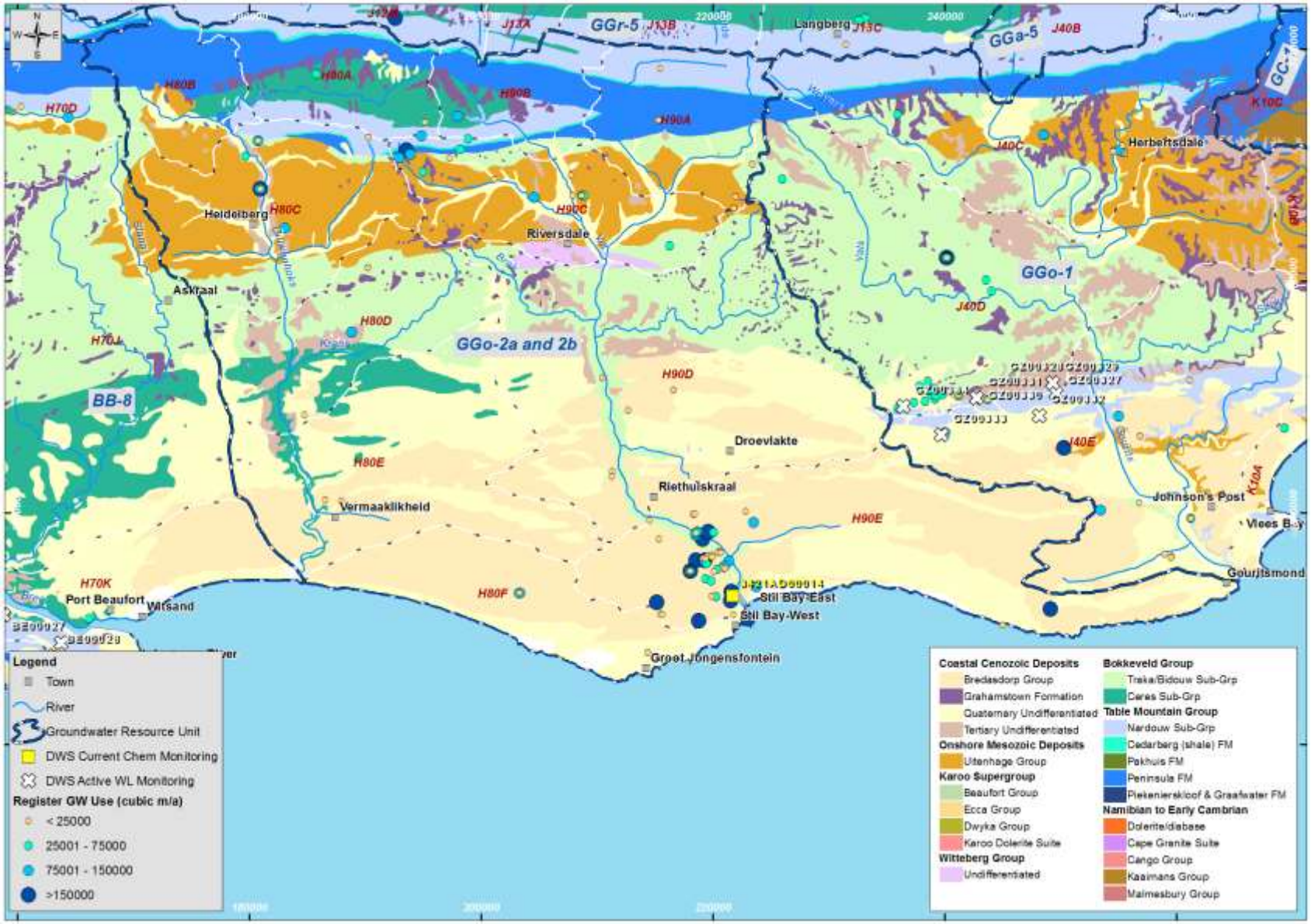
75001 - 150000
>150000
Map for GGa-3

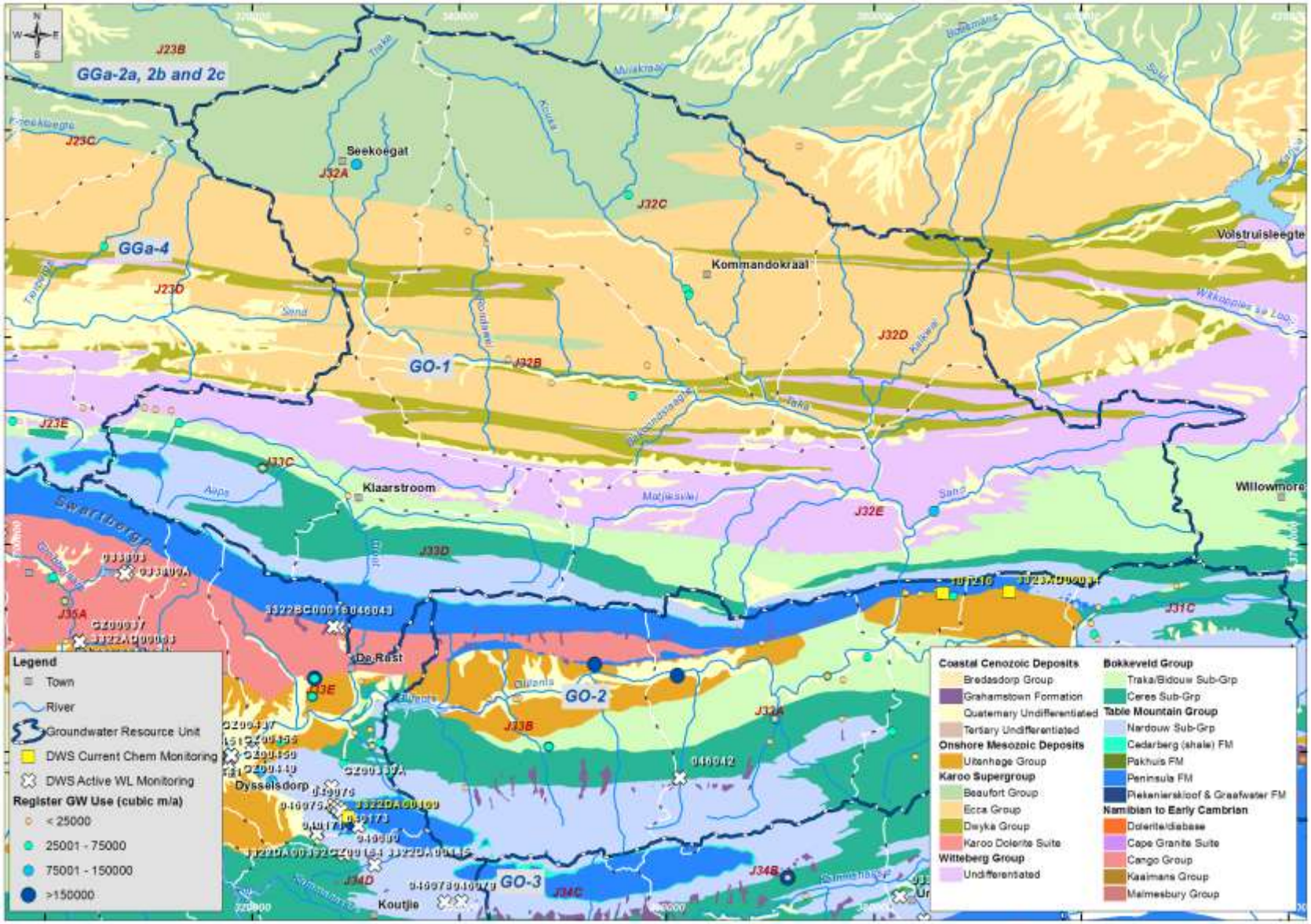

GGa-2a, 2b and 2c
GGa-1
GGa-4
GO-1
GO-4
Prince Albert Road
Prince Albert
Seekoegat
Matjiesrivier
Kruisrivier
Grootkraal
Schoemanshoek
J23B
J24D
J23G
J23C
J32A
J24E
J23F
J23D
J23H
J32B
J24F
J23E
J23J
J33C
J35D
J35A
J35F
J35E
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group

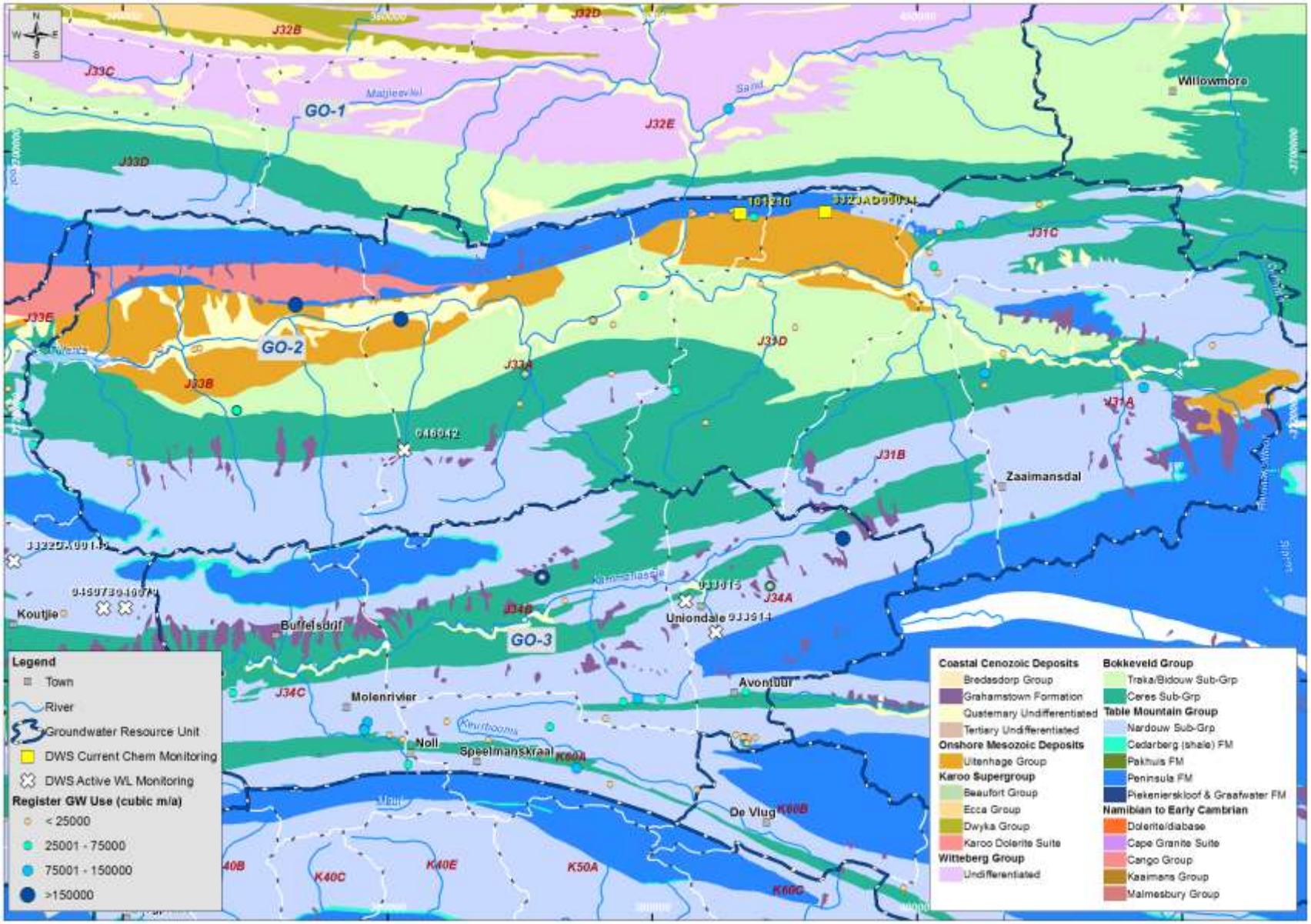
Map for GGa-4

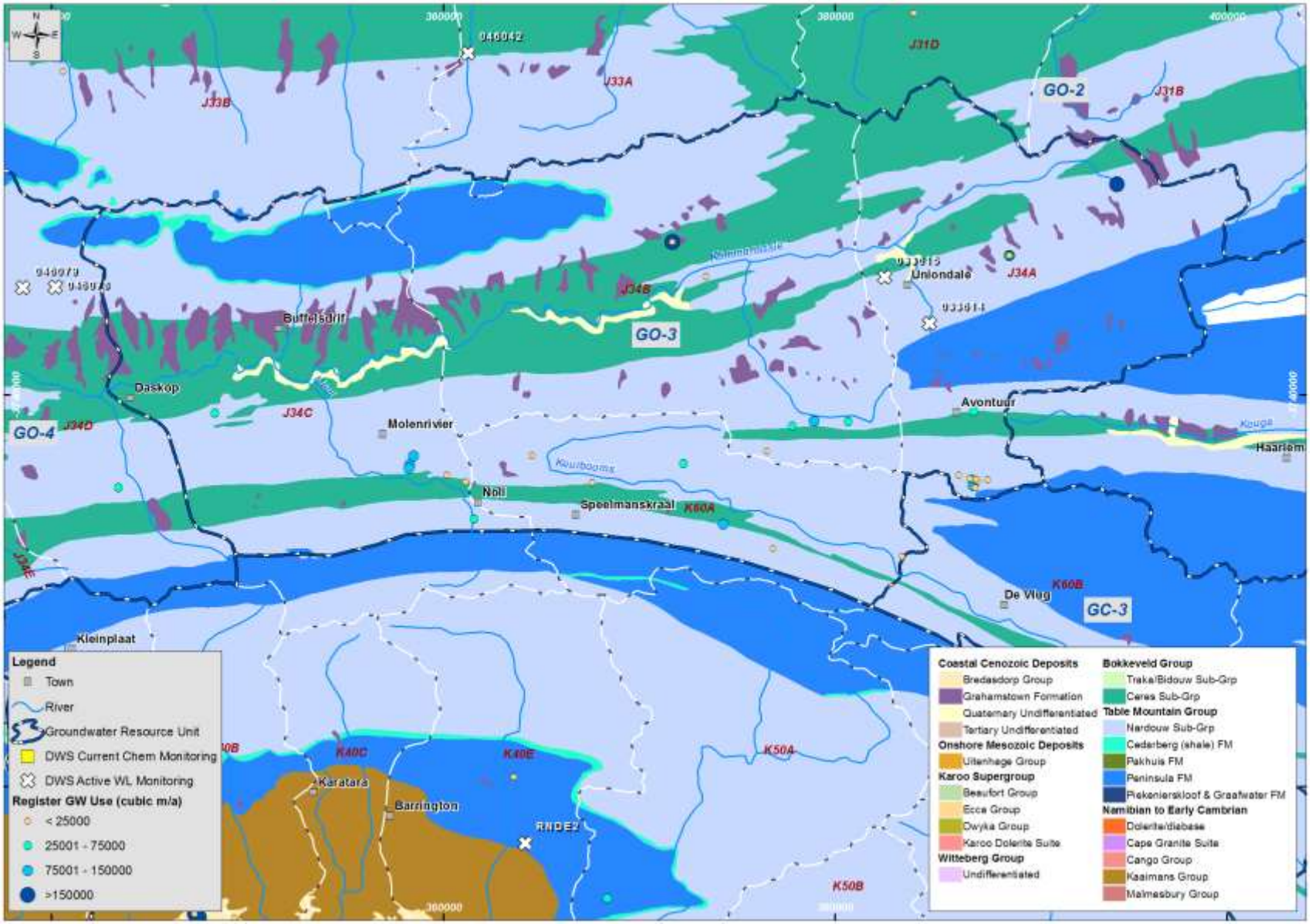

GGa-3
J25E
GO-4
J35F
J35E
J35D
J13B
J40A
J35C
GGr-5
J13C
GGa-5
J40B
Karnma
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Map for GGa-5



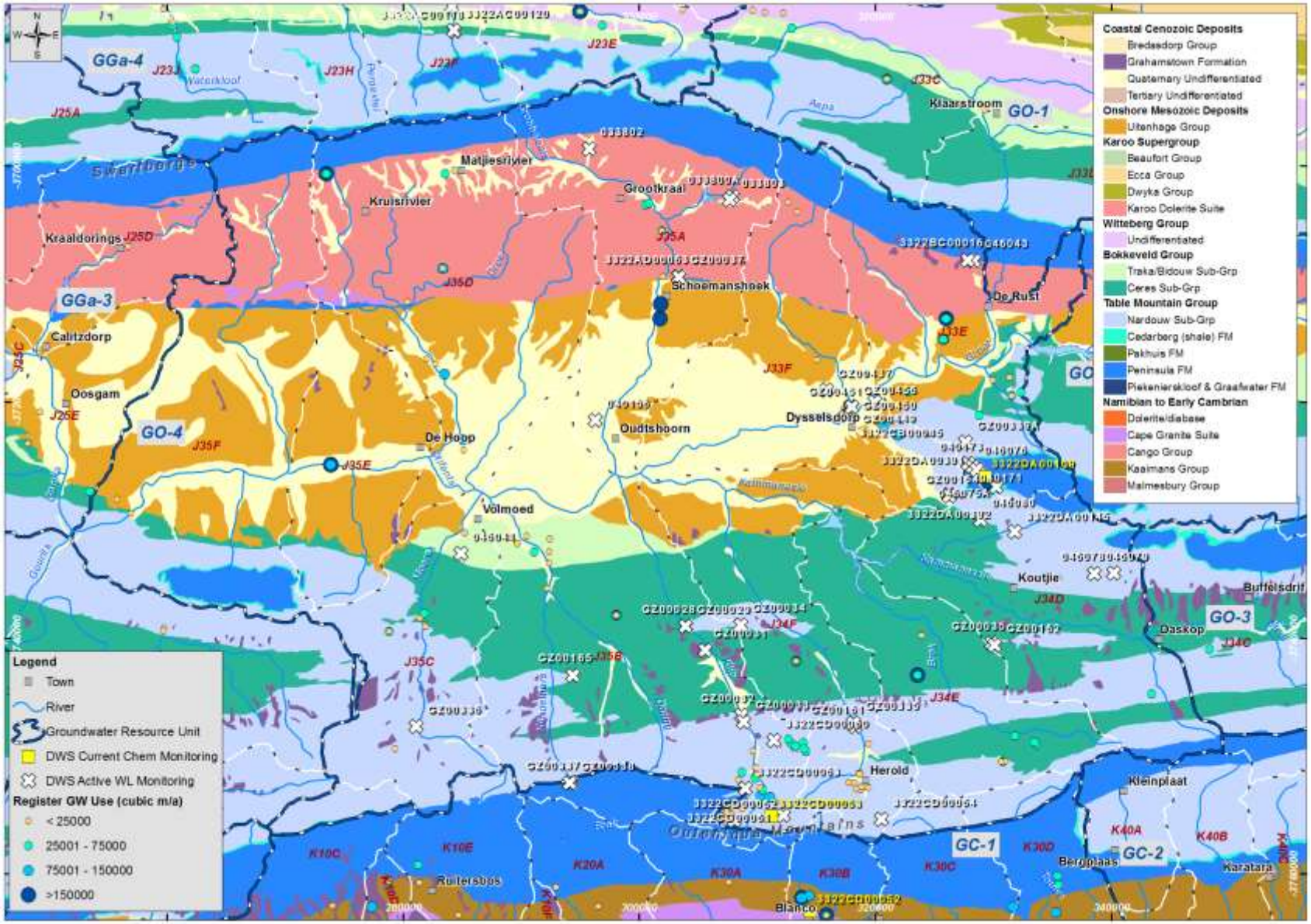
Map for GGo-2a and 2b

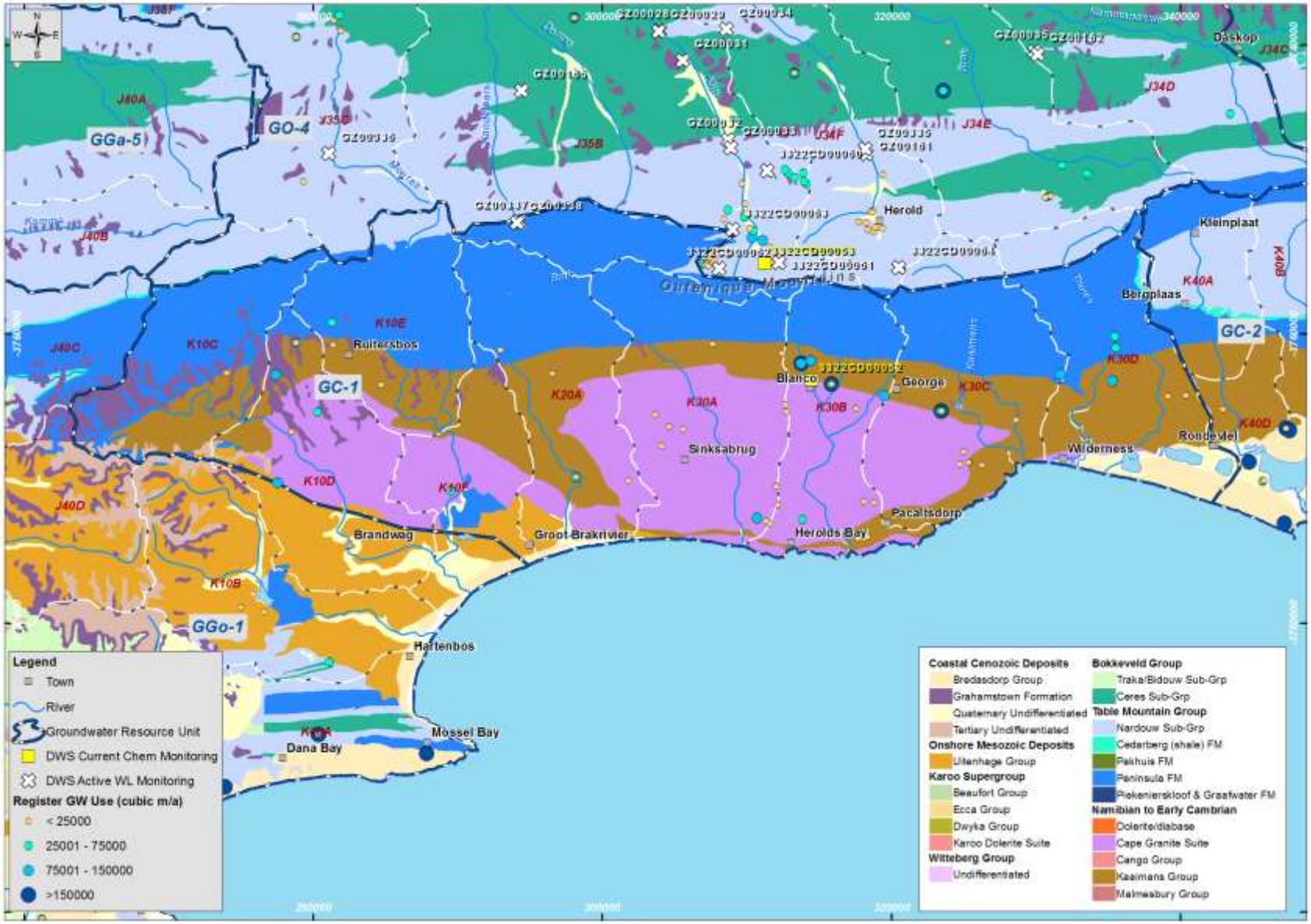

GGa-2a, 2b and 2c
GGa-4
GO-1
GO-2
GO-3
Seekoegat
Kommandokraal
Volstruisleegte
Klaarstroom
Willowmore
De Rust
Dysselsdorp
Koutjie
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Map for GO-1

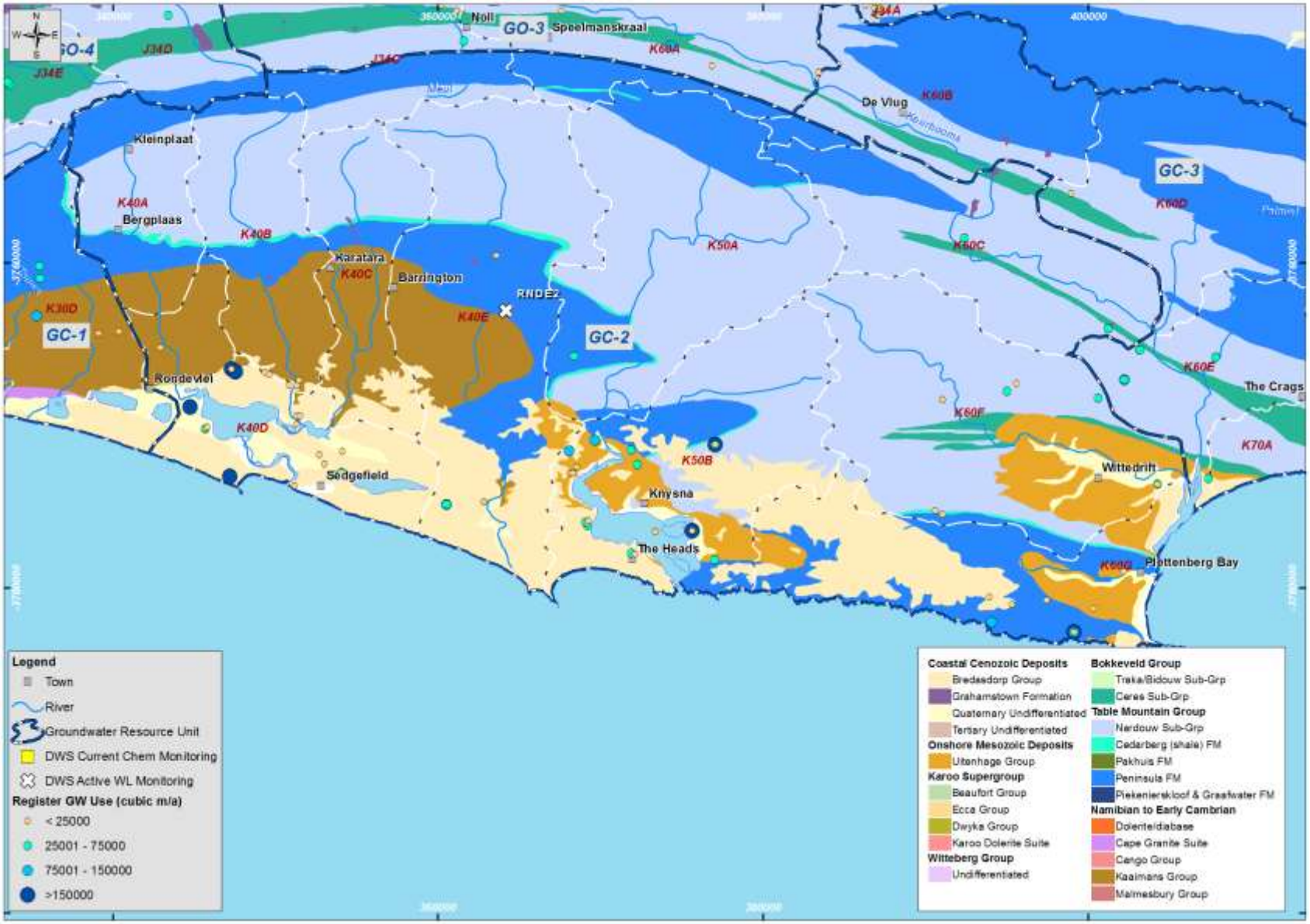

GO-1
GO-2
GO-3
J32B
J32D
J32E
J33C
J33D
J33E
J33B
J33A
J31C
J31D
J31A
J31B
J34A
J34B
J34C
Willowmore
Zaaimansdal
Uniondale
Koutjie
Buffelsdrif
Molenrivier
Avontuur
De Vlug
Noll
Speelmanskraal
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Map for GO-2


GO-2
GO-3
GO-4
GC-3
J31D
J31B
J33A
J33B
J34A
J34B
J34C
J34D
J34E
K40C
K40E
K50A
K50B
K60A
K60B
Uniondale
Avontuur
Haarlem
Buffelsdrif
Daskop
Molenrivier
Noll
Speelmanskraal
De Vlug
Kleinplaat
Karatara
Barrington
RNDE2
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group

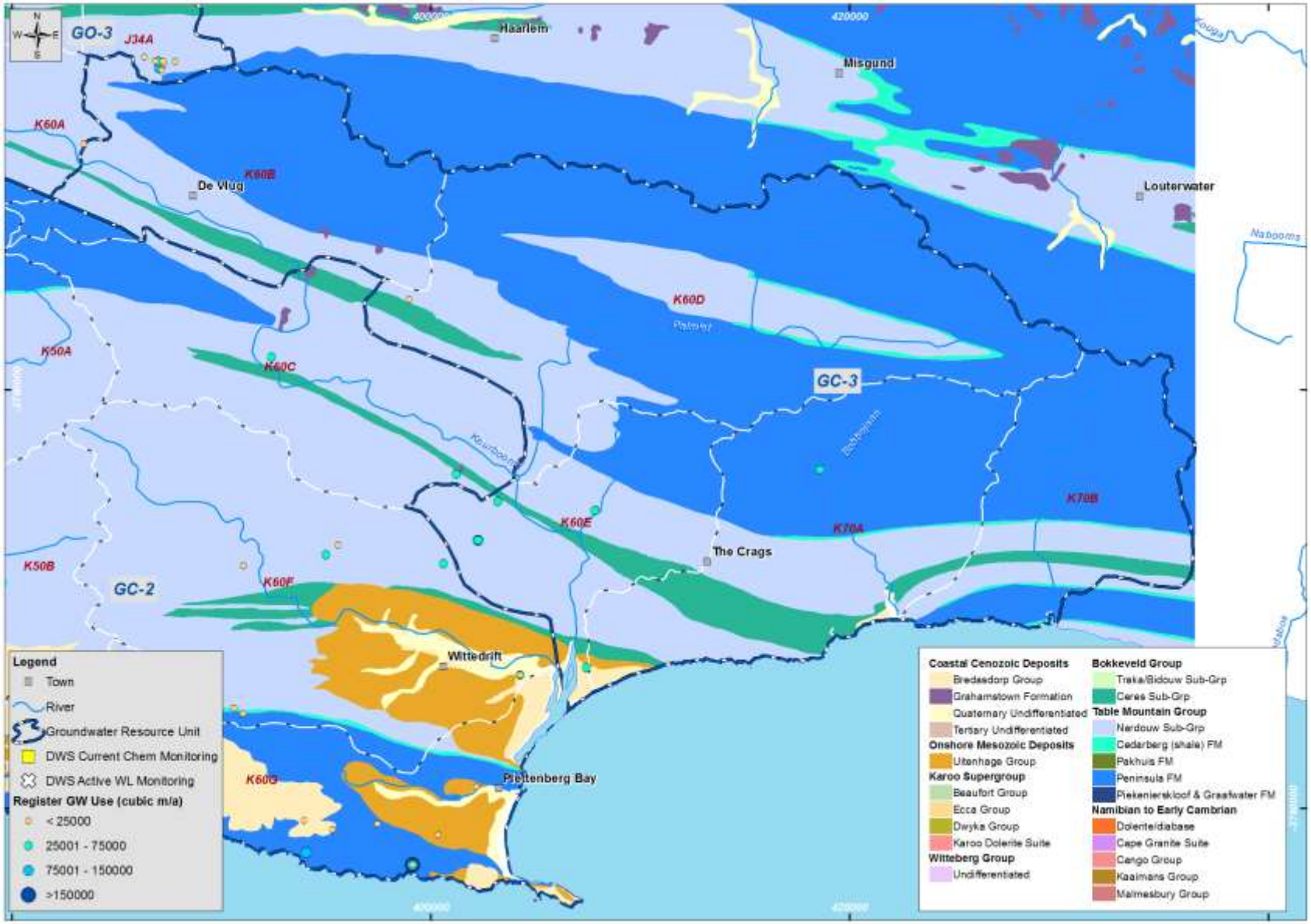
Map for GO-3


Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Doleriteldiabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
GGa-4
GGa-3
GO-4
GO-1
GO-3
GC-1
GC-2
Matjiesrivier
Kruisrivier
Grootkraal
Klaarstroom
Kraaldorings
Schoemanshoek
De Rust
Calitzdorp
Oosgam
De Hoop
Oudtshoorn
Dysselsdorp
Volmoed
Koutjie
Buffelsdrift
Daskop
Herold
Kleinplaat
Rustersbos
Blanco
Bergplaas
Karatara
Outeniqua Mountains
Map for GO-4


GGa-5
GO-4
GC-1
GC-2
GGo-1
Herold
Kleinplaat
Beroplaas
Ruitersbos
Blanco
George
Sinksabrug
Wilderness
Rondevlei
Pacaltsdorp
Herolds Bay
Brandwag
Groot-Brakrivier
Hartenbos
Mossel Bay
Dana Bay
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cederberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/diabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Map for GC-1


GO-3
Spoelmanskraal
Noll
De Vlug
Kleinplaat
Bergplaas
Karatara
Barrington
RIDEZ
GC-1
GC-2
GC-3
Rondevlei
Sedgefield
Knysna
The Heads
Wittedrift
The Crags
Plettenberg Bay
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/dabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group

Map for GC-2


GO-3
J34A
Haarlem
Misgund
K60A
K60B
De Vlug
Louterwater
Nabooms
K60D
K50A
K60C
GC-3
K70B
K70A
K60E
The Crags
K50B
GC-2
K60F
Wittedrift
K60G
Plettenberg Bay
Legend
Town
River
Groundwater Resource Unit
DWS Current Chem Monitoring
DWS Active WL Monitoring
Register GW Use (cubic m/a)
< 25000
25001 - 75000
75001 - 150000
>150000
Coastal Cenozoic Deposits
Bredasdorp Group
Grahamstown Formation
Quaternary Undifferentiated
Tertiary Undifferentiated
Onshore Mesozoic Deposits
Uitenhage Group
Karoo Supergroup
Beaufort Group
Ecca Group
Dwyka Group
Karoo Dolerite Suite
Witteberg Group
Undifferentiated
Bokkeveld Group
Traka/Bidouw Sub-Grp
Ceres Sub-Grp
Table Mountain Group
Nardouw Sub-Grp
Cedarberg (shale) FM
Pakhuis FM
Peninsula FM
Piekenierskloof & Graafwater FM
Namibian to Early Cambrian
Dolerite/dabase
Cape Granite Suite
Cango Group
Kaaimans Group
Malmesbury Group
Map for GC-3

Status Quo assessment for BO-1

GRU name	Breede Overberg sub-catchment unit 1, BO-1, Grabouw
GRU Boundary description	The Southern boundary is formed by the Atlantic Ocean with False Bay in the West. The G40 catchment boundary bounds the north-western part of the GRU, while the Groenlandberg Fault bounds the north-eastern part. The eastern boundary is related to the TMG outcrop (east of Kleinmond). The Peninsula and Nardouw aquifers are significant in the GRU, and shallow groundwater will discharge to surface water. Deep groundwater flow across the GRU boundaries is possible. The Grabouw valley is underlain by Bokkeveld Group.
Catchments	G40A to G40D; G40G
IUAs covered	The GRU covers parts of Lourens Eerste, Overberg West and Overberg West Coastal
Domestic Groundwater use	None of the settlements within the GRU rely on groundwater as sole supply. • Kleinmond can receive 16% of its supply from groundwater (borehole and spring, 0.44 million m^3/a). • The settlements of Grabouw and Betty's Bay, Rooi Els and Pringle Bay are (currently) supplied by surface water.

Long term average water levels

No water level monitoring data

Long term average water quality

No current water quality monitoring data.

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (million m^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Grabouw	Bokkeveld/ TMG	41	1.0	Agriculture - irrigation	None	1000262205 1000262193 (TMG, away from water use)

Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
1000262205	Qual		2012/10/15	2015/01/19	9	TMG	
1000262193	Qual		2012/01/12	2015/04/08	10	TMG	

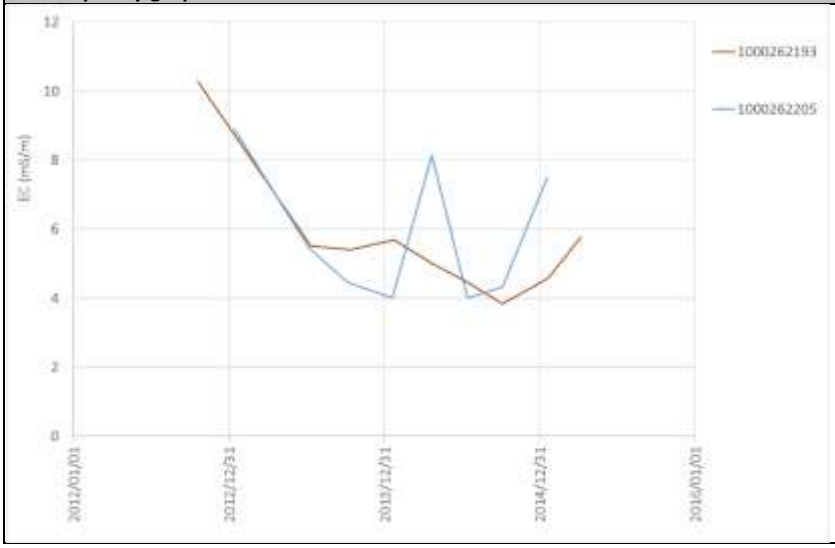
Water Level Graphs

No water level monitoring data is available.

Response to Bulk Abstraction

Although the groundwater abstraction for Kleinmond is registered (WARMS point within the town, registered for water supply service), there is no (available or known of) monitoring data (water level, water quality) detailing the response to abstraction (within DWS databases, or within municipal reports). The All Towns strategy states that the town has not used the groundwater supply from the borehole (only the spring) in the recent years (~2012-2015).

Water quality graphs



EC data lies well below the DWAF 1996 drinking water quality guideline Class 1 (70 mS/m).

Comments
Registered water use is almost exclusively within the Grabouw valley, with water extraction from Bokkeveld Group rocks. • There is no long term or recent water level monitoring data, and only two long term and recent water quality monitoring locations. These are both located in TMG rocks away from any registered water use. The water quality is very good (less than Class 1), with EC <10 mS/m..

Status Quo assessment for BO-2

GRU name, main town	Breede Overberg sub-catchment unit 2, BO-2. Hermanus, Stanford, Caledon
GRU Boundary description	The southern boundary is formed by the Atlantic Ocean. The G40L and G40K catchment bounds the unit in the east and northeast. The northern unit boundary corresponds to the northern contact between the TMG and Bokkeveld Group. The fault related Caledon (deep seated) hot spring is evidence of deep TMG groundwater flow within the GRU. Other than discharge to surface water systems, deep groundwater flow from this area is most likely northwards where the TMG continues beneath the Bokkeveld Group. The unit is bound to the west by the NE-SW fault zone east of Kleinmond. Significant thickness of Cenozoic deposits occur around Walker Bay to the south, and form a significant aquifer (utilized in and around Stanford). Aquifer discharge will occur to low lying wetlands and to river systems.
Catchments	G40E to G40L
IUAs covered	The GRU falls between several IUAs: Overberg East Fynbos, Overberg East Renosterveld, Overberg West Coastal
Domestic Groundwater use	Both Hermanus and Stanford rely on groundwater as the "sole supply" with ground water contributing more that 50% of the water supply: • Hermanus: has 53% GW supplied at 3.20 Mm^3/a • Stanford: has 100% GW supplied at 1.60 Mm^3/a In addition, other smaller settlements use some groundwater as part of their supply (<50%) • Tesselaarsdal has 36% groundwater supply, 0.078 million m^3/a • Greater Gansbaai (including Gansbaai, De Kelders, Kleinbaai, Franskraal) has 23% groundwater at 0.633 million m^3/a • Caledon has 14% groundwater supply at 0.35 million m^3/a

Water use clusters for trend analysis

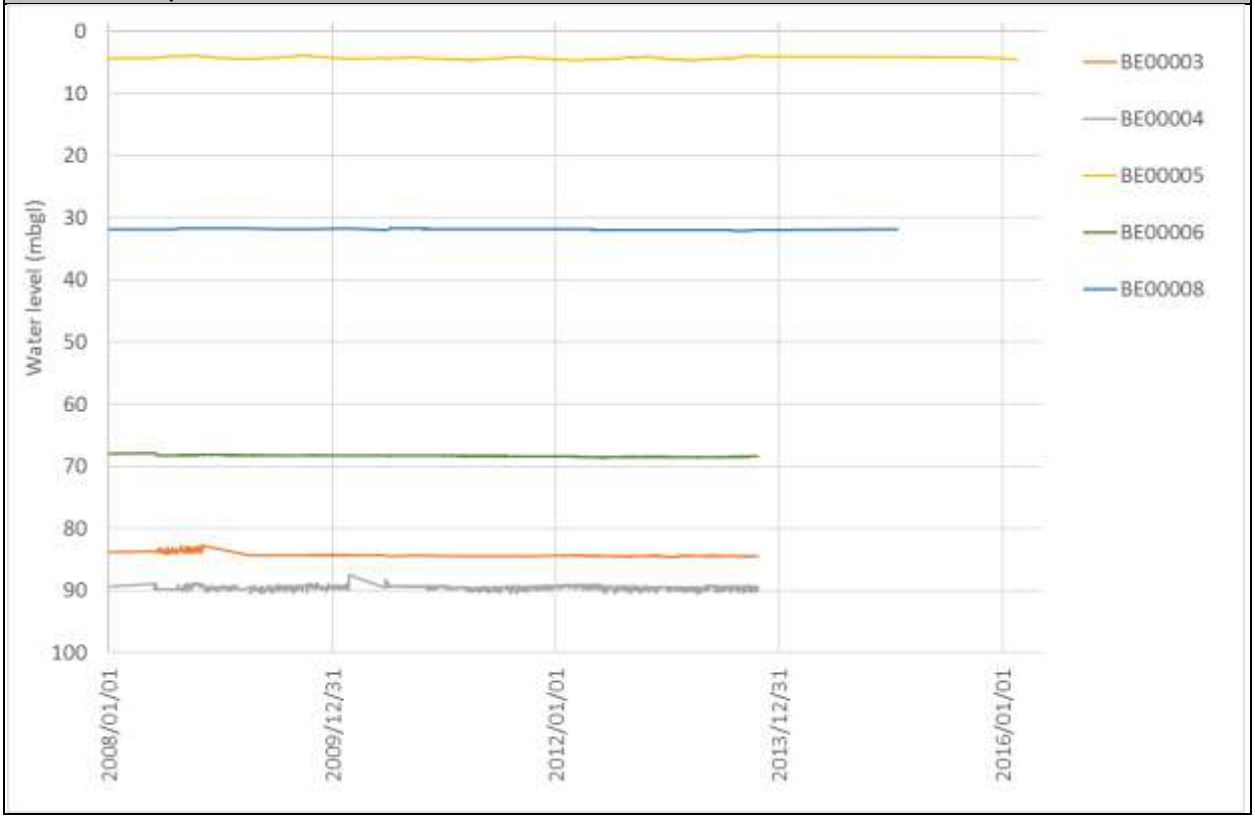
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Stanford	Bokkeveld/ Bredasdorp/ Alluvium	21	1.2	Water supply Agriculture - stock watering	BE00003 – BE00008	3419CB00009 (Bredasdorp)
Hermanus/ Bot River	Bokkeveld/TMG/Granite	60	6.5	Water supply Agriculture - irrigation	None in database	None in database
Caledon	Bokkeveld/TMG	7	0.5	Agriculture - irrigation	None	3419AB00022 (TMG) 3419AB00023 (Bokkeveld) (Both close to water supply)

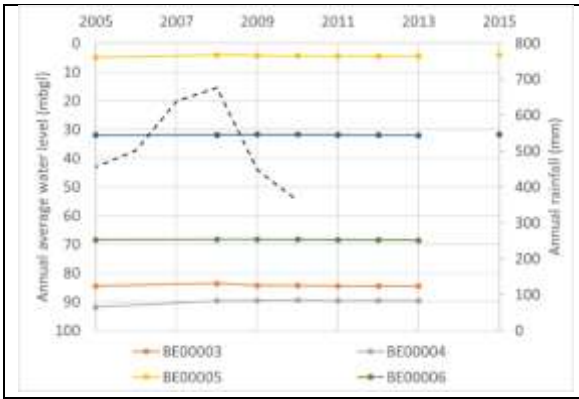
Available monitoring locations for trend analysis (recent data highlighted yellow)

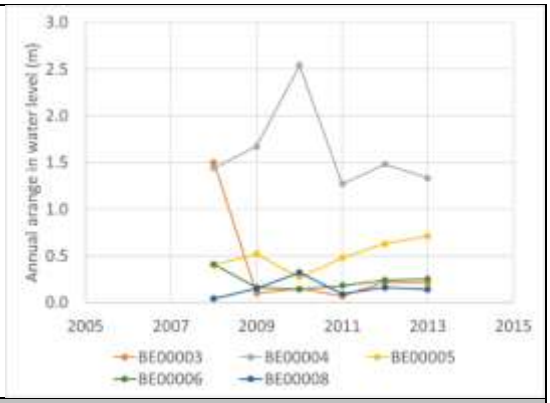
Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
BE00005	WL	Borehole	2005/08/05	2016/02/19	1786	Quaternary	19

BE00007	WL	Borehole	2005/08/15	2016/02/19	16	Bredasdorp	124
BE00008	WL	Borehole	2005/08/15	2015/01/23	1239	Strandveld	67
040115	WL	Borehole	1996/03/29	2014/12/10	11	TMG	
BE00006	WL	Borehole	2005/08/15	2013/10/25	1846	Bredasdorp	
BE00004	WL	Borehole	2005/08/18	2013/10/25	1829	Bredasdorp	118
BE00003	WL	Borehole	2005/08/15	2013/10/25	936	Bredasdorp	106
3419CB00020	WL	Borehole	2000/03/02	2000/04/30	30	Bredasdorp	
3419AD00004	WL	Borehole	1956/07/06	1984/07/25	322	Quaternary	
3419AB00023	Qual	Borehole	1995/04/11	2011/10/20	14	Bokkeveld	
3419CB00009	Qual	Spring	1994/11/22	2015/03/30	33	Bredasdorp	
3419AB00022	Qual	Spring	1994/01/04	2015/09/22	40	TMG	

Water Level Graphs



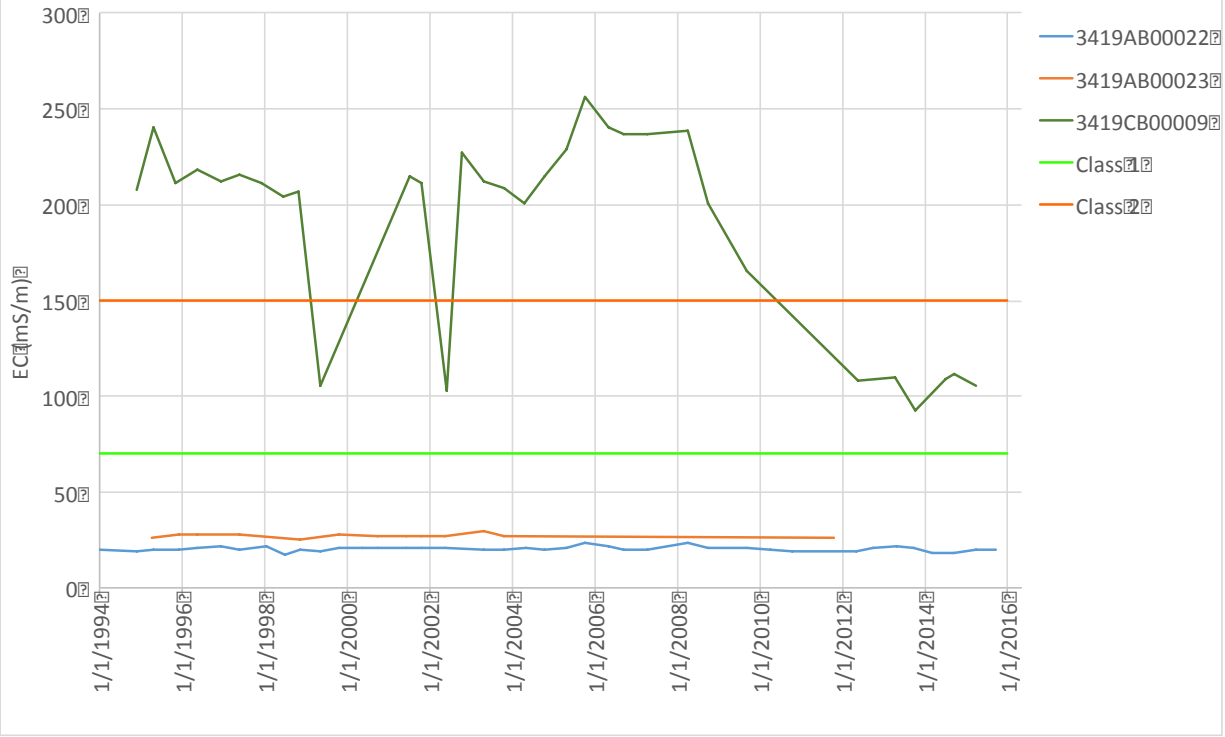


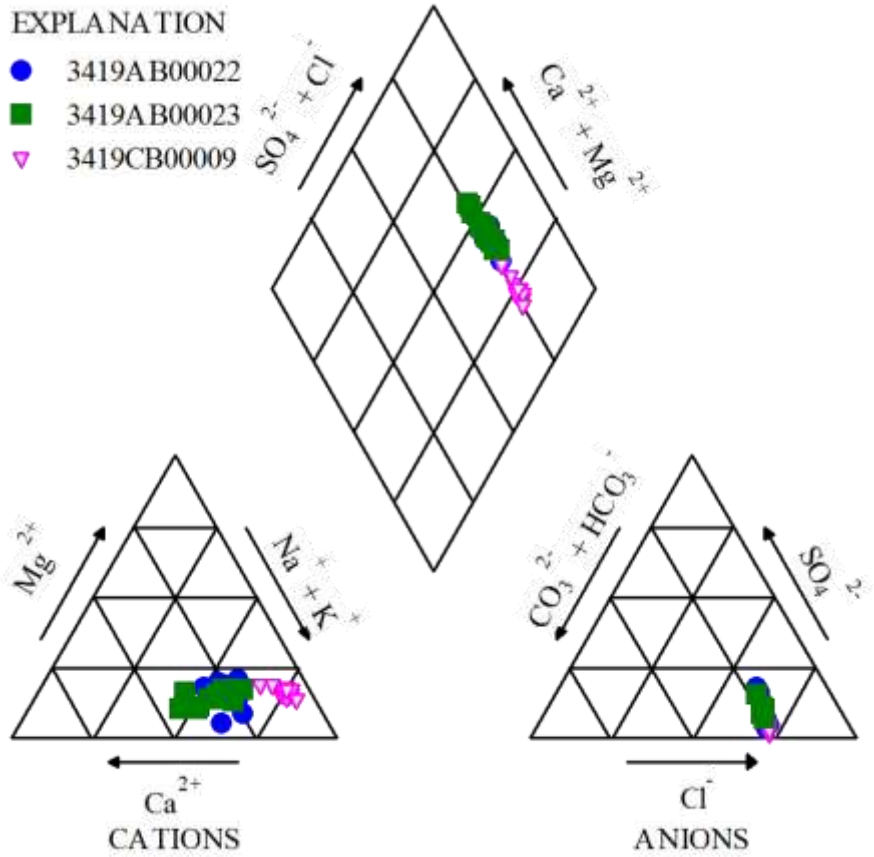


Response to Bulk Abstraction

Significant monitoring data is collected by the Overstrand Municipality to monitor the response to groundwater abstraction for supply to Hermanus and Stanford, as required by the water use licenses. This data will be reviewed should this GRU be prioritised for further investigation.

Water quality graphs


300
250
200
150
100
50
0
EC (mS/m)
1/1/1994
1/1/1996
1/1/1998
1/1/2000
1/1/2002
1/1/2004
1/1/2006
1/1/2008
1/1/2010
1/1/2012
1/1/2014
1/1/2016
3419AB00022
3419AB00023
3419CB00009
Class 1
Class 2


EXPLANATION
3419AB00022
3419AB00023
3419CB00009
SO4 2- + Cl-
Ca 2+ + Mg 2+
Mg 2+
Na + + K +
Ca 2+
CATIONS
CO3 2- + HCO3-
SO4 2-
Cl-
ANIONS

Comments

Several water supply schemes are operated in BO-2, including at Hermanus, Bot River and Stanford.
No water level monitoring or water quality data are available in the database for the Hermanus cluster (although the Hermanus municipality maintains records of water levels). Water level monitoring is conducted to the south and west of Stanford, within the Bredasdorp Group. Water levels vary from 4 to 90 mbgl, but show little seasonal variation (generally <0.5 m), and no long term water level trends. The monitoring locations are away from registered water use, hence reflect background conditions, with the exception of BE0005, which is within 1 km of a registered water use. A spring to the north of Gansbaai is routinely monitored (3419CB00009). The water quality has an EC which appears to have decreased from around 200 mS/m from 1994 to 2008 to around 100 mS/m since 2012.
There is no water level monitoring near Caledon, but water quality monitoring has occurred at two locations, including the hot spring. The water quality at these locations is good (less than Class 1) and has shown no increasing or decreasing trends over the monitoring period, remaining constant at <50 mS/m.

Status Quo assessment for BO-3

GRU name, main town	Breede Overstrand sub-catchment unit 3, BO-3. Bredasdorp, Arniston, Struisbaai.
GRU Boundary description	The GRU is bounded in the south by the Atlantic Ocean with Pearly Beach in the west, Struis Bay in the south-east and Skipskop in the east. The G40M, G50D and G50G catchment bounds the unit in the east, northeast and north. The TMG outcrops largely to the area west of Bredasdorp while the remainder of the area the TMG is buried and this could be potentially recharged by the numerous ranges and inselbergs adjacent to the area. Towards the east the area opens up to the Bontehoek fault. Towards the south and east of Bredasdorp, the Bokkeveld Group rocks underlie Cenozoic cover. Groundwater will discharge to the ocean and to low lying wetlands and to river systems.
Catchments	G40M; G50 to G50J
IUAs covered	The GRU falls over the Overberg East Fynbos, and Overberg East Renosterveld.
Domestic Groundwater use	Many of the settlements in this GRU rely on groundwater as sole supply. • Napier: has 100% GW supplied at 0.42 Mm^3/a • Wolvengat: has 100% GW supplied at 0.01 Mm^3/a • Bredasdorp: has 66% GW supplied at 0.70 Mm^3/a • Struisbaai: has 100% GW supplied at 1.14 Mm^3/a • L'Agulhas: has 100% GW supplied at 0.30 Mm^3/a • Pearly Beach: has 69% GW supplied at 0.21 Mm^3/a • Elim: has 100% GW supplied at 0.06 Mm^3/a • Buffeljachtbaai: has 100% GW supplied at 0.03 Mm^3/a • Suiderstrand: has 100% GW supplied at 0.10 Mm^3/a In addition, Baardskeerdersbos receives 33% of its supply from groundwater; 0.158 million m^3/a. Groundwater makes up only 8% of the supply source to Arniston and Waenhuiskrans, 0.019 million m3/a The settlements of Protem and Klipdale utilise only surface water.

Water use clusters for trend analysis

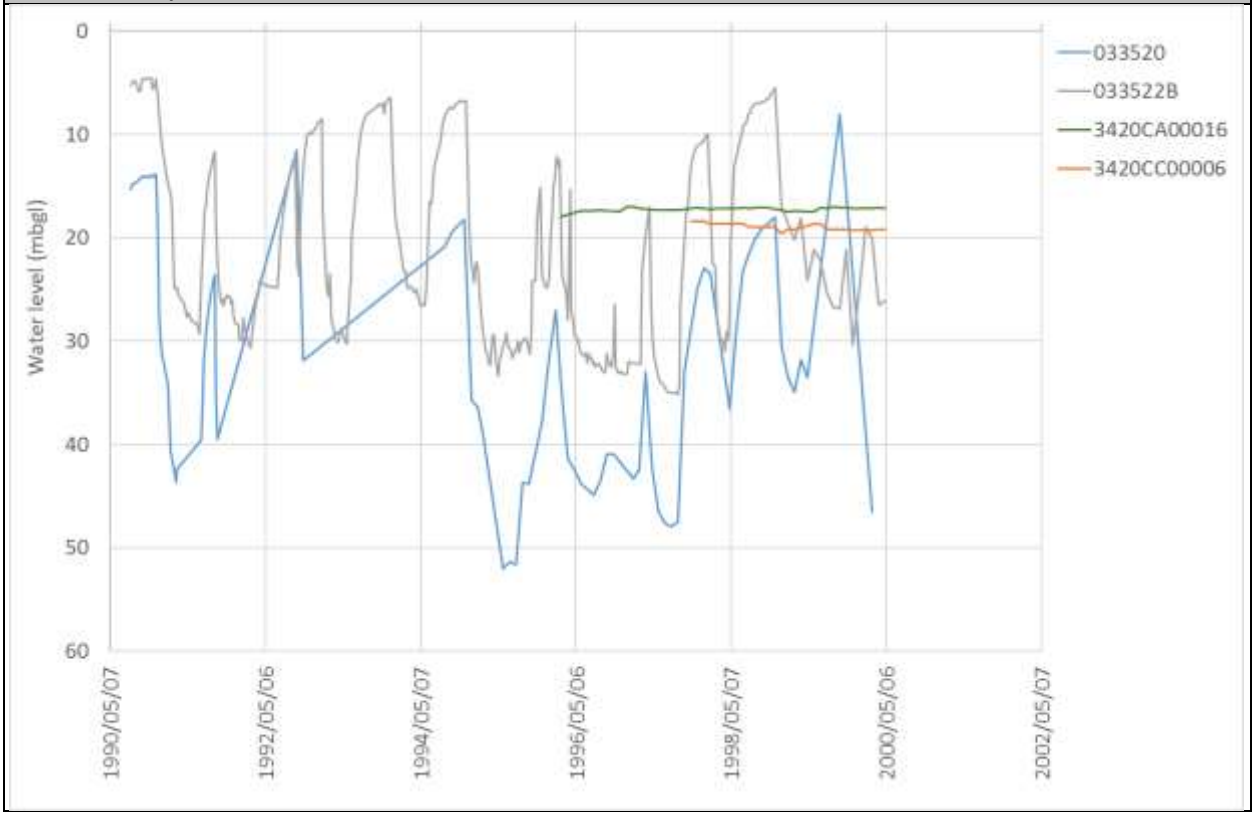
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Bredasdorp/ Napier	TMG/ Malmesbury/ Granite/ Bokkeveld	87	5.7	Agriculture – irrigation Schedule 1 Water Supply	033520/033552B (TMG, away from water use, 1990-2000 only)	3420CA00106 89919 3420AC00043 (TMG/Bokkeveld, remote from water use)
Agulhas/ Struisbaai	Bredasdorp	8	0.4	Water Supply	3420CA00016 (Bredasdorp Group near Arniston, away from water use, 1996 – 2000 only) 3420CC00006 (Bredasdorp Group, near Struisbaai, close	3420CC00002 (Bredasdorp, away from water use)

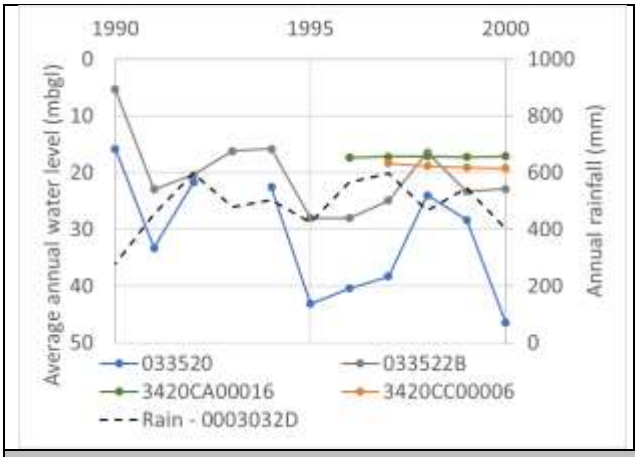
					to water use, 1997-2000 only)	

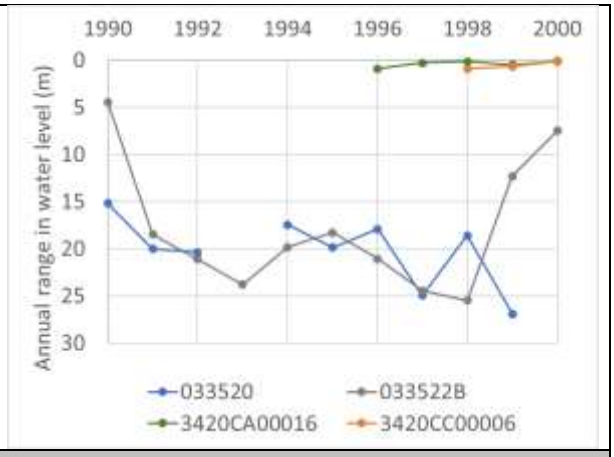
Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
033522B	WL	Borehole	1990/08/10	2000/04/30	419	TMG	156
3420CC00007	WL	Borehole	1995/12/31	2000/04/30	48	Bredasdorp	
3420CA00016	WL	Borehole	1996/02/29	2000/04/30	40	Bredasdorp	
3420CC00006	WL	Borehole	1997/10/31	2000/04/30	28	Bredasdorp	
033520	WL	Borehole	1990/08/10	2000/02/29	92	Bokkeveld	
3420CA00017	WL	Borehole	1996/02/29	1997/02/28	11	Strandveld	
033522A	WL	Borehole	1990/08/10	1995/11/30	136	TMG	180
3420CC00004	WL	Borehole	1994/08/03	1995/10/05	387	Quaternary	42
3420CC00003	WL	Borehole	1994/08/03	1995/10/05	329	Bredasdorp	
3420CA00003	WL	Borehole	1990/12/14	1992/05/29	79	Quaternary	202
3420CA00002	WL	Borehole	1990/08/10	1990/12/07	18	Quaternary	141
3420CC00002	Qual	Borehole	1994/08/02	2015/03/30	36	Bredasdorp	
89919	Qual	Borehole	1994/11/22	2015/03/30	23	Bokkeveld	
3420CA00106	Qual	Spring	2001/07/12	2014/04/30	18	Bokkeveld	
3420AC00043	Qual	Borehole	1993/10/29	2002/10/15	13	Bokkeveld	

Water Level Graphs



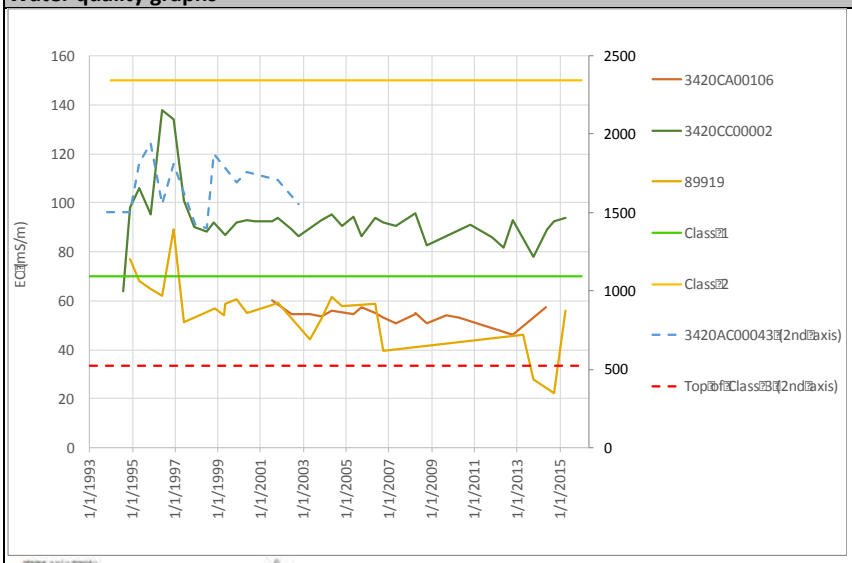


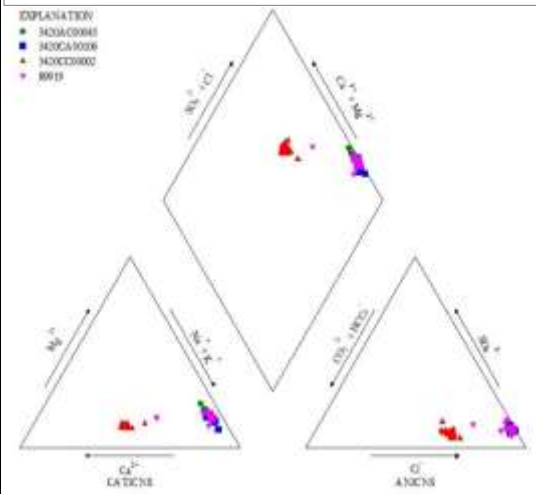


Response to Bulk Abstraction

Significant monitoring data is collected by Cape Agulhas Municipality to monitor the response to groundwater abstraction for supply to the various settlements. This data will be reviewed should this GRU be prioritised for further investigation.

Water quality graphs





Comments

BO-3 is a large GRU with a low density of registered groundwater use. Most of the registered groundwater use is located within TMG and Malmesbury Group rocks to the west of Bredasdorp, with a small amount in the Bredasdorp Group near Agulhus.
Water level monitoring has been conducted in the TMG near Bredasdorp, but only until 2000. There is registered groundwater use in the areas, but the closest registered point is more than 1 km from 033520 and 033522A. Water levels within the two boreholes are 20 to 50 mbgl and vary by 15-25 m seasonally. There may be a slight decrease in average groundwater level between 1990 and 2000, but the current status quo is not known. Water levels in these boreholes appear to show a delayed water level response to rainfall.
In contrast, water levels in the boreholes near Arniston and Struisbaai, which are in the Bredasdorp Group, are consistently <20 m below ground level and show almost no seasonal variation. Although no trends in groundwater level were observed within the monitoring period between 1996 and 2000, the current status quo is not known.
Water quality at borehole 89919 and spring 3420CA00106 on the Bokkeveld close to the Bokkeveld/TMG contact near Bredasdorp is almost identical, both showing an apparent decrease in EC with between 1995 (60 – 80 mS/m) and 2015 (20 – 60 mS/m). Water at 3420CC00002, in the Bredasdorp near Struisbaai also has a very similar water chemistry, also showing a decreasing trend with time, but a higher EC (80 – 100 mS/m). These locations are dominated by Na and Cl and have low relative Ca, Mg, alkalinity and SO4.
Water quality at 3420AC00043, within the Bokkeveld along the Sout River, has a very high EC, more than 10 times the EC of the other representative samples, and a different chemistry, with higher relative levels of Ca and bicarbonate. EC may be expected to increase with distance from the main recharge areas (mountains) due to longer residence time, interaction with more reactive rock types. The EC at this borehole does not appear to be increasing or decreasing.

Status Quo assessment for BR-1

GRU name, main town	Breede Riviersonderend sub-catchment Unit 1, BR-1. Villiersdorp
GRU Boundary description	The overall Berg catchment boundary bounds the unit to the west (a topographic high, and assumed to be a *shallow* groundwater flow divide) and the Groenlandberg Fault bounds the south. The northern and eastern boundary follows the quaternary catchment boundaries that enclose the H60 catchment. Groundwater flow in the Peninsula aquifer could be linked to surrounding GRUs (BB-7).
Catchments	H60A to H60D
IUAs covered	The GRU falls between two IUAs: Overberg West and Riviersonderend Theewaters
Domestic Groundwater use	Only the town of Botrivier relies entirely on groundwater, with 100% of the water supply obtained from boreholes, totalling 0.46 Mm^3/a. Villiersdorp receives 27% of its supply from groundwater, at 0.225 million m3/a

Water use clusters for trend analysis

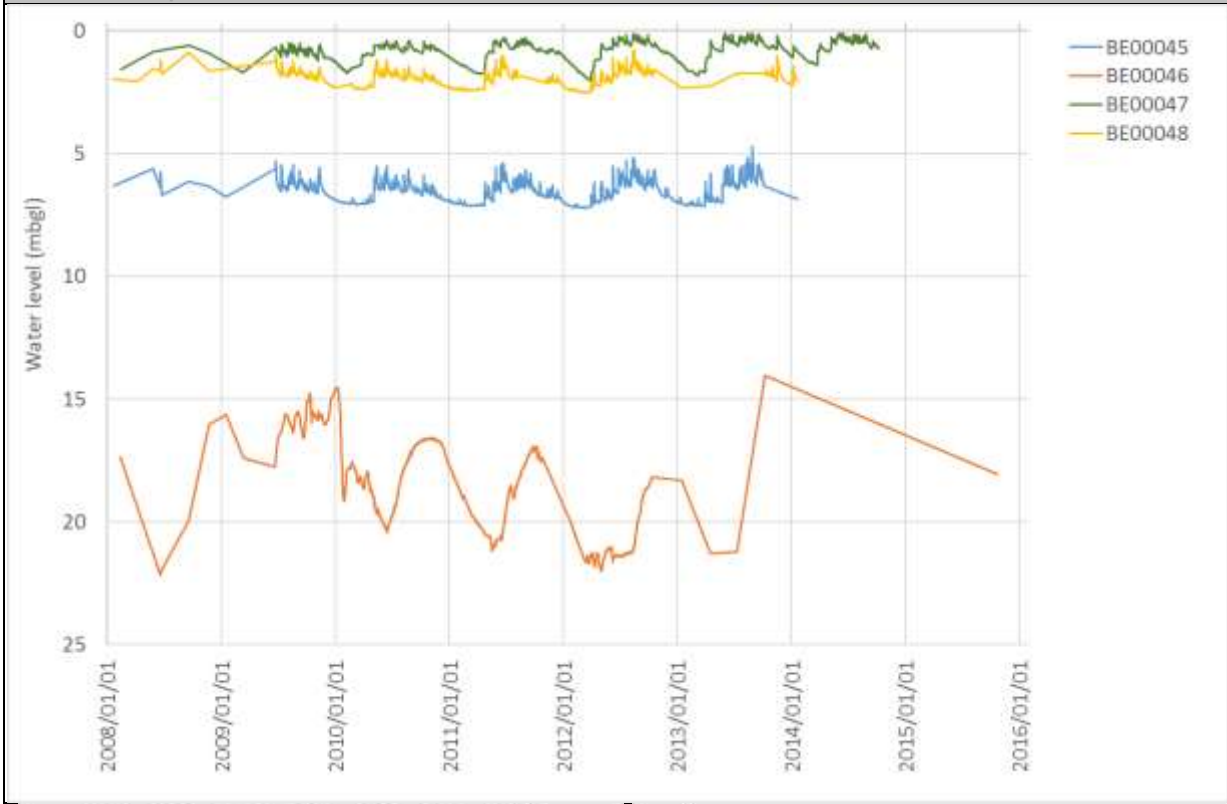
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Villiersdorp	TMG/Bokkeveld/Alluvium	74	4.7	Agriculture - irrigation	BE00045,46,47,48 (away from water use, base of TMG)	1000262211, 1000262196, 1000262207 1000262201 1000262203 1000262204 (TMG)

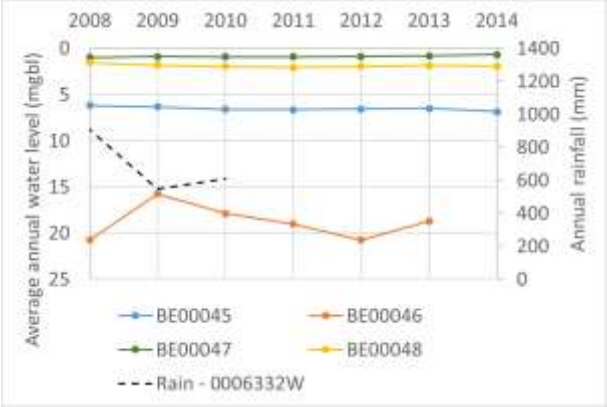
Available monitoring locations for trend analysis (recent data highlighted yellow)

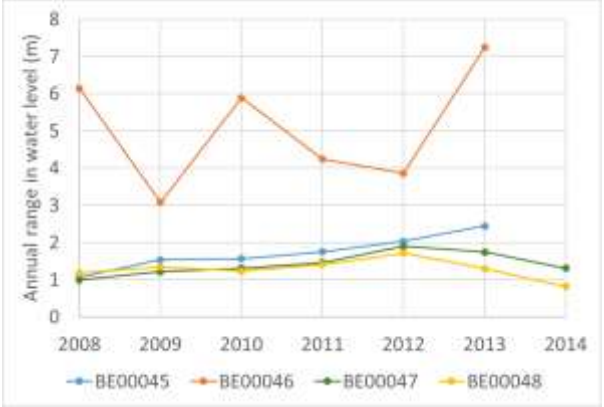
Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
BE00041	WL	Borehole	2007/11/25	2016/01/20	12	TMG	
BE00046	WL	Borehole	2008/02/13	2015/10/22	1132	TMG	
BE00044	WL	Borehole	2008/01/22	2015/10/21	23	TMG	
BE00047	WL	Borehole	2008/02/15	2014/10/08	1921	Quaternary	
BE00045	WL	Borehole	2008/01/22	2014/01/22	1581	Bokkeveld	
BE00048	WL	Borehole	2008/01/20	2014/01/21	1198	Quaternary	
BE00043	WL	Borehole	2008/01/27	2013/04/19	65	TMG	

BE00050	WL	Borehole	2008/02/12	2011/03/02	9	Quaternary	
1000262198	Qual		2012/10/17	2015/04/10	10	TMG	
1000262204	Qual		2012/10/17	2014/10/09	7	TMG	
1000262211	Qual		2012/10/16	2015/04/09	9	TMG	
1000262207	Qual		2012/10/16	2015/04/09	10	TMG	
1000262201	Qual		2012/10/16	2015/04/09	10	TMG	
1000262196	Qual		2012/10/16	2015/04/09	10	TMG	
1000262203	Qual		2012/10/16	2015/01/28	8	TMG	

Water Level Graphs



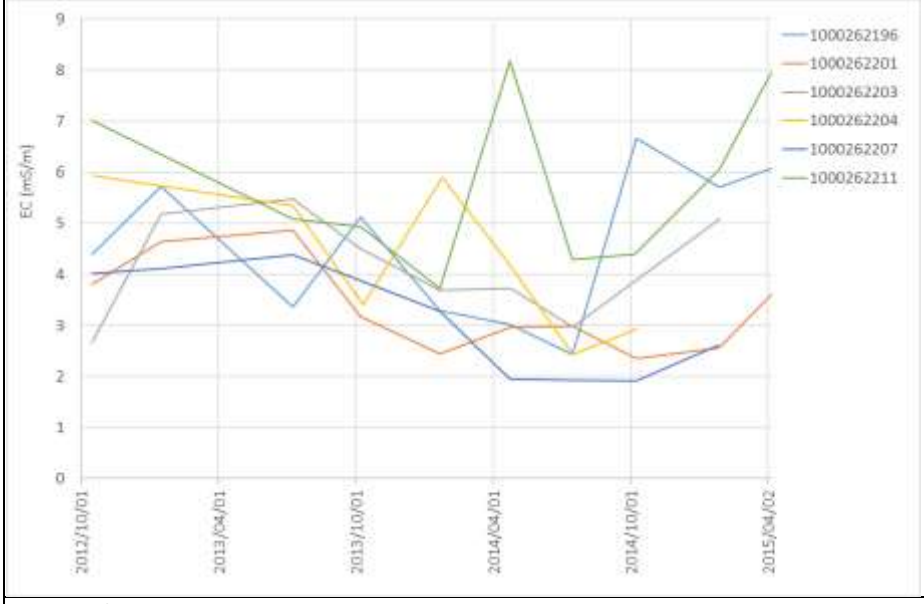




Response to Bulk Abstraction

The extent of municipal groundwater monitoring for abstraction at Botrivier and Villiersdorp is not known. This will be investigated should this GRU be prioritised for further investigation.

Water quality graphs



EC data lies well below the DWAF 1996 drinking water quality guideline Class 1 (70 mS/m).

No Piper diagram

Comments

Registered water use in BR-1 is within the Bokkeveld and alluvium filled valley. Groundwater level monitoring has been been established at the TMG-Bokkeveld contact. These boreholes are located some distance (>2 km) away from registered groundwater use boreholes. The water level data at BE00045, 47 and 48 show clear seasonal cycles with relatively small ranges in water level annually (<2 m) and no indication of the effects of pumping. BE00046 has a deeper water table and a greater range in water levels, which may be due to pumping. None of the boreholes indicate a notable decrease in annual average water levels over the 6 year monitoring period. The EC measurements from the monitoring locations within the mountains and away from urban or farming influences are very low (<10 mS/m), and there are no apparent trends in water quality..

Status Quo assessment for BR-2

GRU name	Breede Riviersonderend sub-catchment Unit 2, BR-2. Riviersonderend
GRU description	The H60E, H60H and H60J catchment bounds the unit in the north associated with the Riviersonderend Mountains, and the Overberg sub-catchment bounds the unit to the south. The TMG forms the Riviersonderend Mountains hence outcrops in the north of the GRU. Shallow discharge from the TMG occurs to surface water systems, both to the north and south. The TMG outcrop dips to the north hence deep groundwater flow will be to the north from the Riviersondered Mountains, linking BR-2 to the BB-7 unit. Towards the east the large, low lying area of rolling hills is dominated by Bokkeveld Group outcrop, with minor Witteberg Group.
Catchments	H60E to H60L
IUAs covered	The GRU falls between two IUAs: Lower Riviersonderend and Riviersonderend Theewaters
Domestic Groundwater use	None of the settlements within the GRU rely on groundwater as sole supply. Genadendal, Bereaville, Voorstekraal, Greyton and Riviersonderend are surface water-supplied

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Riviersonder-end	TMG/ Witteberg Bokkeveld/ Alluvium	17	1.4	Water supply Agriculture - irrigation	None	None

Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
88870	Qual	Borehole	1985/10/15	1987/10/07	7	Dwyka Group	

Water Level Graphs

No water level monitoring data.

Response to Bulk Abstraction
There is no bulk abstraction within the GRU
Water quality graphs
No current water quality monitoring data.
Comments
There is little registered water use in the Riviersonderend GRU. Water use is generally in the Bokkeveld, with one location in Malmesbury Group. There is no recent or long term groundwater level or quality monitoring.

Status Quo assessment for BB-1

GRU name, main town	Breede sub-catchment Unit 1, BB-1. Prince Alfred Hamlet/Ceres.
GRU Boundary description	The Berg catchment boundary bounds the unit to the north. To the west the boundary follows the axis of the Hansiesberg Anticline. It was assumed that the major groundwater will flow towards the Berg WMA along the centre of the Agter-Witzenberg Syncline axis. The eastern boundary follows the quaternary catchment boundaries enclosing the H10 catchment.
Catchments	H10A to H10C
IUAs covered	The whole of the GRU falls within the Upper Breede Tributaries IUA.
Domestic Groundwater use	None of the settlements within the GRU rely on groundwater as sole supply. • Ceres is supplied by surface water • Groundwater makes up ~30% of the supply source for Prince Alfred Hamlet (0.215 million m^3/a), abstracted from boreholes in alluvium and Rietvlei aquifers

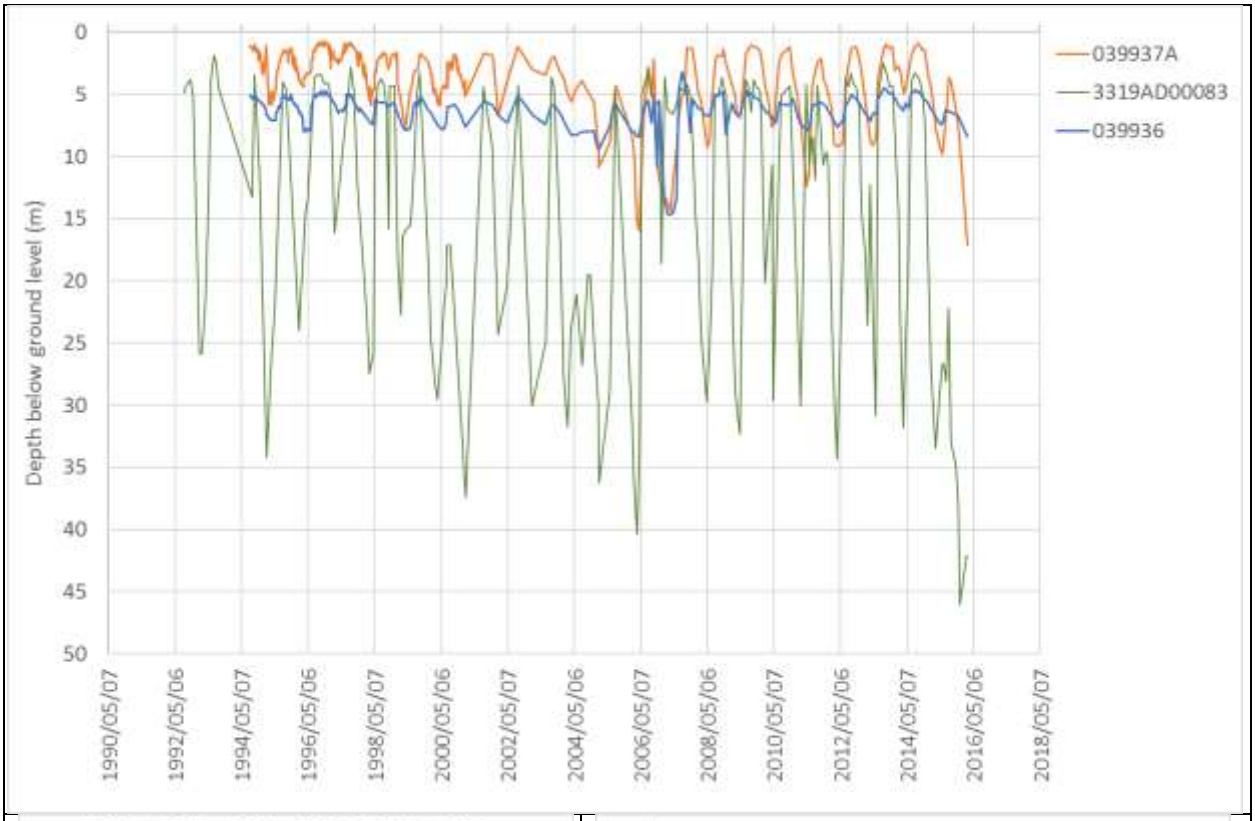
Water use clusters for trend analysis

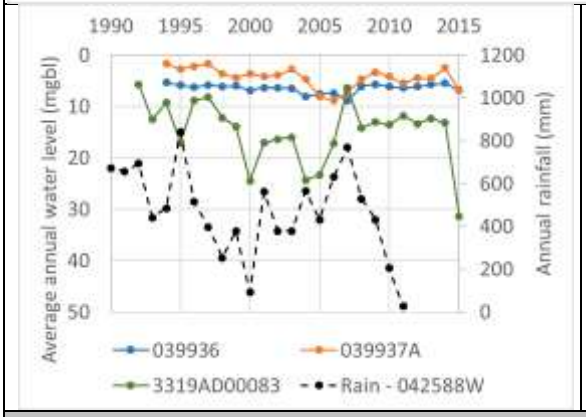
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Linearly along southern boundary of Ceres valley, adjacent to TMG mountains	Bokkeveld/ TMG.	99	10.1	Agriculture - irrigation	None	3319AD00082
Prince Alfred Hamlet	Bokkeveld	59	3.3	Agriculture - irrigation	None	None
Koue Bokkeveld	Bokkeveld	68	13.2	Agriculture - irrigation	039937A; 3319AD00083 039936 (upgradient TMG)	None

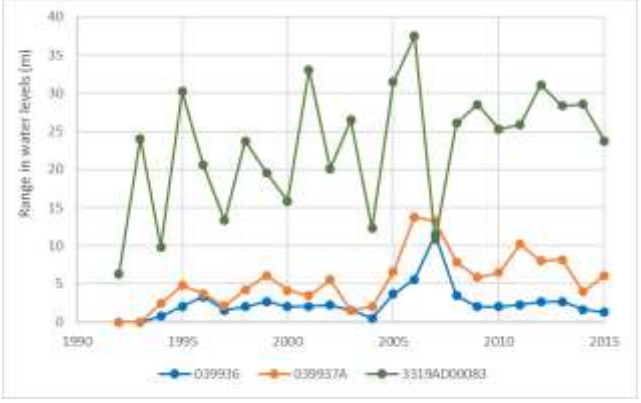
Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
039937A	WL	Borehole	1994/08/05	2016/03/01	1297	Bokkeveld	21
039936	WL	Borehole	1994/08/05	2016/03/01	893	TMG	
3319AD00083	WL	Borehole	1992/08/19	2016/03/01	201	TMG	
039937	WL	Borehole	2012/05/29	2016/03/01	46	TMG	
3319AD00082	Qual	Borehole	1994/06/02	2015/03/31	34	Bokkeveld	
039938A	WL	Borehole	1993/10/22	1996/01/18	11	Bokkeveld	181
3319AD00043	WL	Borehole	1990/10/16	1995/07/05	39	TMG	
3319AD00042	WL	Borehole	1991/02/14	1992/06/10	14	TMG	
3319AD00041	WL	Borehole	1984/08/15	1987/11/04	166	TMG	
3319AD00079	WL	Borehole	1972/12/05	1976/09/10	28	Quaternary	
3319AD00080	WL	Borehole	1971/06/29	1976/08/24	27	Quaternary	
149091	Qual	Borehole	1974/01/23	1976/09/10	13	Quaternary	

Water Level Graphs



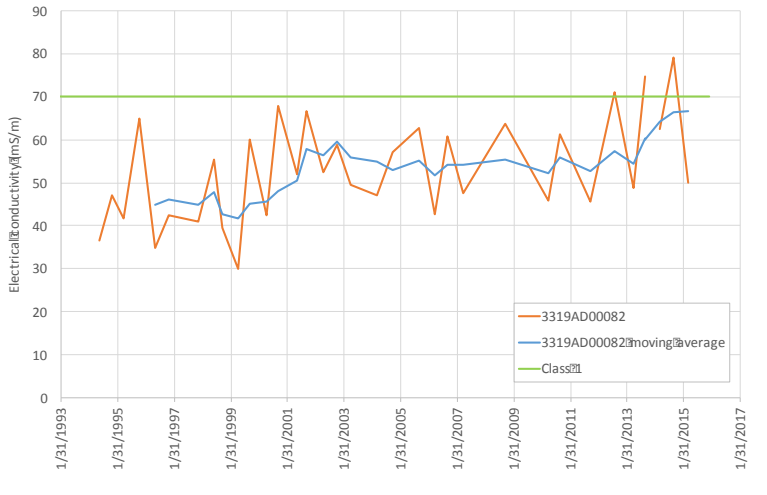


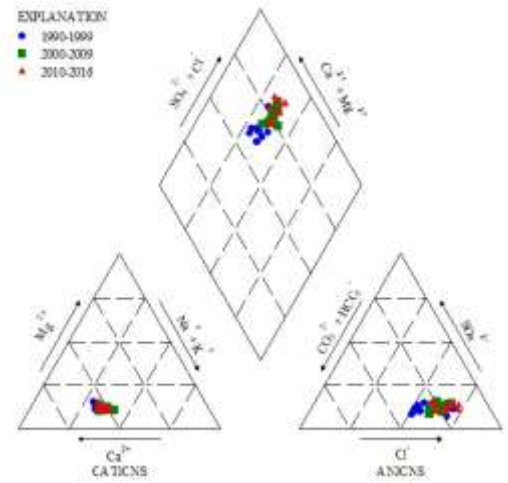


Response to Bulk Abstraction

The availability of municipal groundwater monitoring of abstraction at Prince Alfred Hamlet is not known. This will be investigated should this GRU be prioritised for further investigation.

Water quality graphs





Comments

Three main clusters of groundwater use were identified within GRU BB-1. Observations on the water level and groundwater quality trends are listed below:

Ceres:

- Only one location (3319AD00082) with water level data since 2000. This location has four readings collected over four years and it is not possible to assess any trends.
- There is a substantial dataset for water quality for 3319AD00082, from 1994 to 2014. The data appears to show a seasonal trend, with higher EC measurements in September/October, and lower measurements in April. Assessing the 5-point moving average indicates a long term increasing trend, with averages between 40 and 50 mS/m before 2001, increasing to between 50 and 60 mS/m from 2001 to 2013, and more recently increasing to between 60 and 70 mS/m. The increase in EC appears to be related to a slight increase in chloride concentrations, coupled with decrease in total alkalinity (see Piper diagram). Salinisation of groundwater related to clearance of vegetation and irrigation practices has been observed in the Berg River catchment, and this may be due to similar causes. Nevertheless, the EC remains below class 1 for almost all measurements.

Prince Alfred Hamlet

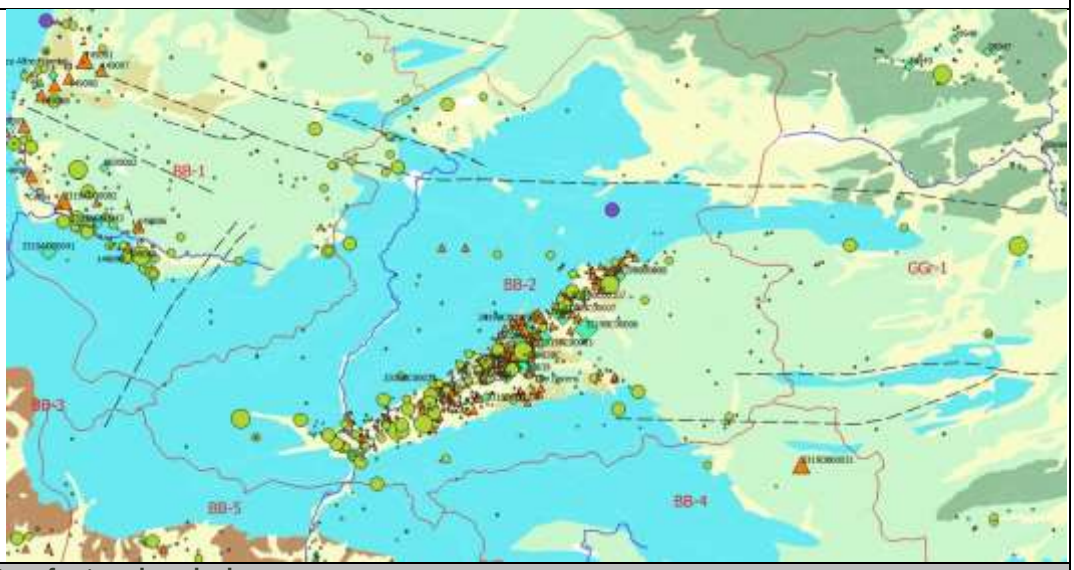
- No locations with water level or water quality data since 1976.

Koue-Bokkeveld

- Three locations with long term data from the early 1990s to 2016 – 039936, 3319AD00083, 039937A.
- 039936 is located within the TMG mountains to the east of the Koue Bokkeveld, and does not appear to be located near to a WARMS-registered borehole. Water levels show a seasonal variation of around 2-3 m, with occasional larger seasonal differences (e.g. 2007).
- 039937A is located more than 1.5 km away from WARMS registered borehole. The borehole is 21 m deep and into sandstone. Seasonal variations of generally <5 m are observed, although these appear to have become larger with time.
- 3319AD00083 is located within an area where several WARMS registered boreholes are found, with the closest one approximately 250 m away (bearing in mind the uncertainty on the positions of the WARMS boreholes). This borehole shows the largest seasonal variations in water levels, with drops in water level of 20 to 40 m from August/September to

Feb/Mar/April. The high seasonal varation is likely caused by seasonal pumping. Generally the water levels recover to the same level each year, less than 5 m bgl. Occasions when water levels don't recover to <5 mbgl may be because the water level did not recover, or because of gaps in the dataset (e.g. in 2000, water level had not recovered to <5 mbgl by August, but no further measurements were done until the following January. The water level may have continued to recover into September and even October, but this is not recorded in the dataset). Data from 2015/2016 however do indicate that the water level did not recover following the 2015 wet season, most likely due to lower rainfall preventing complete replenishment of utilised stored groundwater / recovery of groundwater levels, and subsequently causing higher drawdown in the following pumped season.

Status Quo assessment for BB-2

GRU name, main town	Breede sub-catchment Unit 2, BB-2. De Doorns.
GRU Boundary description	The Berg catchment boundary bounds the unit to the north beyond the Touws river Fault. The eastern boundary follows the quaternary catchment boundaries that enclose the H20 catchment. The GRU contains the Hex River Valley, bounded by the TMG-dominated Hex River Mountains and the Kwadouwsberge. Groundwater flow from the Peninsula Formation in the south from unit BB-5 is likely. Groundwater flow is possible from the Hex River Mountains into the Ceres valley and link to the BB-2 and BB-1 units. Groundwater will discharge to river systems.
Catchments	H20A to H20; J12A
IUAs covered	The GRU falls over three IUAs: Touws in the east, Upper Breede Tributaries in the west, Breede Working Tributaries in the south
Domestic Groundwater use	None of the settlements within the GRU rely on groundwater as sole supply. The settlements of De Doorns, Orchard and Sandhills utilise surface water.
Map	

Water use clusters for trend analysis

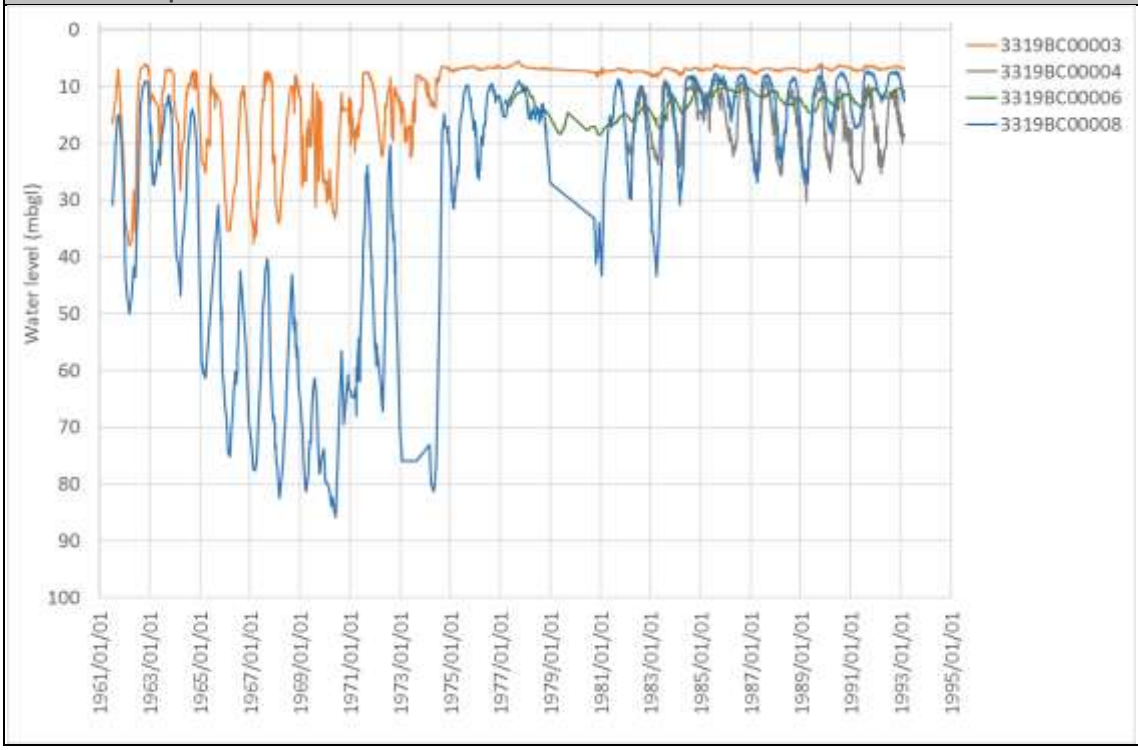
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
De Doorns Valley	Alluvial/ Bokkeveld	181	19.6	Agriculture - irrigation	No water level data collected since 1993. 3319BC0003,4, 6 and 8 plotted as examples.	Lots with 2-5 measurements. Large amount of data collected in mid-1970s, none since.

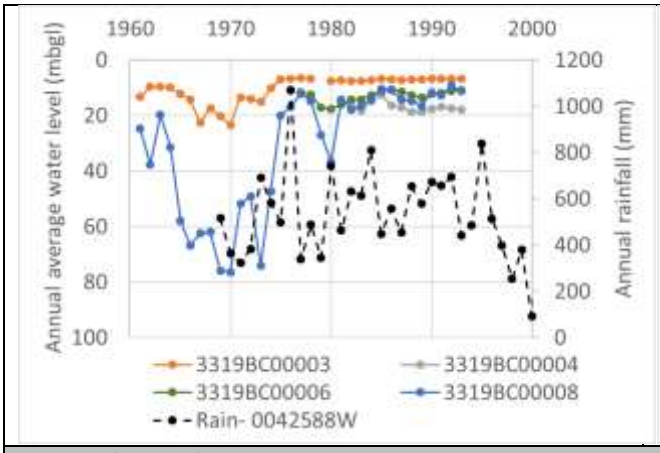
Available monitoring locations for trend analysis (no recent data)

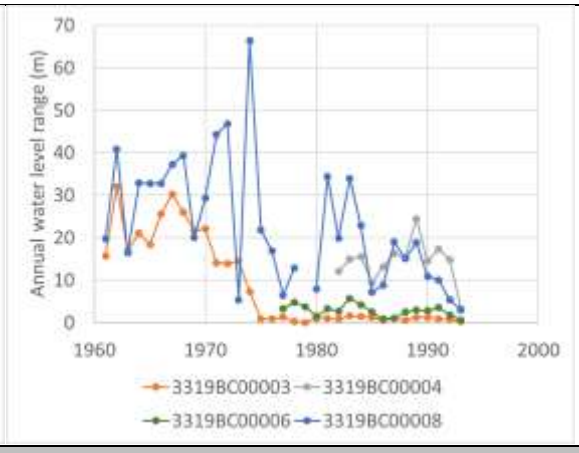
Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3319BC00008	WL	Borehole	1961/07/06	1993/02/23	4689	Quaternary	

3319BC00003	WL	Borehole	1961/07/06	1993/02/23	2586	Quaternary	
3319BC00004	WL	Borehole	1982/01/13	1993/02/23	1805	Tertiary	
3319BC00006	WL	Borehole	1977/03/08	1993/02/23	1134	Quaternary	
030897	WL	Borehole	1982/01/13	1993/02/23	965	Tertiary	
3319BC00011	WL	Borehole	1972/09/01	1993/02/23	339	Quaternary	
030838C	WL	Borehole	1982/01/11	1993/02/20	1539	Quaternary	
030839	WL	Borehole	1982/01/18	1993/01/17	2125	Quaternary	
3319BC00007	WL	Borehole	1982/01/12	1992/12/09	1122	Quaternary	
3319BC00005	WL	Borehole	1982/01/11	1992/10/28	113	Tertiary	
030998	WL	Borehole	1982/02/09	1992/04/15	117	Tertiary	
3319BC00010	WL	Borehole	1982/01/11	1988/12/07	81	Tertiary	
3319BC00012	WL	Borehole	1961/07/05	1988/01/28	290	Quaternary	
3319BC00108	WL	Borehole	1961/07/11	1977/08/08	123	Quaternary	
3319BC00071	WL	Borehole	1961/11/14	1972/09/01	117	TMG	
3319BC00107	WL	Borehole	1961/08/22	1968/05/27	63	Quaternary	
159605	Qual	Borehole	1979/09/06	1979/09/20	6	Tertiary	
150279	Qual	Borehole	1976/06/23	1977/03/21	6	Tertiary	

Water Level Graphs







Water quality graphs

No current water quality data.

Comments

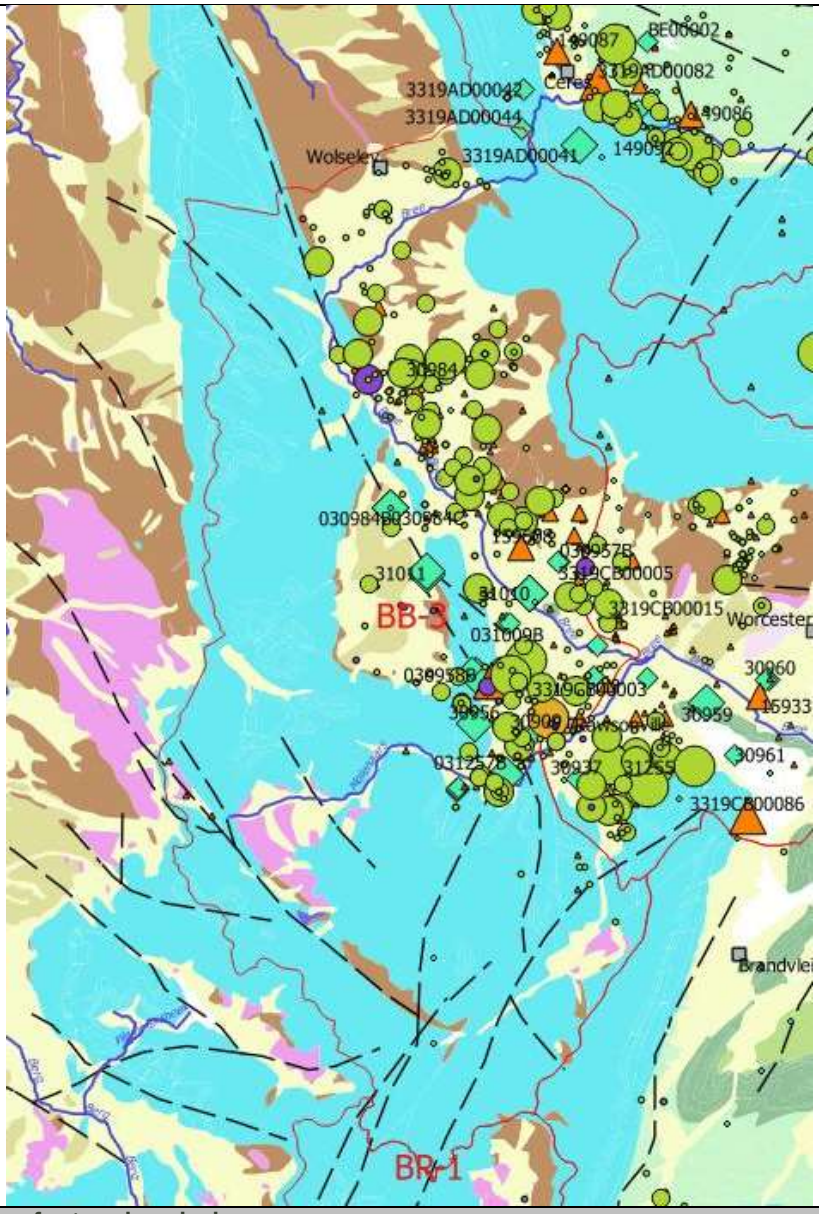
Registered water use is largely within the De Doorns valley, which is infilled with Bokkeveld, Tertiary and Quaternary sediments. There is relatively little water use registered within the TMG mountains surrounding the valley, however is is likely that the TMG aquifers are connected to the Bokkeveld, Tertiary and Quaternary sediments, supporting the relatively high abstraction volumes. A large amount of water level data was collected from the 1960s to the 1990s, with no data available since then, therefore the current water level status in the valley is not known.

Four boreholes were selected for an illustsration of historical water levels, that are within the valley and would be expected to be affected by groundwater abstraction. Water levels in the selected boreholes show strong seasonal trends. Seasonal fluctuations were very high (20 – 60 m difference between high and low water levels) prior to the mid-1970s, likely due to nearby seasonal pumping, but in the 1980s and 1990s, seasonal fluctuations were far more moderate (generally <20 m) and average annual water levels became more constant. This may simply reflect a cessation of seasonal pumping in a borehole close to those showing this trend.

Status Quo assessment for BB-3

GRU name, main town	Breede sub-catchment Unit 3, BB-3: Wolseley
GRU Boundary description	The northern boundary follows the H10D and H10H quaternary boundary. The GRU includes the Upper Breede Valley, which is an anticline with TMG rocks forming the mountainous limbs to south-west and north-east, and the core of the valley exposing older Malmesbury rocks, and infilled with Quaternary and Tertiary deposits. Groundwater flow within the Breede Alluvial aquifer will flow from BB-3 to BB-5.
Catchments	H10D to H10F; H10J;H10K
IUAs covered	Most of the GRU falls within the Upper Breede Tributaries, with the centre east of the GRU falling within the Breede Working Tributaries
Domestic Groundwater use	No settlements in the GRU are supplied by groundwater.

Map



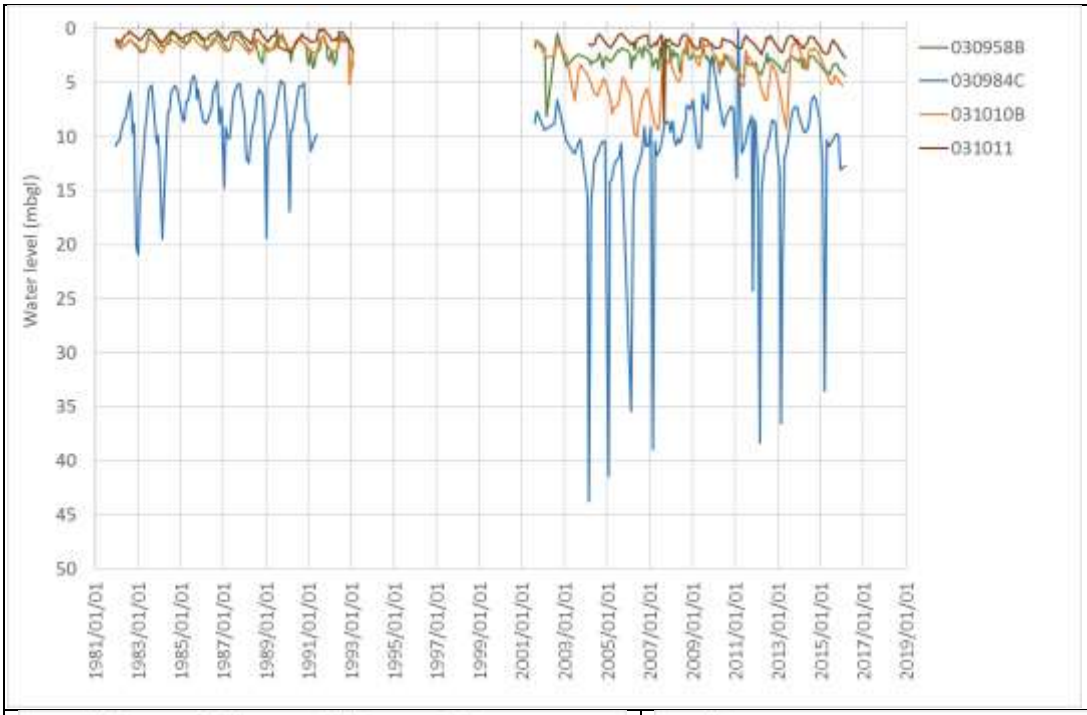
Water use clusters for trend analysis

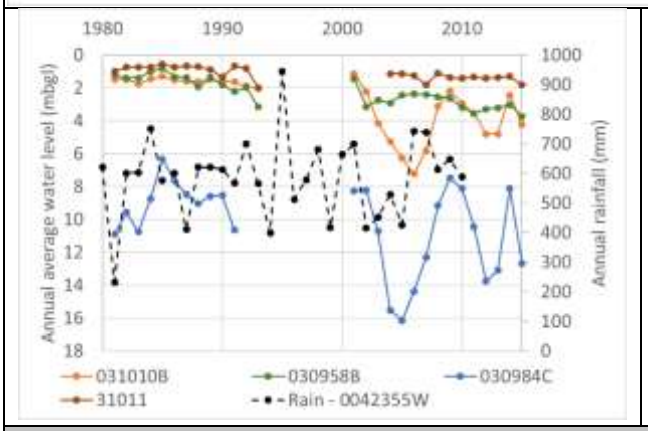
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Slanghoek Valley / Upper Breede	Alluvial/ Malmesbury ; surrounded by TMG mountains	297	24.7	Agriculture - irrigation	Close to water use (<1 km): 030958B (TMG) 030984C (fault/Malmesbury) Away from water use (>1 km): 031011 (fault/Malmesbury) 031010B (Malmesbury/ alluvium)	90009; 3319CB00085 (Locations are close to each other and close to a registered water use)

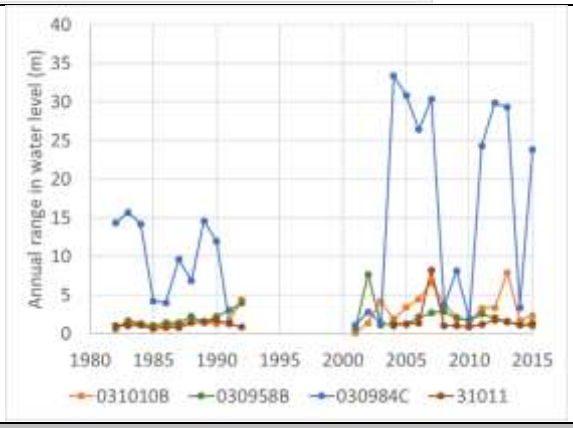
Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth

030984B	WL	Borehole	1981/12/22	2016/03/01	257	Quaternary	
030958B	WL	Borehole	1981/12/22	2016/03/01	255	TMG	
031257B	WL	Borehole	1981/12/21	2016/03/01	253	Quaternary	
031011B	WL	Borehole	1981/12/21	2016/03/01	253	Quaternary	
030984C	WL	Borehole	1981/12/22	2016/03/01	228	Quaternary	
031011	WL	Borehole	1981/12/21	2016/03/01	219	Quaternary	
031010	WL	Borehole	1981/12/22	2016/03/01	217	Quaternary	
030956	WL	Borehole	1981/12/22	2016/02/15	228	TMG	
031010B	WL	Borehole	1981/12/22	2016/01/06	257	Quaternary	
031010C	WL	Borehole	1981/12/22	2013/09/19	227	Quaternary	
030984	WL	Borehole	1981/12/22	1993/02/03	114	Quaternary	
3319CB00013	WL	Borehole	1981/12/22	1992/08/20	107	Quaternary	
3319CB00005	WL	Borehole	1981/12/22	1992/06/10	105	Quaternary	
3319CB00016	WL	Borehole	1981/12/22	1992/01/02	94	Quaternary	
030957B	WL	Borehole	1981/12/22	1991/11/28	98	Quaternary	
031009B	WL	Borehole	1981/12/22	1991/09/16	92	Quaternary	
030909	WL	Borehole	1981/12/22	1991/08/14	87	Quaternary	
3319CB00014	WL	Borehole	1981/12/22	1990/10/16	72	Quaternary	
3319AD00044	WL	Borehole	1984/10/15	1990/03/07	60	TMG	
3319CB00085	Qual	Spring	1994/07/20	2015/06/22	38	TMG	
90009	Qual	Spring/Eye	1994/11/18	2014/03/13	37	TMG	
159608	Qual	Borehole	1979/10/20	1981/02/16	6	Quaternary	
Water Level Graphs							



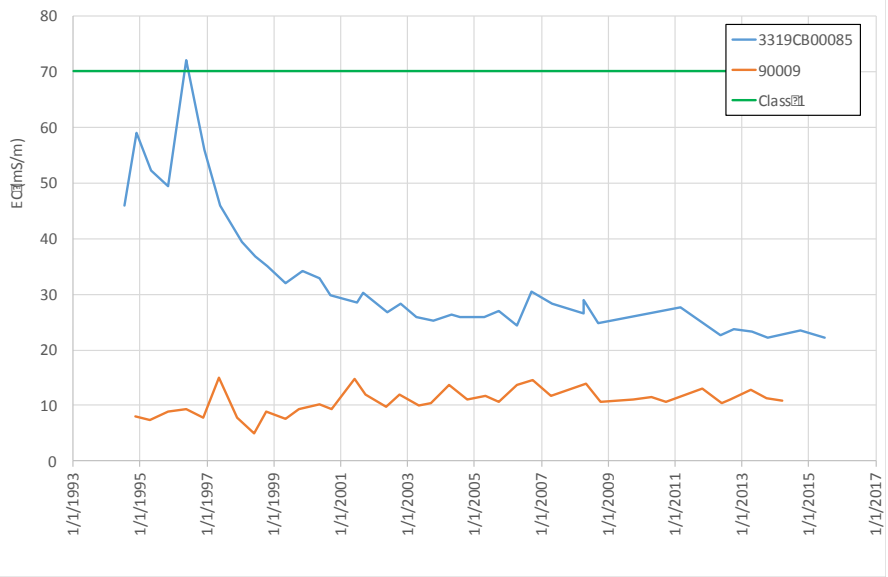


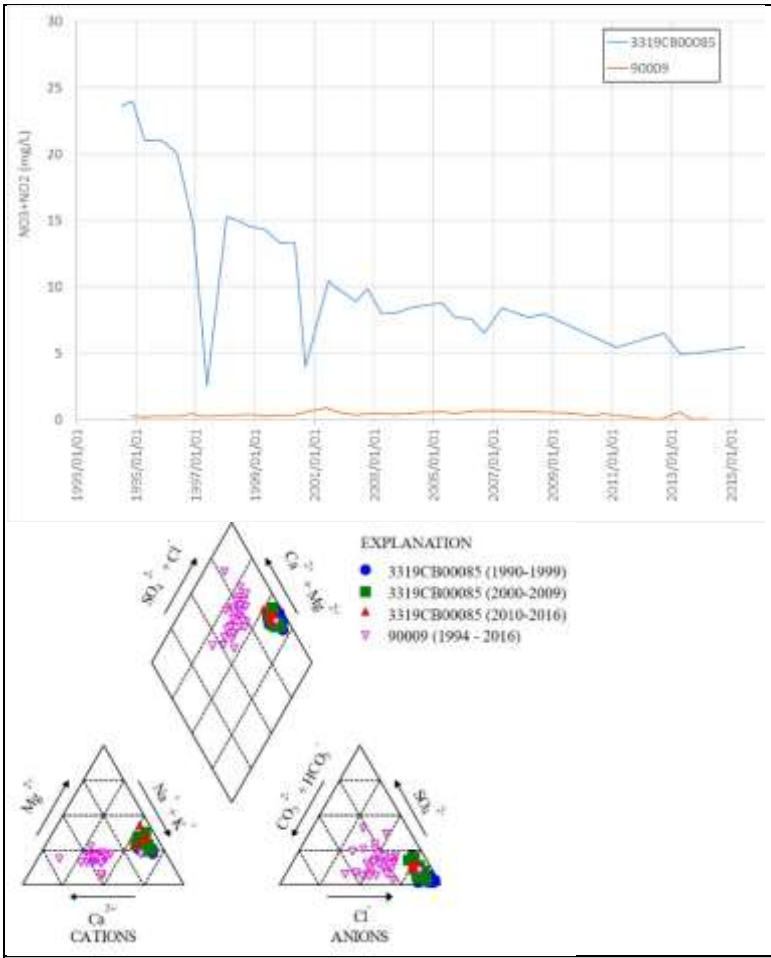


Response to Bulk Abstraction

There is no bulk /point abstraction in the GRU.

Water quality graphs





Comments

Registered water use is almost exclusively within the Upper Breede valley, stretching from Worcester to Wolseley.

Water levels have been monitored at numerous locations from 1981 to 1993 and again from 2001 to 2015. Four locations have been selected to show different proximity to water use and different aquifers /geology. The water levels show strong seasonal fluctuations, with the annual range in water levels varying between boreholes from <5 m to >30 m (higher range likely to be impacted by seasonal pumping). The range in water levels is greater in the monitoring period after 2001 than prior to 1993, except for 031011, which appears to be stable through the monitoring period. This may be because this location is not affected by groundwater use, whereas 030984C, which is located close to water use, has a much larger range in seasonal maximum and minimum water levels. Average annual water levels in 031011, 031010B and 030958B appear to show a long term decreasing trend, with average water levels 1 – 3 m deeper on average in 2015 compared to 1981. Unfortunately, there is no lithological data for these boreholes. The range in water levels shows a delayed correlation with rainfall, and there appears to be a decline in water levels over time which does not correlate with a decline in average rainfall, hence could be related to abstraction impacting groundwater storage (which will occur until a new aquifer equilibrium is reached, section **Error! Reference source not found.**).

Only two water quality monitoring points are available that have current and trend data. These points are springs of the Goudini spa, and are not very representative of activities within the valley as they are located very close together and, originating in the TMG, would be expected to represent water from upgradient of farming and urban activities. Water from 90009 has a fairly constant EC of around 10 mS/m, whereas the long term EC trends shows a general improvement of quality at 3319CB00085 to approximately 25 mS/m due to decreases in concentration of most ions. The chemical signatures of water from the two springs is quite different. 3319CB00085 has a relatively high nitrate concentration, also decreasing with time, which suggests impact by farming activities..

Status Quo assessment for BB-4

GRU name, main town	Breede sub-catchment Unit 4, BB-4. Upper Koo

GRU Boundary description	The Gouritz catchment boundary bounds the unit to the east and northeast. The GRU encloses the Upper Koo valley, a syncline structure with TMG buried beneath the Bokkeveld Group in the valley. Some upwards leakage may occur from the TMG into the Bokkeveld Group sustaining abstraction. Groundwater flow in the Nardouw Aquifer will discharge to the Nuy River, while flow will occur from the Peninsula Formation outcropping in unit BB-5 to this GRU..
Catchments	H40A; H40B
IUAs covered	The whole of the GRU falls within the Breede working Tributaries IUA.
Domestic Groundwater use	There are no settlements with municipal water supply in BB-4

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Koo Valley	Bokkeveld, alluvial in valley; surrounded by TMG mountains	225	1.7	Agriculture - irrigation	3319DB00073 (within valley); 3319DB00093 (within valley) 3319DB00107 (within valley close to water use) 3319DB00061 (within valley close to water use) 3319DA00206 (on edge of valley away from water use) 3319DB00075 (on edge of valley away from water use)	3319DB00073 (within valley) 3319DB00031 (adjacent valley, no registered water use)

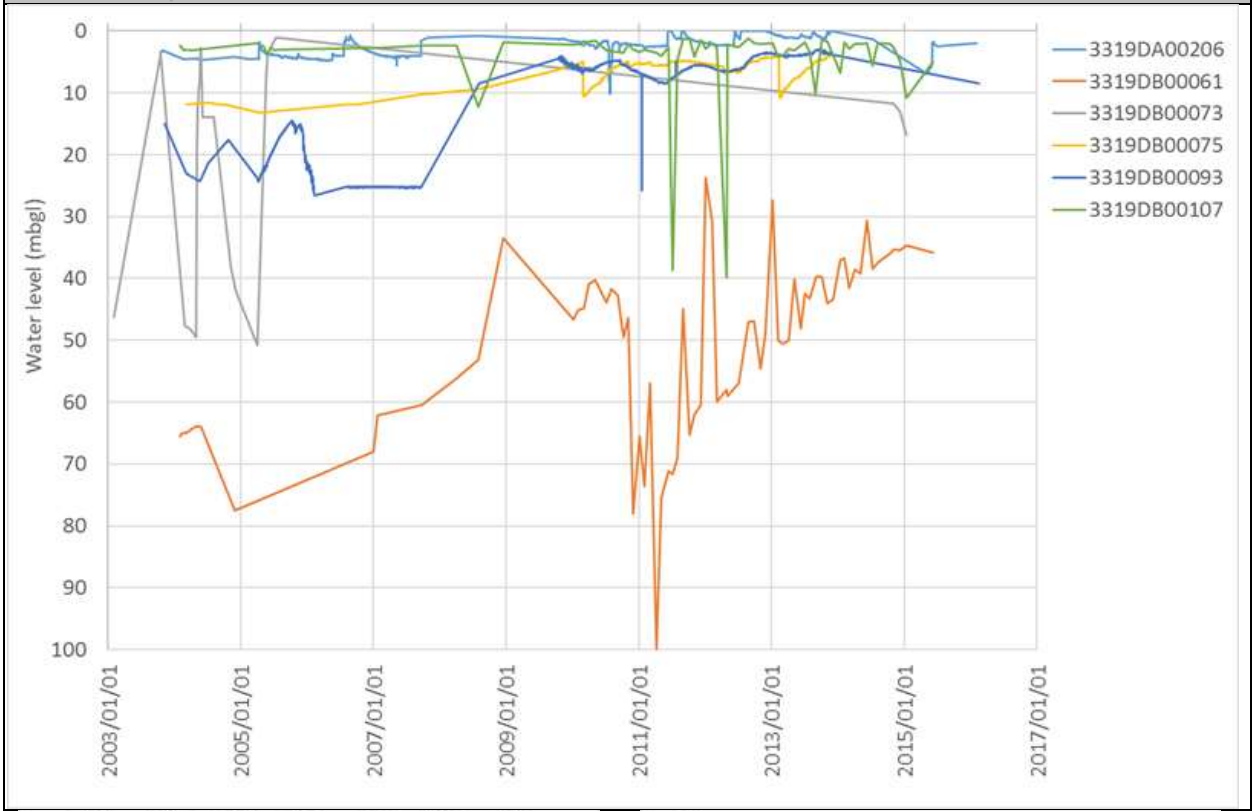
Available monitoring locations for trend analysis (recent data highlighted yellow)

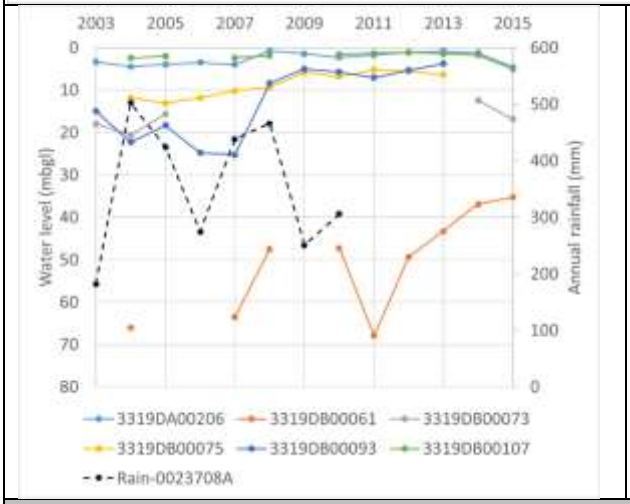
Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3319DB00093	WL	Borehole	2003/11/07	2016/02/16	2228	Quaternary	
3319DA00206	WL	Borehole	2003/10/16	2016/02/06	2472	Bokkeveld	
3319DB00088	WL	Borehole	2004/02/25	2015/08/06	77	TMG	
3319DB00087	WL	Borehole	2004/01/12	2015/06/11	116	TMG	
3319DB00077	WL	Borehole	2003/03/14	2015/06/11	110	Quaternary	
3319DB00098	WL	Borehole	2003/10/14	2015/06/11	95	Quaternary	
3319DB00033	WL	Borehole	2003/10/16	2015/06/11	78	Bokkeveld	
3319DB00061	WL	Borehole	2004/02/02	2015/06/11	76	Quaternary	
3319DB00086	WL	Borehole	2004/02/25	2015/06/11	76	TMG	
3319DB00078	WL	Borehole	2004/02/25	2015/06/11	75	Quaternary	
3319DB00102	WL	Borehole	2004/04/02	2015/06/11	74	Bokkeveld	
3319DA00202	WL	Borehole	2004/02/25	2015/06/11	74	Bokkeveld	

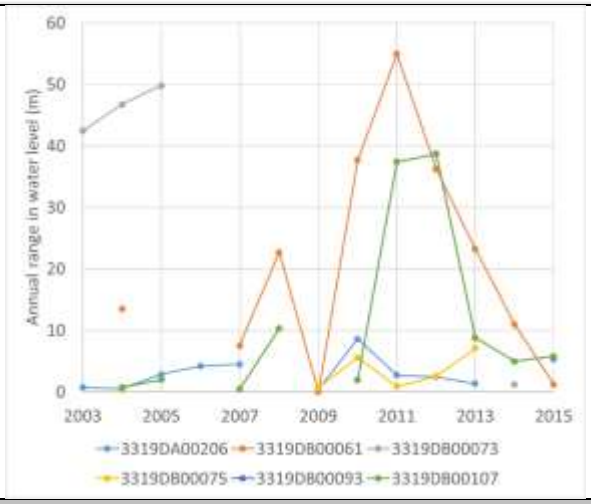
3319DB00108	WL	Borehole	2004/02/25	2015/06/11	74	Bokkeveld	
3319DA00201	WL	Borehole	2004/02/25	2015/06/11	73	Bokkeveld	
3319DB00107	WL	Borehole	2004/02/01	2015/06/11	71	Quaternary	
3319DB00082	WL	Borehole	2004/02/25	2015/06/11	69	TMG	
3319DB00090	WL	Borehole	2004/11/29	2015/06/11	68	Bokkeveld	
3319DB00089	WL	Borehole	2007/01/02	2015/06/11	64	TMG	
BE00079	WL	Borehole	2008/04/03	2015/06/11	60	Bokkeveld	
3319DB00092	WL	Borehole	2007/01/02	2015/06/11	59	TMG	
3319DB00099	WL	Borehole	2003/10/14	2015/06/11	55	Quaternary	
3319DB00100	WL	Borehole	2004/02/25	2015/06/11	54	Bokkeveld	
3319DB00055	WL	Borehole	2007/01/02	2015/06/11	53	TMG	
3319DB00057	WL	Borehole	2004/02/26	2015/06/11	50	Bokkeveld	
3319DB00106	WL	Borehole	2004/02/25	2015/06/11	34	Quaternary	
3319DB00060	WL	Borehole	2004/03/29	2015/01/15	78	Quaternary	
3319DB00096	WL	Borehole	2003/09/10	2015/01/15	60	Quaternary	
3319DB00047	WL	Borehole	2003/10/27	2015/01/15	59	Bokkeveld	
3319DB00074	WL	Borehole	2003/10/22	2015/01/15	31	TMG	
3319DB00076	WL	Borehole	2003/03/18	2015/01/15	26	Bokkeveld	
3319DB00073	WL	Borehole	2003/02/04	2015/01/15	26	Bokkeveld	
3319DB00114	WL	Borehole	2004/02/25	2014/11/06	67	Quaternary	
3319DA00205	WL	Borehole	2003/03/12	2013/11/25	1615	TMG	
3319DB00075	WL	Borehole	2004/03/09	2013/11/25	1514	TMG	
3319DB00048	WL	Borehole	2007/01/02	2013/11/07	9	Bokkeveld	
3319DB00070	WL	Borehole	2004/03/09	2012/01/24	20	Bokkeveld	
3319DB00080	WL	Borehole	2007/01/02	2011/07/07	7	TMG	
3319DB00079	WL	Borehole	2007/01/02	2011/03/03	6	Bokkeveld	
3319DB00072	WL	Borehole	2004/02/25	2010/05/06	19	Quaternary	
3319DB00056	WL	Borehole	2004/01/14	2007/01/25	26	TMG	
3319DB00069	WL	Borehole	2003/10/16	2005/07/28	18	Bokkeveld	
3319DB00068	WL	Borehole	2004/02/25	2004/05/21	7	Bokkeveld	

3319DB00031	Qual	Borehole	1991/11/19	2015/03/31	29	Bokkeveld	76

Water Level Graphs



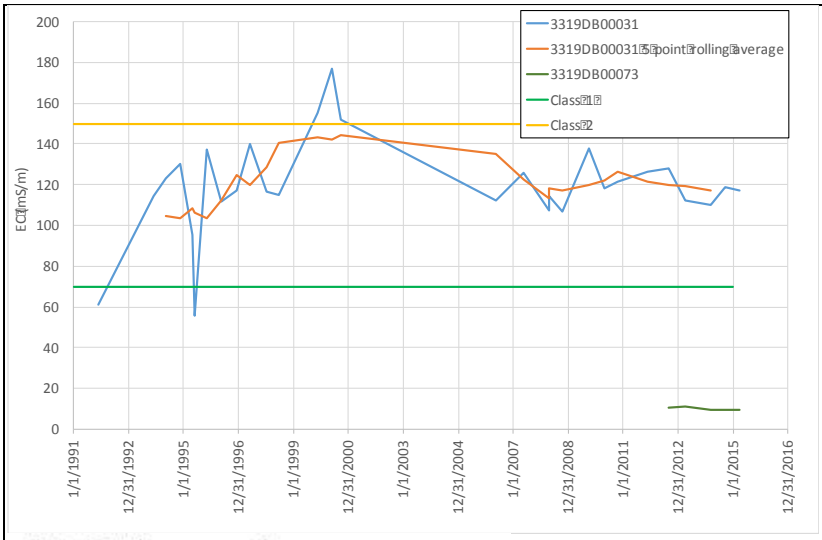


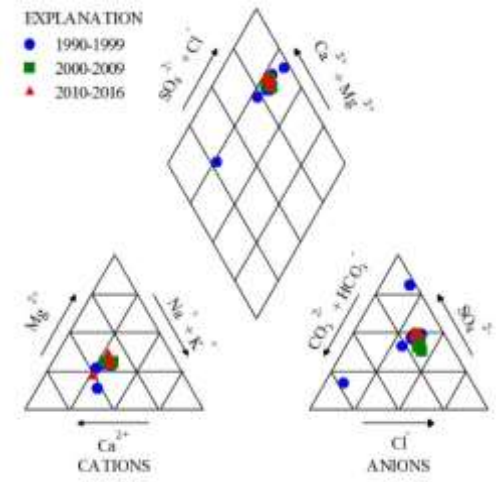


Response to Bulk Abstraction

There is no bulk /point abstraction in the GRU.

Water quality graphs





Comments

Registered water use is almost exclusively within the Koo valley. The valley is infilled with Bokkeveld, Witteberg and alluvial deposits.

Relative to registered water use, there has been a lot of water level monitoring in the infill sediments of the upper Koo valley and in TMG adjacent to the valley. However, the data are inconsistent in terms of frequency of monitoring, and some locations (3319DA00206, 3319DB00075, 3319DB00061) appear to have been pumped during the monitoring period. However, some observations can be made:

- The seasonal variation in water levels observed in BB1 to BB3 is less evident. This may be due to inconsistency with the sampling timeframes, smaller seasonal variations or seasonal variations being masked by pumping activities.
- Generally the range in water levels is <10 m. Borehole 3319DB00061 has a very large range in water levels of more than 70 m from the highest measured water level to the lowest measured water level, and 35-40 m within one season.
- There is no indication of a decrease in water level at any of the locations with time.

There is only one water quality data point within the Koo valley (3319DB00073) which shows a consistently low (<20 mS/m) EC for the short period that it has been monitored. 3319DB00031 is located in an adjacent valley where there is almost no registered water use. The water has had an EC consistently around 120 mS/m since 2006, and relative ion concentrations have remained stable.

Status Quo assessment for BB-5

GRU name, main town	Breede sub-catchment Unit 5, BB-5. Worcester
GRU Boundary description	The northern boundary follows the contact between the Peninsula Formation outcrop and the remaining rocks of the TMG and the overlying Bokkeveld Group which corresponds closely to the quaternary boundary enclosing H40H, H40L. The unit Is limited towards the east by the H50

	catchment. Sediments overlie these rocks and alluvium borders the Breede River, which is connected to the alluvial aquifer in BB-4. Groundwater flow occurs in the Peninsula and Nardouw Aquifers into deep confinement below the rocks of the Bokkeveld and Witteberg
Catchments	H10H; H20G; H20H; H40C
IUAs covered	The majority of the GRU falls within the Breede working tributaries IUA, with a small portion of the southwest of the GRU falling within the Upper Breede Tributaries IUA.
Domestic Groundwater use	Rawsonville is able to source 90% of the water supply from a wellfield of 4 boreholes, with the yield totalling 0.62 Mm^3/a. However, the wellfield is only used in summer months when the run-of-river surface water abstraction is insufficient to meet requirements. Worcester is supplied by surface water only

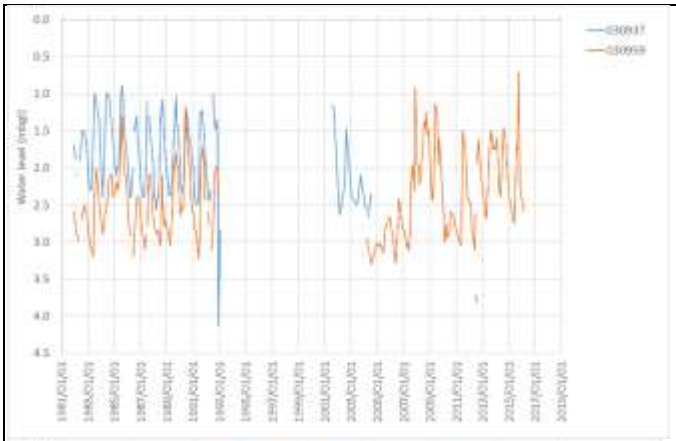
Water use clusters for trend analysis

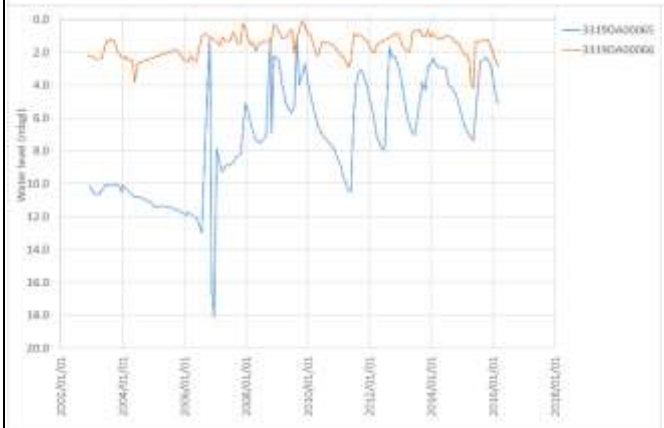
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Rawsonville South	Witteberg alluvial	68	9.4	Agriculture - irrigation	30937 (close to water use – ends 2004) 30959 (away from water use (Witteberg))	3319CB00086 (Brandvlei)
Alluvial fans	Malmesbury, alluvial	61	2.7	Agriculture - irrigation	3319DA00065 (Malmesbury, approx. 500 m from water use) 3319DA00066 (Malmesbury, away from water use)	None

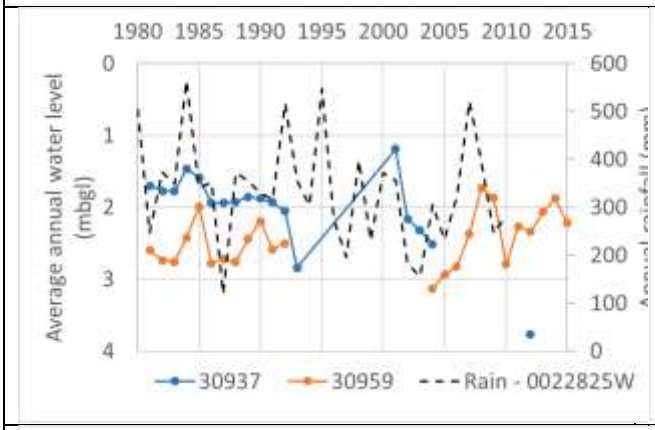
Available monitoring locations for trend analysis (recent data highlighted yellow)

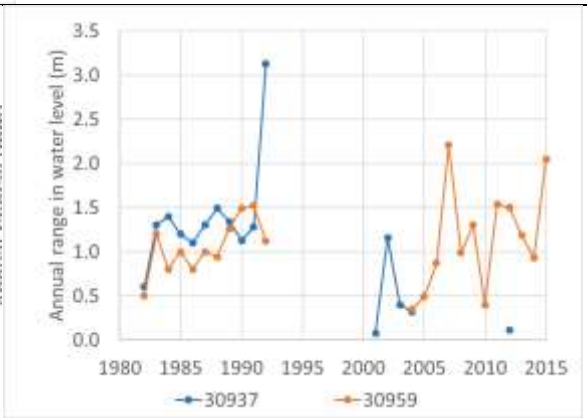
Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
030959	WL	Borehole	1981/12/22	2016/03/01	242	Quaternary Deposits	
3319DA00065	WL	Borehole	2002/12/11	2016/03/01	132	Malmesbury Group	
3319DA00064	WL	Borehole	2002/11/12	2016/03/01	131	Malmesbury Group	
3319DA00066	WL	Borehole	2002/11/12	2016/03/01	121	Malmesbury Group	
3319CB00100	WL	Borehole	2004/07/21	2016/03/01	110	Quaternary Deposits	
030960	WL	Borehole	1978/11/21	2016/02/14	144	Quaternary Deposits	
030937	WL	Borehole	1981/12/22	2012/07/30	134	Quaternary Deposits	
3319DA00068	WL	Borehole	2002/12/11	2005/01/26	19	Quaternary Deposits	
3319CB00027	WL	Borehole	1981/12/22	2004/06/29	130	Quaternary Deposits	
3319CB00003	WL	Borehole	1981/12/22	1993/02/04	109	Quaternary Deposits	
031255	WL	Borehole	1982/05/04	1993/02/03	102	Quaternary Deposits	
3319CB00015	WL	Borehole	1981/12/22	1992/03/17	106	Quaternary Deposits	
030961	WL	Borehole	1981/12/22	1988/06/22	61	Quaternary Deposits	
3319CB00086	Qual	Spring	1994/01/05	2015/03/31	40	Quaternary Deposits	
159335	Qual	Borehole	1979/02/11	1979/04/19	7	Quaternary Deposits	

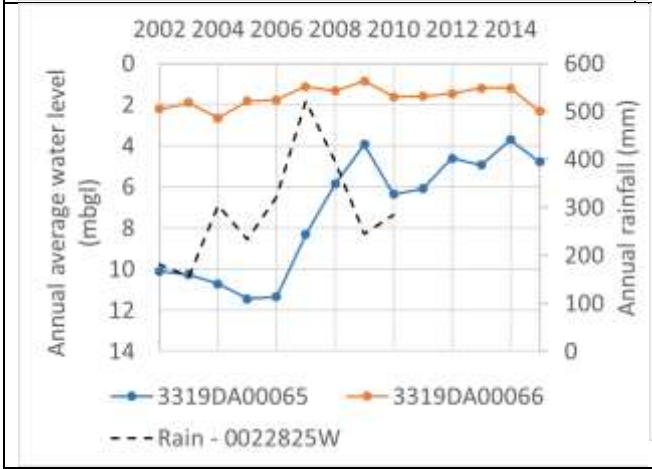
Water Level Graphs

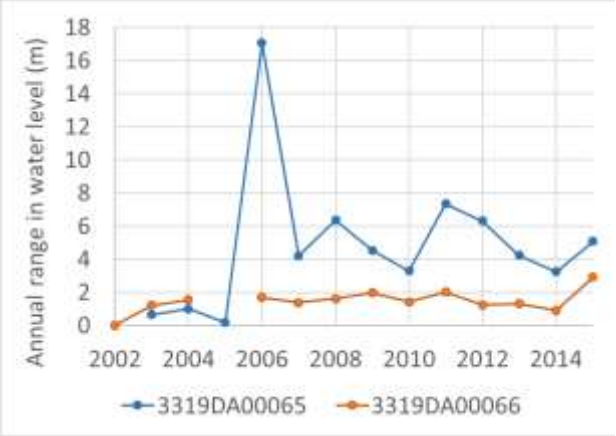






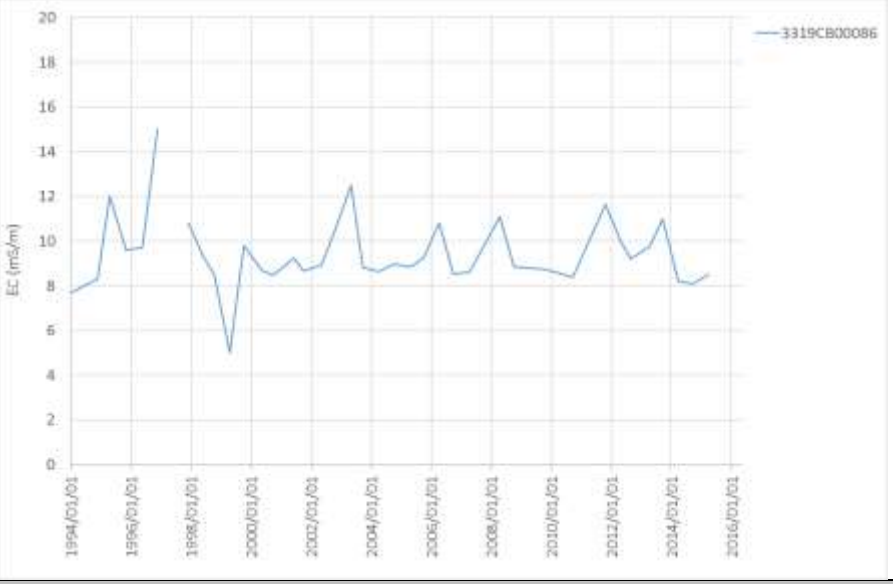






Response to Bulk Abstraction
The Breede Valley Local Municipality carries out monitoring for abstraction at Rawsonville. This data will be investigated should this GRU be prioritised for further investigation.

Water quality graphs



EC data lies well below the DWAF 1996 drinking water quality guideline Class 1 (70 mS/m).

Comments

Water use is clustered in two areas, namely to the south-east of Rawsonville and south of Worcestor on alluvial sediments overlying Witteberg Group and possibly Karoo rocks, and to the north of the Worcestor fault, in alluvial fan sediments overlying Malmesbury Group rocks (referred to as Alluvial fans).

Water levels in the Rawsonville area vary by 1.5 to 2.0 m seasonally. Annual average water levels show no signs of increasing or decreasing, and have varied between 1 and 3 m bgl over the monitoring period of 1980 to 2015. The only water quality monitoring location in the area with trend data since 2000 is the Brandvlei hot spring (3319CB00086), which is unlikely to be representative of water quality in the valley, and is also unlikely to have been impacted by farming activities. The EC has been stable at between 6 and 14 mS/m through the monitoring period.

Water level in the Malmesbury boreholes is more variable than in the Rawsonville boreholes. Borehole 3319DA00065, which is closer to a registered water use, shows generally lower water levels and larger differences between minimum and maximum annual water levels, compared to 3319DA00066, which is away from any registered water use. Neither borehole show a decreasing trend in water levels over the monitoring period, in fact water levels appear to have increased at 3319DA00065 from an approximately 10 mbgl prior to 2007 to 4 – 6 mbgl since 2009. This appears to show a delayed correlation with increasing annual rainfall over the preceding years. There is no water quality monitoring in this water use cluster.

Status Quo assessment for BB-6

GRU name, main town	Breede sub-catchment Unit 6, BB-6. Montague, Barrydale.
GRU Boundary description	The unit straddles the Breede and Gouritz catchment boundary. The area is dominated mainly by the Bokkeveld Group with some Witteberg Group outcropping towards the east. Minor to moderate groundwater resources will occur in the Bokkeveld Group sandstone units, or in alluvial materials in river valleys (e.g. Koo River), or screes and other slope materials. Major groundwater resources are available at depth in the TMG, which is recharged in the surrounding mountains (i.e. Langeberg Mountains to the south). Deep groundwater flow of the TMG will link the Peninsula Formation within unit BB-7 and BB-8.
Catchments	H30A to H30D; J12J;H70C
IUAs covered	The GRU falls between the Breede Working Tributaries IUA (its main part), and the Touws IUA (the northeast of the GRU).
Domestic Groundwater use	None of the towns within BB-6 use groundwater for municipal domestic supply. Barrydale and Montagu are 100% supplied by surface water.

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Lower Koo	Bokkeveld/Witteberg/ alluvial; surrounded by TMG mountains	164	6.9	Agriculture - irrigation	None	3320CC00019 (Avalon Springs)

Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3320CC00019	Qual	Spring	1994/01/06	2015/09/22	37	TMG	NA

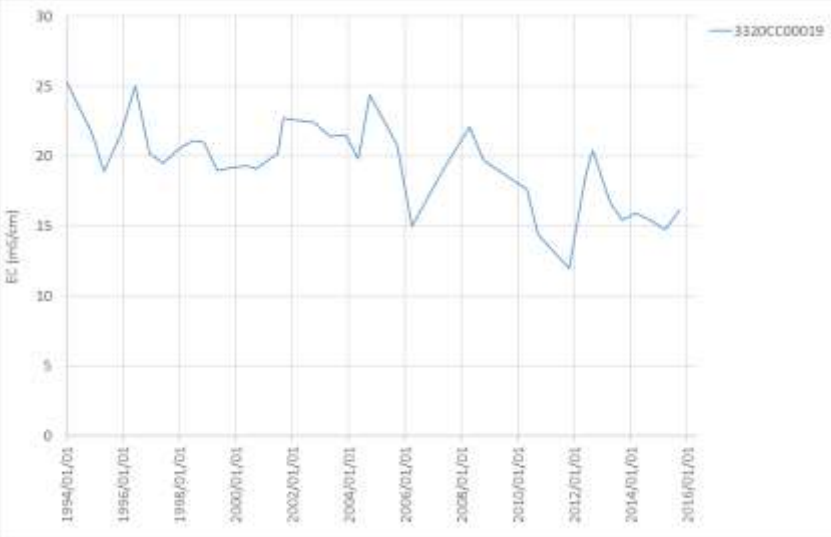
Water Level Graphs

No water level data available.

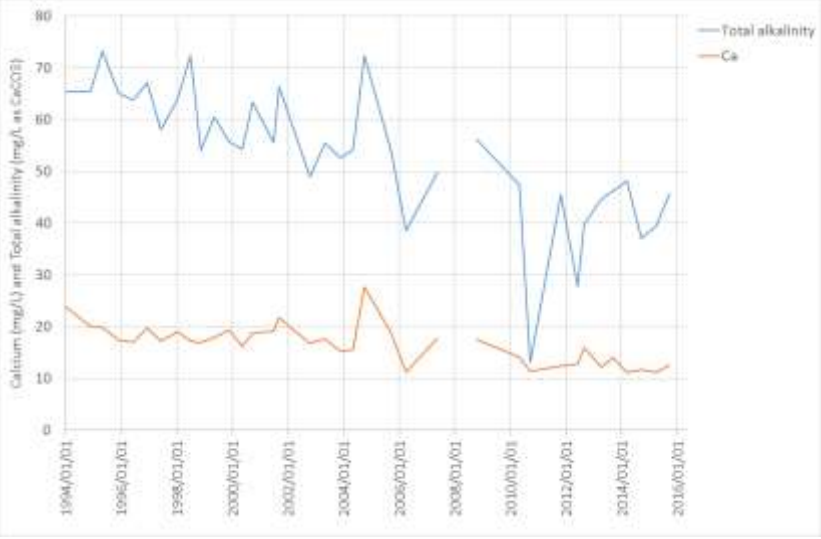
Response to Bulk Abstraction

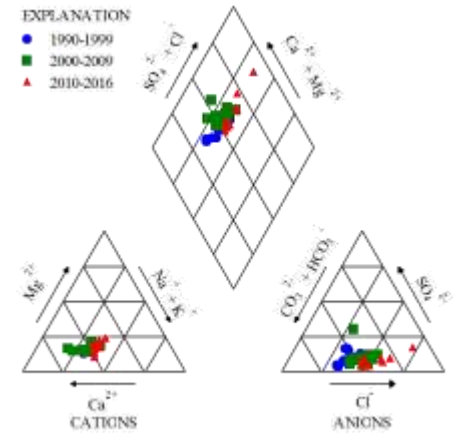
There is no bulk /point abstraction in the GRU.

Water quality graphs



EC data lies well below the DWAF 1996 drinking water quality guideline Class 1 (70 mS/m).





Comments
Water use is within the Bokkeveld and Witteberg Group rock formations, generally along the margins of the TMG exposure. There is no current water or long term water level monitoring data for BB-6. Long term water quality monitoring is available at one location, the Avalon Springs hot spring near Montagu. This hot spring has an EC lower than 25 mS/m which shows a decreasing trend from initial monitoring in the early 1990s (20-25 mS/m) to recent monitoring (15 – 20 mS/m). The decrease appears to be associated with a decrease in total alkalinity and calcium concentrations. The reason for this is not known.

Status Quo assessment for BB-7

GRU name, main town	Breede sub-catchment Unit 7, BB-7. Robertson.
GRU Boundary description	Similar to unit BB-5 the northern boundary follows the contact between the Peninsula Formation outcrop and the remaining rocks of the TMG and the overlying Bokkeveld Group which corresponds closely to the quaternary boundary enclosing the H50 catchment. The unit Is limited towards the south and east by the H60 and H70 catchments, respectively. Deep groundwater flow of the TMG will link the Peninsula Formation within unit BR-2.
Catchments	H40D to H40L; H30E; H50A;H50B
IUAs covered	Most of the GRU falls within the Middle Breede Renosterveld, with its north falling in Breede Working Tributaries IUA.
Domestic Groundwater use	All of the settlements within BB-7 are 100% surface water supplied (Ashton, Bonnievale, McGregor, Robertson)

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Villiersdorp	Bokkeveld/alluvial; surrounded by TMG mountains	26	1.7	Agriculture - irrigation	None	None
McGregor (S of River)	Bokkeveld/Witteberg/ alluvial; surrounded by TMG mountains	102	4.9	Agriculture - irrigation	None	None
Robertson/ Ashton	Malmesbury/ Uitenhage/ Alluvial/ TMG	33	1.4	Agriculture - irrigation	None	None

Available monitoring locations for trend analysis (no recent data)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
100155	Qual		1973/10/17	1975/01/10	6	Quaternary Deposits	
100145	Qual		1973/06/14	1976/07/23	15	Quaternary Deposits	
100122	Qual		1972/07/18	1976/09/13	27	Quaternary Deposits	

Water Level Graphs

No water level data available.

Response to Bulk Abstraction

There is no bulk /point abstraction in the GRU.

Water quality graphs

No recent water quality

Comments

Water use is within the Bokkeveld and Witteberg Group rock formations, generally along the margins of the TMG exposure.
The amount of water use is significantly lower than in the adjacent Worcester valley (BB-3).
There is no current or long term water level or water quality monitoring data for BB-7.

Status Quo assessment for BB-8

GRU name, main town	Breede sub-catchment Unit 8, BB-8. Swellendam.
GRU Boundary description	The northern boundary of the lower Breede unit follows the contact between the Peninsula Formation outcrop and the remaining rocks of the TMG and the overlying Bokkeveld Group which corresponds closely to the quaternary boundary enclosing the H70 catchment. Its southern half is bounded by the Atlantic Ocean with Witsand in the south and the Bontehoek fault in the west. The overall Gouritz catchment boundary bounds the unit to the east.
Catchments	H70A to H70K; G50K
IUAs covered	Most of the GRU falls within Lower Breede Renosterveld, with just a small coastal section of the GRU falling within the Overberg East Fynbos IUA.
Domestic Groundwater use	Most of the settlements within BB-8 are supplied by surface water (Buffeljags River, Suurbraak, Swellendam, Slangrivier). Witsand uses groundwater to support the supply in peak season only

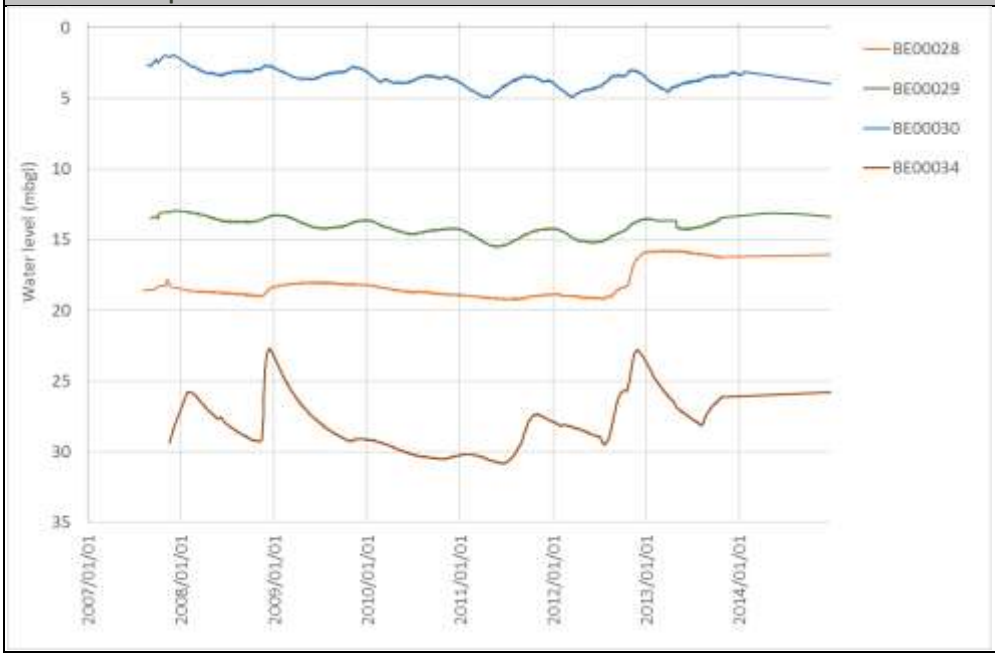
Water use clusters for trend analysis

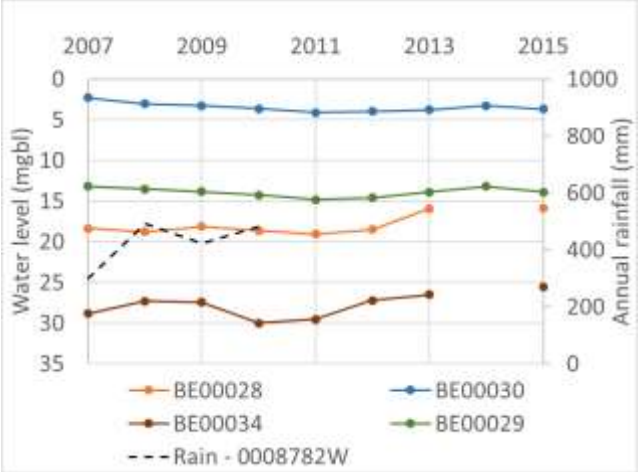
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Swellendam	Bokkeveld/ Witteberg/ Alluvium	9	0.5	Agriculture - irrigation	None	None
Witsand	TMG	2	0.1	Agriculture - irrigation	BE00028/29/30/34 (away from registered water use)	None

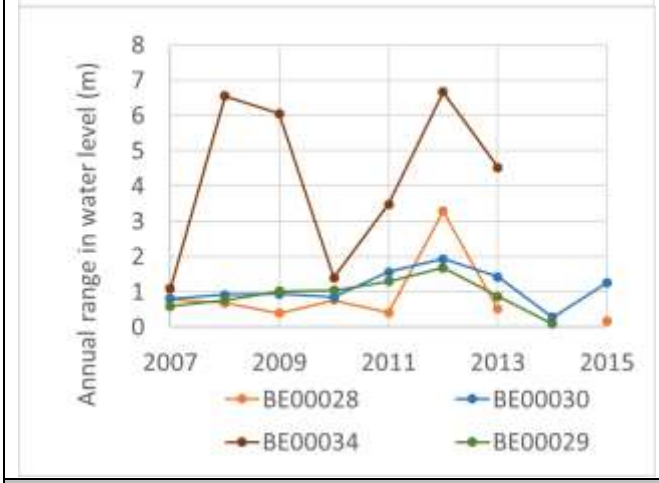
Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
BE00031	WL	Borehole	2007/09/06	2016/02/18	2060	TMG	
BE00030	WL	Borehole	2007/08/23	2015/10/29	2205	TMG	
BE00032	WL	Borehole	2007/11/02	2015/10/29	2199	TMG	
BE00028	WL	Borehole	2007/08/06	2015/10/29	2107	Quaternary	
BE00029	WL	Borehole	2007/09/06	2015/10/29	2100	TMG	
BE00034	WL	Borehole	2007/11/19	2015/10/29	2098	TMG	
BE00027	WL	Borehole	2007/09/06	2014/01/30	1930	TMG	
BE00033	WL	Borehole	2007/11/02	2013/01/29	1517	TMG	

Water Level Graphs







Response to Bulk Abstraction
The extent of municipal groundwater monitoring for abstraction at Witsand is not known. This will be investigated should this GRU be prioritised for further investigation.
Water quality graphs
No recent water quality data.
Comments
Although there is more registered water use in the Swellendam cluster, all available groundwater monitoring is conducted in a TMG inlier to the west of Witsand. Long term records are available for a number of locations, of which four were selected as representative. The water levels vary from <5 to approximately 30 m bgl. Seasonal variations are evident in BE00029 and BE00030, but less so in BE00028 and BE00034. The water levels generally vary by less than 1 m within one season, except in BE00034 where ranges of up to 7 m have been noted. Water levels at BE0030 appear to show a gradual decrease with time, but this is not noticeable at the other locations.

Status Quo assessment for GGr-1

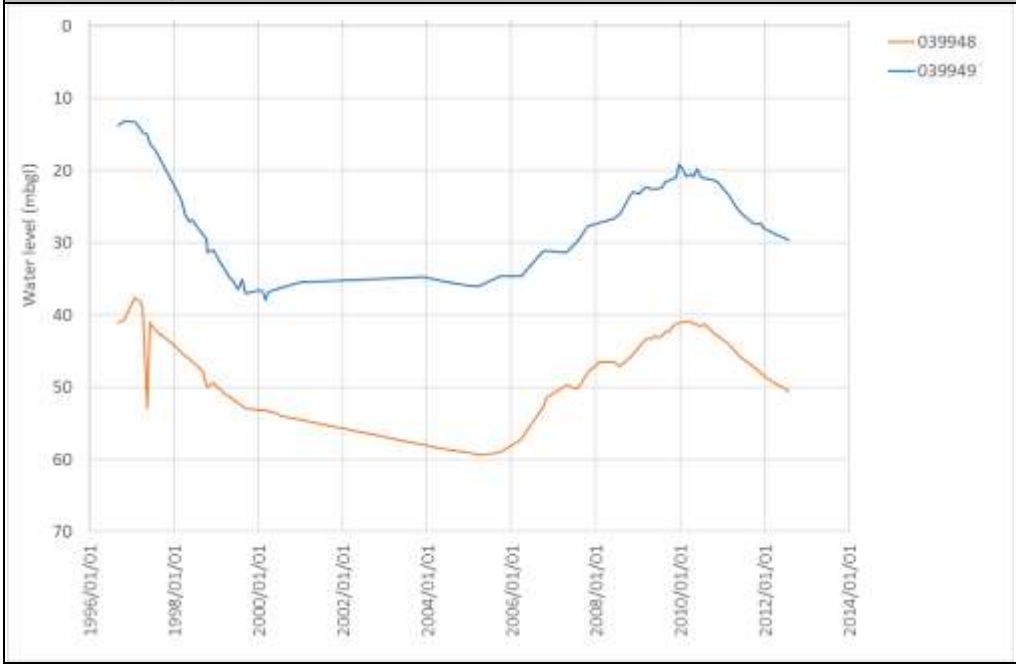
GRU name, main town	Gouritz Groot sub-catchment Unit 1, GGr-1. Touwsrivier
GRU Boundary description	The Gouritz catchment boundary encloses the unit in the northwest, while the northern boundary deviates along the contact between the Witteberg Group and overlying Karoo Supergroup. The area is dominated mainly by the Bokkeveld Group and Witteberg Group outcrops. Cenozoic cover occurs over much of the area and alluvial materials in river valleys (e.g. Touws River), or screes and other slope materials could results in moderate groundwater resources.
Catchments	J12B to J12E
IUAs covered	The whole of the GRU falls within the Touws IUA.
Domestic Groundwater use	Groundwater provides Touws River with 35% of its supply source: 0.342 million m3/a (via groundwater fed springs and a borehole)
Water use clusters for trend analysis	

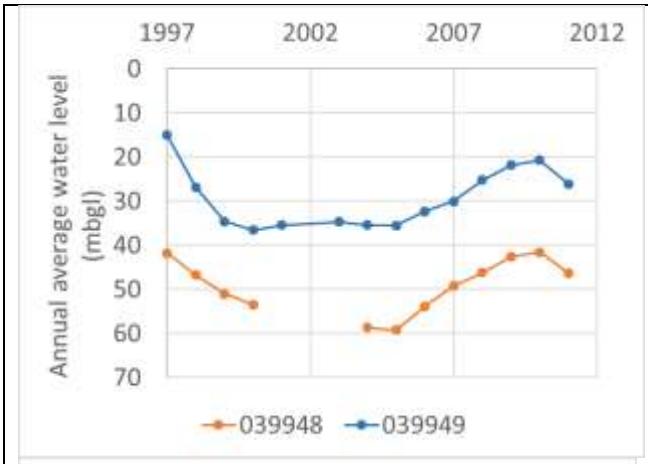
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Touws Rivier	Witteberg/ Bokkeveld TMG/Alluvium	82	5.1	Agriculture – irrigation	039947 (Witteberg, away from water use) 039948/9 (Quaternary/Bokkeveld, away from water use)	None

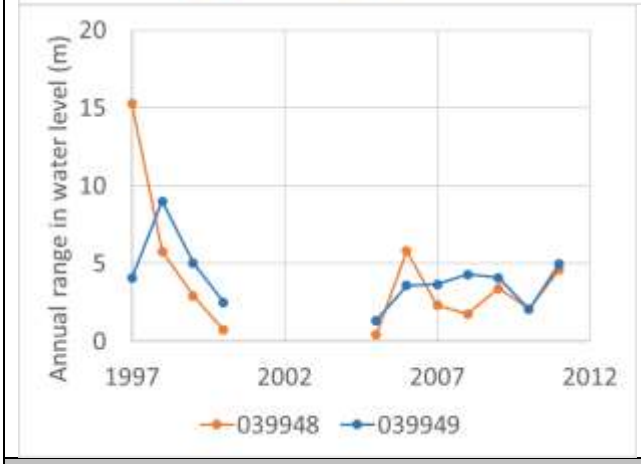
Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
039949	WL	Borehole	1996/09/05	2012/07/31	90	Quaternary	
039948	WL	Borehole	1996/09/04	2012/07/31	88	Quaternary	
039947	WL	Borehole	1996/09/06	2012/02/29	12	Witteberg	

Water Level Graphs







Response to Bulk Abstraction

The Breede Valley Local Municipality conducts groundwater monitoring for abstraction at Touws River. This data will be assessed should this GRU be prioritised for further investigation.

Water quality graphs

No recent water quality data.

Comments

Groundwater use within GGr-1 is not clustered in any area, but is spread across the GRU in different geologies.
Long term water level monitoring has been conducted in only three locations to the north-west of Touwsrivier. These locations appear to target Witteberg and Bokkeveld Groups. Groundwater levels do not show large seasonal variations, but a long term cyclicity (over 10 years) is observed – likely to be climate related. The water levels show a long term decrease of about 20 m from 1996 to 2005, and then water level recovery of 15 – 20 m from 2005 to 2010. Between April 2010 and the end of monitoring in 2012, water levels were decreasing again.

Status Quo assessment for GGr-2-

GRU name, main town	Gouritz sub-catchment Unit 2, GGr-2. Anysberg
GRU Boundary description	The northern boundary deviates along the contact between the Wittberg Group and overlying Karoo Supergroup. The unit is limited to the J12F and J12H catchment boundaries in the east. The area is dominated mainly by the Bokkeveld Group and Witteberg Group outcrops. The TMG (mainly the Nardouw sub-group) exposed to the east dips north under the rest of the Cape Supergroup and under the Karoo Supergroup. Cenozoic cover occurs over much of the area and alluvial materials in river valleys, or screes and other slope materials could results in moderate groundwater resources.
Catchments	J12F; J12G
IUAs covered	The majority of the GRU falls within the Touws IUA, with a small northern portion falling within the Gamka-Buffels IUA.
Domestic Groundwater use	There are no settlements with municipal water supply in GGr-2

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Anysberg	Witteberg/ Bokkeveld/ TMG/Alluvium	35	1.6	Agriculture – irrigation	None	None

Available monitoring locations for trend analysis (recent data highlighted yellow)

None

Water Level Graphs

No water level data available.

Response to Bulk Abstraction

There is no bulk /point abstraction in the GRU.

Water quality graphs

No recent water quality data.

Comments

Groundwater use within GGr-2 is minimal and is associated with alluvium along the Touws River and within the TMG of the Anysberg mountains. No long term water level or water quality monitoring has been undertaken in this GRU.

Status Quo assessment for GGr-3

GRU name, main town	Gouritz Gamka sub-catchment Unit 3, GGr-3. Laingsburg.
GRU Boundary description	The Gouritz catchment boundary encloses the unit in the northwest and north, while the Dwyka drainage tributaries and associated catchment bounds the unit in the east. The Dwyka and Ecca Groups of the Karoo Supergroup dominate the unit and groundwater occurrence is associated with the intrusion of dolerite dykes and the degree of weathering and fracturing.
Catchments	J11A to J11F
IUAs covered	The whole of the GRU falls within the Gamka-Buffels IUA.
Domestic Groundwater use	Both settlements within this GRU are dependent on groundwater: • Matjiesfontein receives 100% of its supply from groundwater; 0.12 million m^3/a • Laingsburg receives 91% of its supply from groundwater; 1.19 million m^3/a

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Laingsburg	Dwyka, Ecca, Beaufort	44	2.2	Water supply Agriculture – irrigation	None	3320BA00056 (Beaufort, away from water use) 3320BA00057 (Dwyka, away from water use)

Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3320BA00057	Qual	Borehole	1994/05/18	2015/08/31	28	Dwyka	
3320BA00056	Qual	Borehole	1991/12/10	2014/09/29	35	Beaufort	

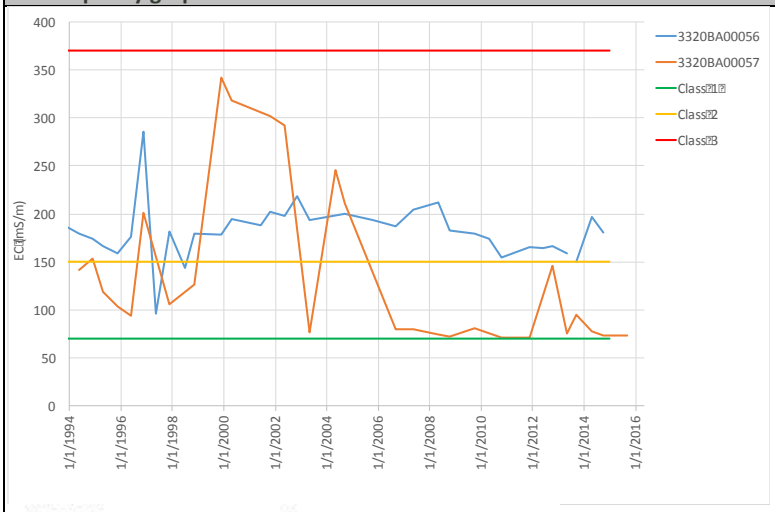
Water Level Graphs

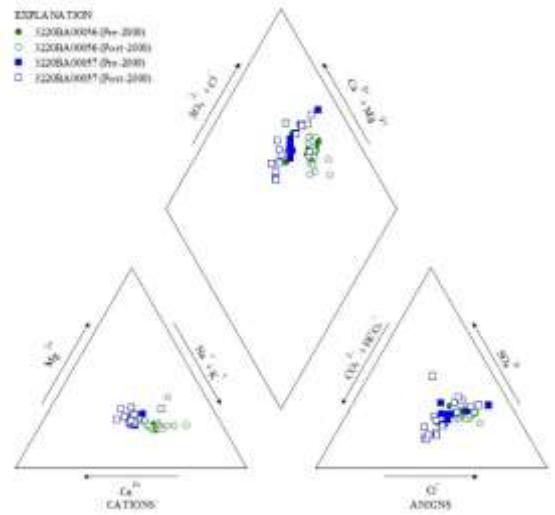
No water level data available

Response to Bulk Abstraction

The extent of current municipal groundwater monitoring for abstraction at Laingsburg and Matjiesfontein is not known, however some data does exist from previous groundwater exploration activities. Available data will be sourced and investigated should this GRU be prioritised for further investigation.

Water quality graphs





Comments

Registered water use boreholes in the Laingsburg GRU (GGr-3) are relatively sparsely distributed, with the largest water use being close to Laingsburg and Matjiesfontein (municipal abstraction for supply). Most of these locations target alluvium overlying Ecca Group.

There is no long term water level monitoring within the GRU. There are two water quality monitoring locations, 3320BA00056 in the Beaufort Group away from water use, and 3320BA00057, on Dwyka Group rocks north of Matjiesfontein, also away from registered groundwater use. The EC of both locations is in the same order of magnitude (50 – 350 mS/m), with large variations of up to 150 mS/m. A slight long term downward trend is noted for 3320BA00057. The locations have similar anion chemistry, with data suggesting fluctuations in the relative amounts of chloride, sulphate and bicarbonate. 3220BA00056 has a relatively higher Na content.

Status Quo assessment for GGr-4

GRU name, main town	Gouritz sub-catchment Unit 4 , GGr-4. Ladismith.
GRU Boundary description	The unit straddles the Cango-Baviaanskloof Fault and also the Swartberg. This area of very rugged mountains is dominated by the Peninsula Formation, with higher TMG Formations only really occurring on the highest peak. Discharge from the TMG also occurs to surface water systems, mainly to the south. The unit is bounded in the north by the Witteberg Group and the overlying Karoo Supergroup contact zone and to the south by the Rooiberg fault zone. The east and west coincide with J12 and J25 catchment boundaries.
Catchments	J11H to J11K;
IUAs covered	The GRU falls within the Touws IUA.
Domestic Groundwater use	Ladismith is currently in the process of establishing a wellfield, the boreholes for which have been drilled, pump and (some) supply infrastructure installed, and (some) testing completed. The wellfield has been used to supply the town in recent summer months (summer months 2015-2016), especially required with the reduced yield of Fanie Le Grange dam (safety issues), however the groundwater abstraction is not yet licensed. The available groundwater yields could support the whole of the towns current demand.

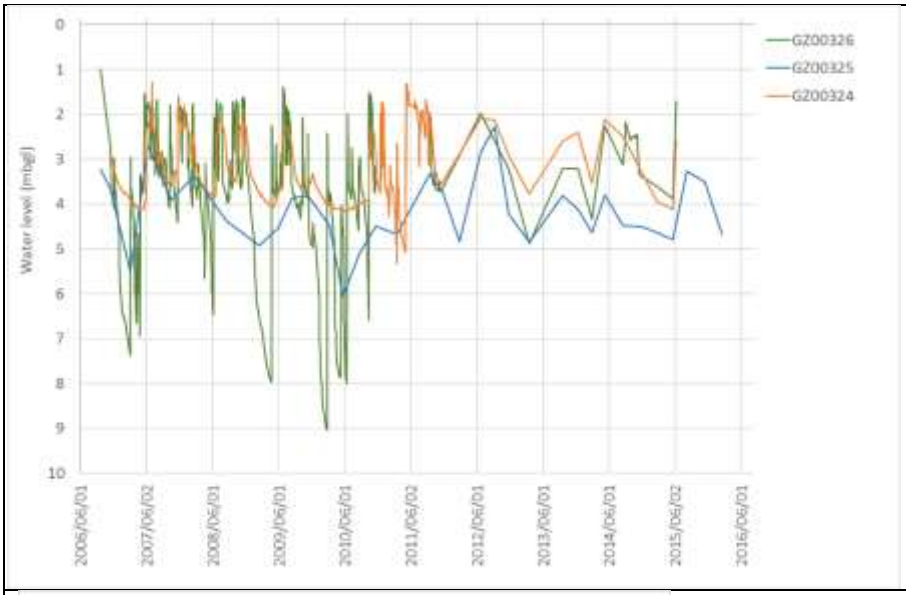
Water use clusters for trend analysis

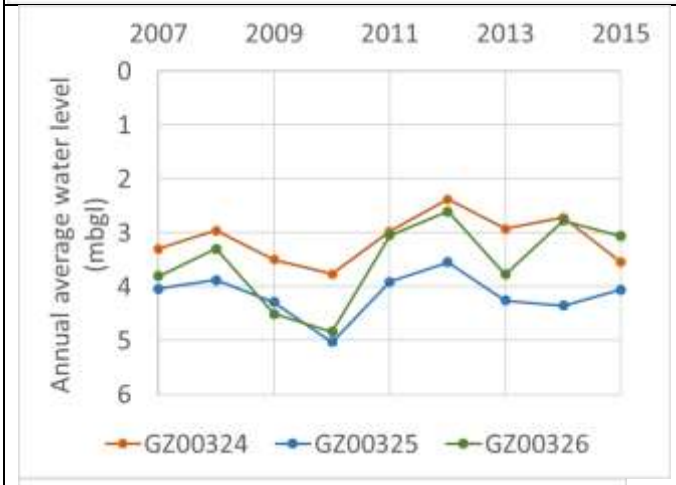
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Ladismith	Witteberg/ Bokkeveld/ Alluvium	59	3.1	Agriculture – irrigation	GZ00324 (Alluvium/Witteberg, close to water use) GZ00325/326 (Alluvium/Witteberg, away from water use)	None
Middelplaas	Bokkeveld/ TMG	27	1.1	Agriculture – irrigation	None	None

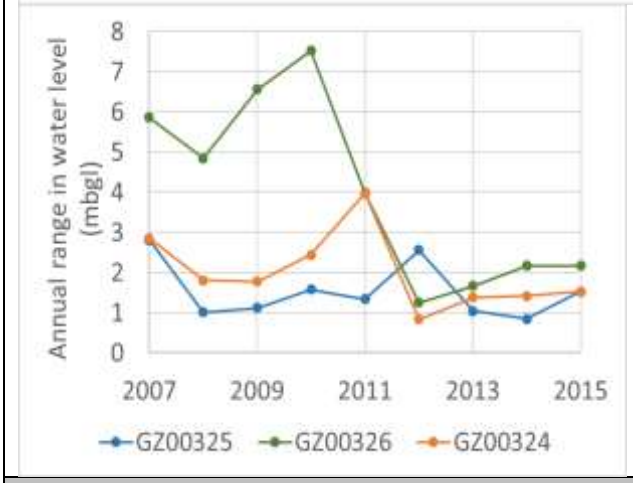
Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
GZ00325	WL	Borehole	2006/09/20	2016/02/17	34	Quaternary	16
GZ00326	WL	Borehole	2006/09/20	2015/06/09	1853	Witteberg	11
GZ00324	WL	Borehole	2006/11/14	2015/06/09	1843	Quaternary	22
3321AC00009	WL	Borehole	1971/09/27	1981/04/07	129	Bokkeveld	
3321AD00001	WL	Borehole	1972/02/14	1981/04/07	113	Bokkeveld	
3321AC00001	WL	Borehole	1971/09/27	1981/04/07	106	Bokkeveld	
3321AD00004	WL	Borehole	1971/11/10	1981/04/07	85	Bokkeveld	
3321AC00007	WL	Borehole	1974/05/16	1981/04/07	84	Bokkeveld	
3321AC00004	WL	Borehole	1971/12/01	1981/03/07	114	Bokkeveld	59
3321AC00003	WL	Borehole	1971/09/27	1981/01/05	97	TMG	
3321AC00010	WL	Borehole	1971/11/08	1980/12/03	92	Bokkeveld	
3321AC00008	WL	Borehole	1975/07/02	1977/11/15	28	Bokkeveld	
3321AC00005	WL	Borehole	1971/09/27	1976/01/29	56	Quaternary	
3321AC00002	WL	Borehole	1971/10/08	1975/11/28	55	Bokkeveld	
3321AC00006	WL	Borehole	1971/10/01	1973/09/07	26	Bokkeveld	

Water Level Graphs







Response to Bulk Abstraction

Groundwater monitoring is conducted in Ladismith in response to the municipal abstraction. This will be investigated should this GRU be prioritised for further investigation.

Water quality graphs

No recent water quality data.

Comments

Groundwater use occurs to the south and the north of the TMG Klein Swartberg range.
Long term groundwater level monitoring has occurred in the vicinity of Ladismith in the Ladismith cluster to the south of the fault marking the boundary of the Witteberg and TMG to the north of Ladismith. The three monitoring boreholes in the

vicinity of Ladismith show seasonal fluctuations of 1 to 8 m with lowest water levels between January and April. GZ000326 shows a large range in water levels during the initial years of monitoring (2006 – 2010) compared to GZ00324

Status Quo assessment for GGr-5

GRU name, main town	Gouritz Groot sub-catchment Unit 5, GGr-5. Van Wyksdorp.
GRU Boundary description	The J12K catchment bounds the unit in the north but the boundary deviates along the fault zone and along the contact between the Peninsula Formation outcrop and the remaining rocks of the TMG and the overlying Bokkeveld Group, which corresponds closely to the quaternary boundary enclosing J13 A, J13B, J13C and J40A. The area is dominated by the Bokkeveld Group outcrop. This is however underlain by the TMG, recharged from the surrounding mountains. Deep groundwater flow of the TMG will link the Peninsula Formation within unit GGo-1, GGo-2a and 2b.
Catchments	J12K to J12M; J13A to J13C
IUAs covered	The GRU falls within the Touws IUA.
Domestic Groundwater use	Van Wyksdorp is the only settlement within this GRU, and relies solely on groundwater with 68% of the supply (totalling 0.03 Mm^3/a) being abstracted from boreholes.

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
West	TMG, Bokkeveld, Witteberg, alluvium	51	2.4	Agriculture – irrigation	None	3320DD00019 (Bokkeveld/TMG contact, close to water use)
East	Bokkeveld/TMG	67	1.4	Agriculture – irrigation	None	3321CD00011 (Bokkeveld, away from water use)

Available monitoring locations for trend analysis (no recent data)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3320DD00019	Qual	Spring	1994/01/06	2015/06/08	37	Bokkeveld	
3321CD00011	Qual	Borehole	1992/08/10	2012/10/05	11	Bokkeveld	

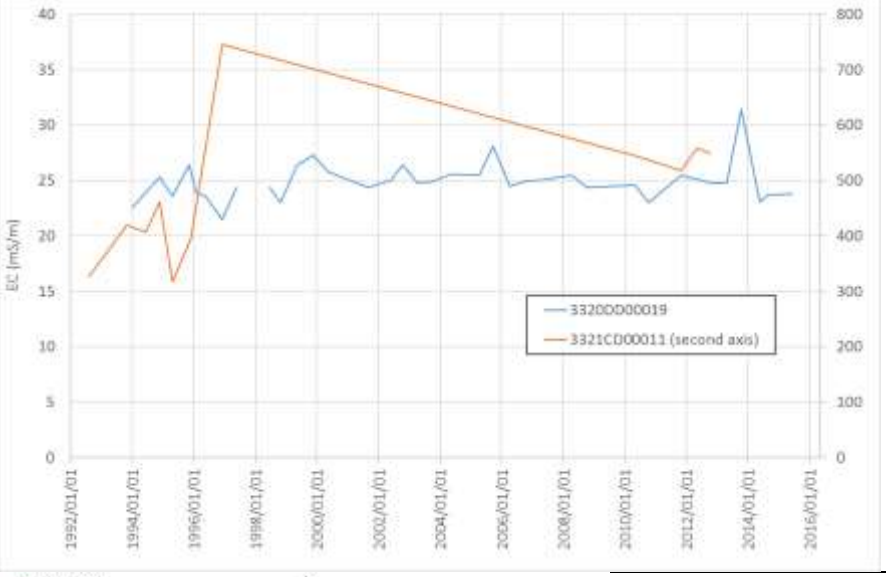
Water Level Graphs

No water level data available.

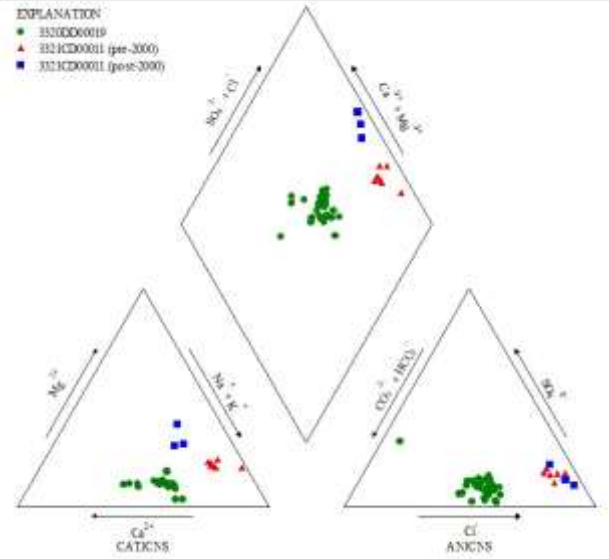
Response to Bulk Abstraction

The extent of municipal groundwater monitoring for abstraction at Van Wyksdorp is not known. This will be investigated should this GRU be prioritised for further investigation.

Water quality graphs



EC data (for 3320DD00019) lies well below the DWAF 1996 drinking water quality guideline Class 1 (70 mS/m).
EC data (for 3321CD00011) at times exceeds the DWAF 1996 drinking water quality guideline Class 3 (370-520 mS/m).



Comments

GGr-5 is a relatively large GRU with a low density of registered groundwater use. Groundwater use is noted in two clusters, the first in Bokkeveld Group sediments and along a TMG contact near Van Wyksdorp, and the second in Bokkeveld Group sediments and in the east of the GRU, around the Warmwaterberg.

Status Quo assessment for GGa-1

GRU name, main town	Gouritz Gamka sub-catchment Unit 1, GGa-1. Merweville
GRU Boundary description	The Gouritz catchment boundary encloses the unit in the northwest and north, while the Gamka sub-catchment bounds the unit in the east. The Dwyka and Ecca Groups of the Karoo Supergroup dominate the unit and groundwater occurrence is associated with the intrusion of dolerite dykes and the degree of weathering and fracturing
Catchments	J24A to J24E
IUAs covered	The GRU falls within the Gamka-Buffels IUA
Domestic Groundwater use	The settlements in this sub-catchment both rely solely on groundwater: • Prince Albert Road: has 100% GW supply but the yield is unknown • Merweville: has 100% GW supply at 0.32 million m^3/a
Water use clusters for trend analysis	

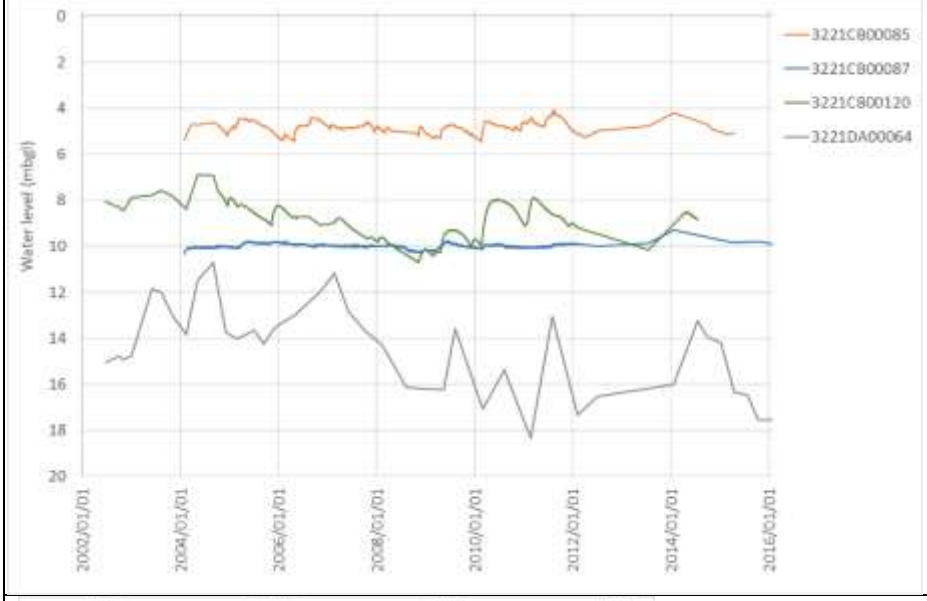
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Merweville	Ecca, Beaufort	40	1.6	Agriculture – irrigation	3221CB00085 (Beaufort, away from water use), 3221CB00087 (Beaufort, away from water use), 3221CB00120 (Beaufort, away from water use); 3221DA00064 (Beaufort, at water use)	3221DA00001 (Beaufort, away from water use) 3221CB00010 (Beaufort, away from water use) 3221AB00059 (Beaufort, at water use)

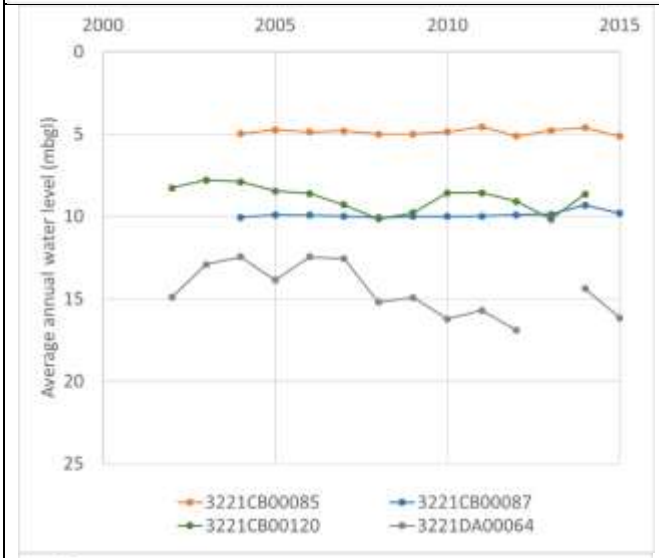
Available monitoring locations for trend analysis (recent data highlighted yellow)

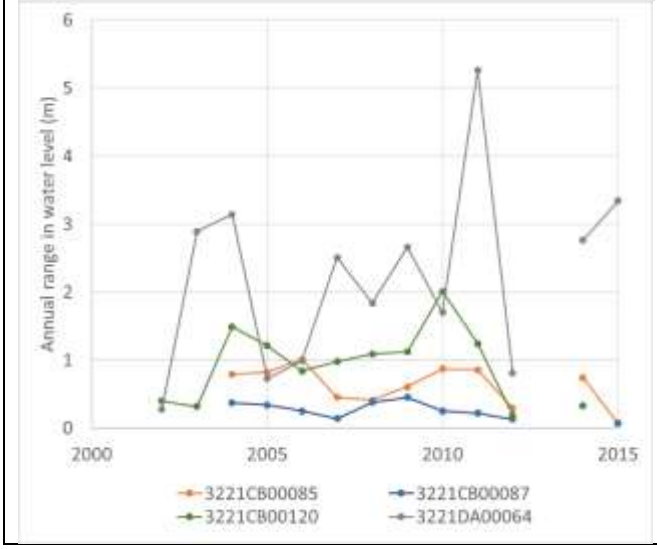
Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3221CB00087	WL	Borehole	1978/07/14	2016/01/26	2927	Beaufort Group	
3221DA00064	WL	Borehole	2002/06/24	2016/01/26	38	Beaufort Group	
3221CB00085	WL	Borehole	2004/02/02	2015/04/21	2835	Beaufort Group	
3221CB00120	WL	Borehole	2002/06/24	2014/07/22	2611	Beaufort Group	
3221CB00098	WL	Borehole	1978/07/07	2012/05/09	25	Beaufort Group	
3221CA00019	WL	Borehole	1978/07/11	2012/02/09	25	Beaufort Group	
3221CA00030	WL	Borehole	1978/07/11	2012/02/09	25	Beaufort Group	
3221CB00053	WL	Borehole	1978/07/14	2012/02/09	25	Beaufort Group	
3221CB00059	WL	Borehole	1978/07/14	2012/02/09	24	Beaufort Group	
3221CA00040	WL	Borehole	1978/07/13	2012/02/09	24	Beaufort Group	
3221CA00057	WL	Borehole	2004/01/14	2012/02/09	23	Beaufort Group	
3221CB00078	WL	Borehole	1978/07/06	2012/02/09	23	Beaufort Group	
3221CB00047	WL	Borehole	1978/07/07	2012/02/09	22	Beaufort Group	
3221CB00119	WL	Borehole	2004/02/03	2012/02/09	18	Beaufort Group	
3221CB00118	WL	Borehole	1992/06/30	2012/02/09	18	Beaufort Group	
3221CB00115	WL	Borehole	1994/01/31	2011/02/23	25	Beaufort Group	
3221CB00111	WL	Borehole	2003/09/02	2011/02/23	23	Beaufort Group	
3221CB00121	WL	Borehole	2004/05/14	2011/02/23	21	Beaufort Group	
3221CB00116	WL	Borehole	1994/01/31	2011/02/23	21	Beaufort Group	
3221CA00018	WL	Borehole	1978/07/11	2009/05/18	13	Beaufort Group	
3221CB00107	WL	Borehole	1978/07/14	2009/05/18	12	Beaufort Group	
3221DA00001	Qual	Borehole	1994/05/26	2015/04/15	29	Beaufort Group	

3321AB00059	Qual	Borehole	1993/12/17	2015/04/15	33	Beaufort Group	
3221CB00010	Qual	Borehole	1993/12/16	2014/09/30	38	Beaufort Group	

Water Level Graphs



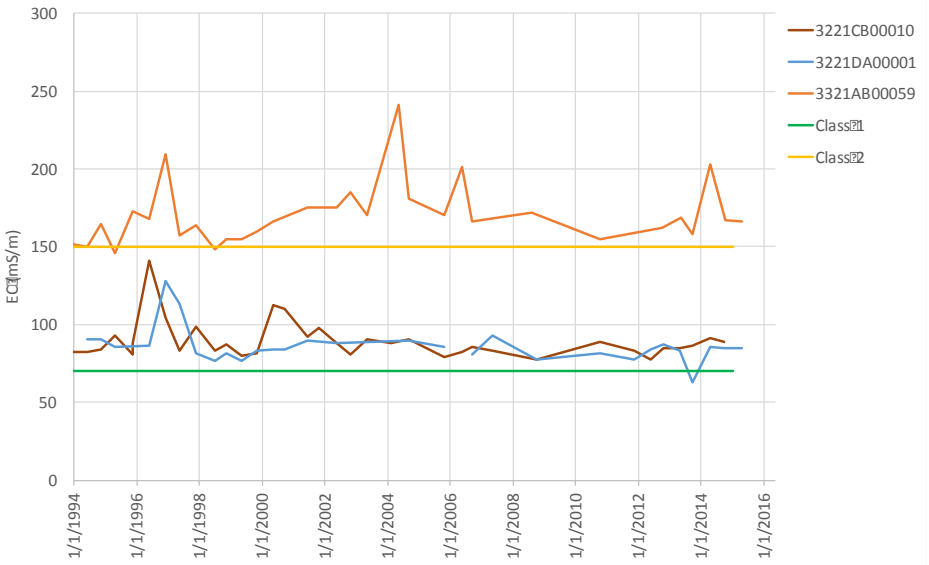


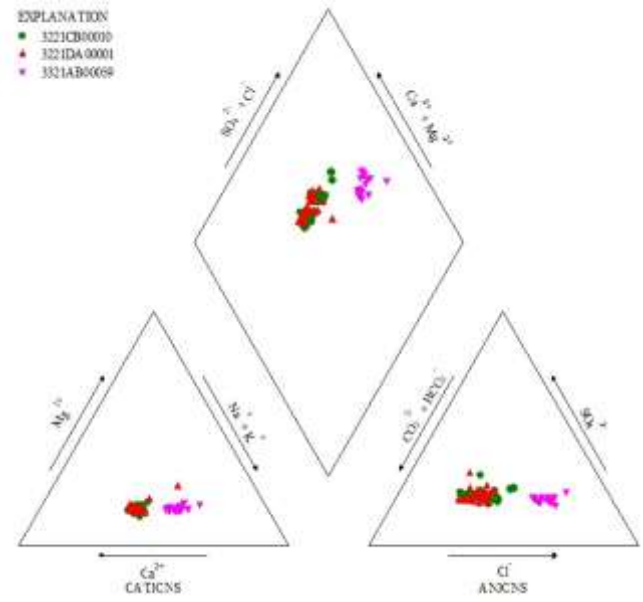


Response to Bulk Abstraction

The extent of municipal groundwater monitoring for abstraction at Prince Albert Road and Merweville is not known. This will be investigated should this GRU be prioritised for further investigation.

Water quality graphs





Comments

Registered water use boreholes in the Merweville GRU (GGa-1) are relatively widely spread and most source water from the Beaufort Group.

Long term water level monitoring has been restricted to the northern part of the GRU, around and to the north-west of Merweville. Four locations were selected to represent the water level monitoring, three that have long and detailed monitoring records (3221CB00085/87/120), but are away from registered water use, and one that is at a registered water use location, but has less detailed records (3221DA00064). Water levels range from approximately 7 to 18 mbgl. The water levels show varying degrees of seasonal fluctuations, with barely any fluctuation at 3221CB00087, and pronounced seasonal variation at 3221DA00064. No long term trends are visible in the annual average water levels in 3221CB00085 or 3221CB00087, but an apparent decreasing water level trend is visible in 3221DA00064, from generally <15 mbgl prior to 2008 to generally >15 mbgl after 2008. 3221DA00064 is at or near a registered water use borehole.

There are three long term water quality monitoring boreholes, two in the area to the north-west of Merweville (3221CB00010 and 3221DA00001), and one much further south, much closer to the contact with the Ecca, and near a registered water use (3321AB00059). The EC (approximately 100 mS/m) and relative ion concentrations of groundwater from the two boreholes near Merweville is very similar, and does not show any increasing or decreasing trends with time. Water from 3321AB00059 has an EC between 150 and 200 mS/m, and the ion chemistry is relatively more Na and Cl dominant. Although the EC is variable, there is no marked increase or decrease over the monitoring period.

Status Quo assessment for GGa-2a, 2b and 2c

GRU name, main town	Gouritz Gamka sub-catchment Unit 2, GGa-2a, 2b and 2c. Leeu Gamka and Beaufort West.
GRU Boundary description	The GRU comprises of the upper Gamka catchment and is dominated by rocks of the Dwyka and Ecca Groups of the Karoo Supergroup. The J23B catchment bounds the unit in the south.
Catchments	J22A to J22F; J21A to J21E; J23A; J23 B
IUAs covered	The GRU falls within the Gamka-Buffels IUA.
Domestic Groundwater use	All three of the settlements in this sub-catchment use groundwater as "sole supply" (>50%). • Beaufort West: has 77% GW supplied at 2.71 million m^3/a • Leeu Gamka and Bitterwater: has 100% GW supplied at 0.10 million m^3/a • Murraysburg: has 100% GW supplied at 0.45 million m^3/a

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Beaufort West	Beaufort, dolerite, alluvium	133	5.2	Water supply Agriculture – irrigation	029946B (alluvium, close to water use) 029855F (alluvium, away from water use) 3222BC00137 (Beaufort, at water use) 029935A (Beaufort, away from water use)	3222BC00023 (Beaufort, at water use, spring)
Leeu Gamka	Beaufort, alluvium	87	4.3	Agriculture – irrigation Agriculture – watering livestock	3221DB00068 (Beaufort, away from water use) 3221DD00048 (Beaufort, away from water use) 3221DD00116 (alluvium, close to water use) 3221DD00150 (alluvium, close to water use)	3221DD00017 (alluvium, away from water use)

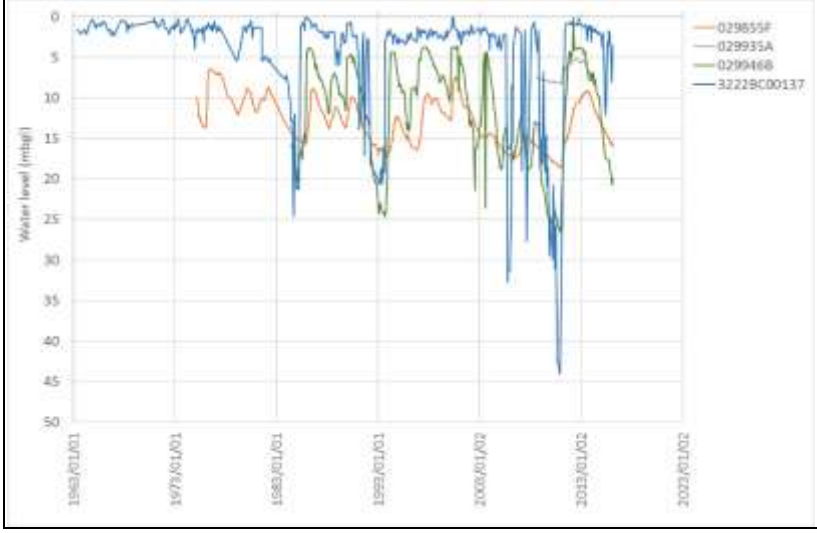
Available monitoring locations for trend analysis (recent data highlighted yellow)

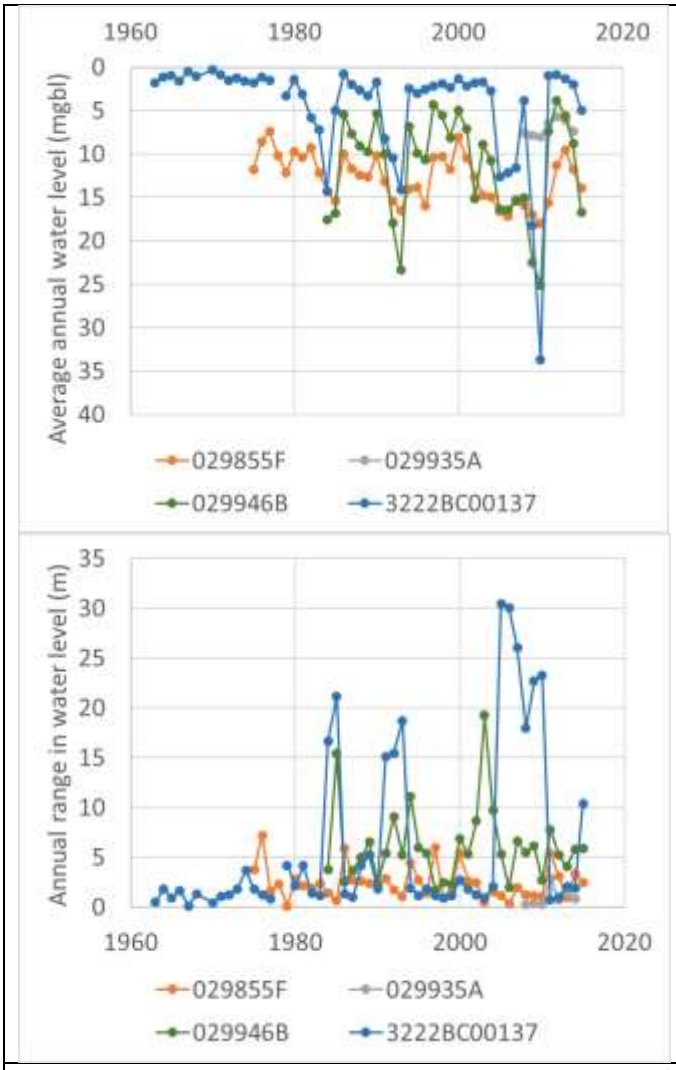
Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
029856A	WL	Borehole	1974/06/12	2016/02/23	3432	Quaternary	102
029855F	WL	Borehole	1975/02/24	2016/02/23	3287	Quaternary	85
029946B	WL	Borehole	1984/06/24	2016/02/23	1010	Quaternary	79
029940D	WL	Borehole	1977/12/09	2016/02/23	431	Quaternary	91
3222BC00179	WL	Borehole	1974/01/29	2016/02/19	427	Beaufort	
3222BC00137	WL	Borehole	1963/05/12	2016/02/18	519	Beaufort	
3222BC00151	WL	Borehole	1974/01/29	2016/02/18	442	Beaufort	
3222BC00170	WL	Borehole	1974/01/29	2016/02/18	427	Beaufort	
029879B	WL	Borehole	1984/06/22	2016/02/18	334	Quaternary	82
029879BR	WL	Borehole	1986/05/21	2016/02/18	316	Karoo Dolerite	
3222BC00180	WL	Borehole	2007/08/26	2016/02/18	89	Beaufort	
3222BC00181	WL	Borehole	1979/01/08	2016/02/08	9332	Beaufort	
029879BS	WL	Borehole	1986/05/21	2016/01/27	2774	Quaternary	
3221DD00048	WL	Borehole	1985/10/01	2016/01/26	2653	Beaufort	
GZ00020	WL	Borehole	1985/09/17	2016/01/26	34	Quaternary	
3221DD00188	WL	Borehole	1985/09/18	2016/01/26	31	Beaufort	
3222CA00140	WL	Borehole	1985/10/19	2016/01/26	31	Beaufort	
3222CA00121	WL	Borehole	1985/10/18	2016/01/26	29	Quaternary	
3221DD00032	WL	Borehole	1985/10/01	2015/12/02	42	Quaternary	
3221DD00116	WL	Borehole	1985/10/28	2015/11/29	3041	Quaternary	

3221DD00150	WL	Borehole	1987/07/01	2015/07/30	2664	Quaternary	
3221DB00068	WL	Borehole	1985/09/23	2015/07/30	2617	Quaternary	
3222BC00176	WL	Borehole	1974/01/29	2015/07/29	2989	Beaufort	
029898TA	WL	Borehole	2004/11/15	2015/05/06	2576	Beaufort	
029885B	WL	Borehole	1975/04/15	2015/04/23	3409	Quaternary	75
029879BN	WL	Borehole	1977/01/10	2015/01/14	2871	Quaternary	73
029935A	WL	Borehole	2008/08/05	2014/04/17	1296	Beaufort	
029937B	WL	Borehole	1977/02/02	2013/07/12	265	Beaufort	79
3221DD00115	WL	Borehole	1985/10/28	2012/02/16	20	Beaufort	
3221DD00065	WL	Borehole	1985/10/01	2012/02/16	20	Beaufort	
3221DD00095	WL	Borehole	1985/11/13	2012/02/16	19	Quaternary	
3222CA00093	WL	Borehole	2001/06/26	2012/02/09	28	Beaufort	
3221DB00042	WL	Borehole	1985/10/01	2012/02/09	23	Quaternary	
3221DD00087	WL	Borehole	1985/11/13	2010/08/10	16	Beaufort	
3221DD00017	Qual	Borehole	1994/05/26	2015/04/15	35	Quaternary	
3222BC00023	Qual	Spring	1993/12/16	2013/06/06	36	Beaufort	

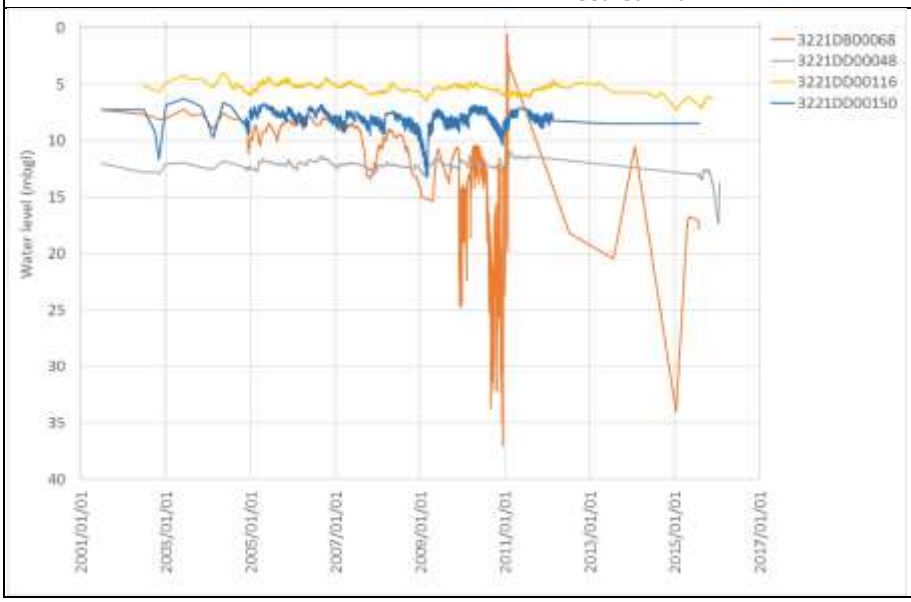
Water Level Graphs

Beaufort West




1960
1980
2000
2020
Average annual water level (mgbl)
0
5
10
15
20
25
30
35
40
029855F
029935A
029946B
3222BC00137
Annual range in water level (m)
0
5
10
15
20
25
30
35
1960
1980
2000
2020
029855F
029935A
029946B
3222BC00137

Leeu Gamka


Water level (mbgl)
0
5
10
15
20
25
30
35
40
2001/01/01
2003/01/01
2005/01/01
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2017/01/01
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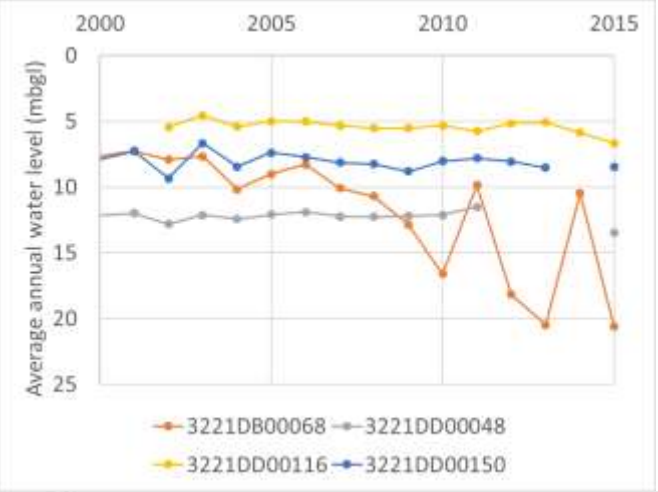
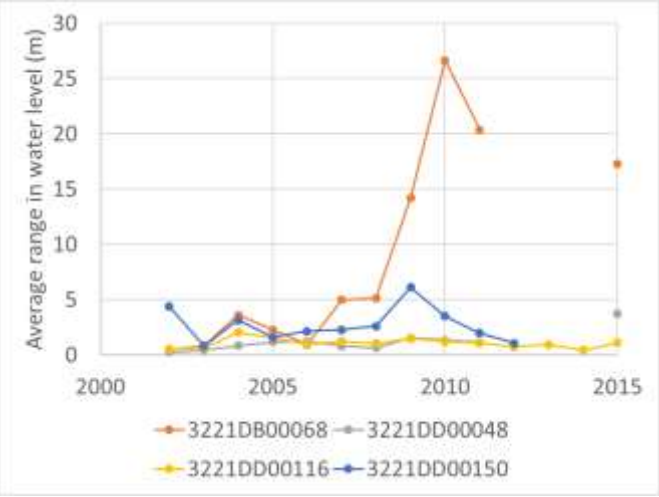
3221DD00048
3221DD00116
3221DD00150

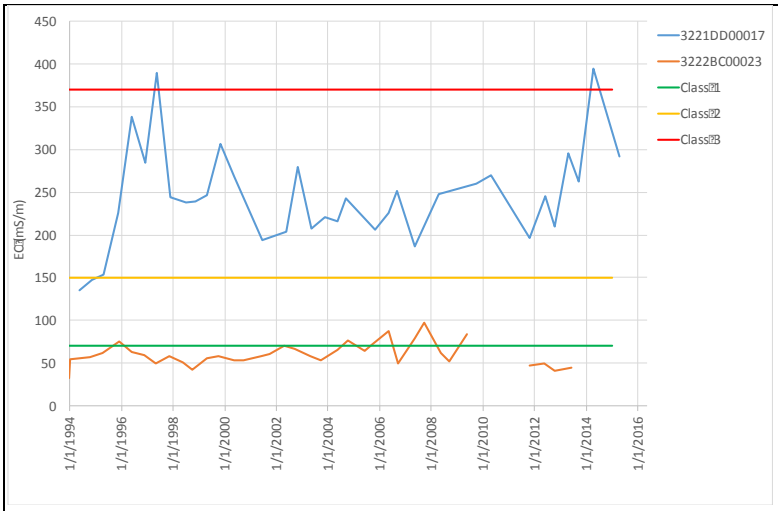


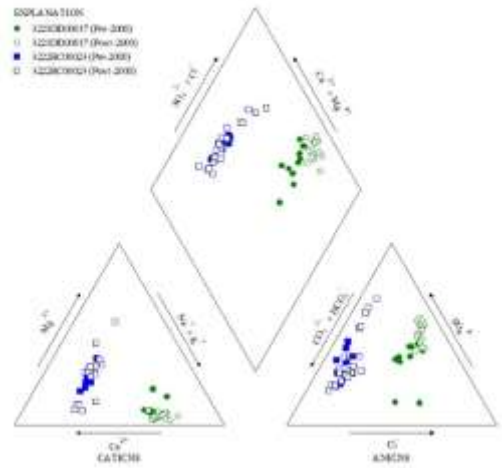


Response to Bulk Abstraction

There is a significant dataset available within consultant reports for Beaufort West (compiled for the municipality, and for the South African Petroleum Industry Association), and also for Leeu Gamka. This data will be reviewed should this GRU be prioritised for further investigation.

Water quality graphs





Comments

Registered groundwater use in GGa-2a, 2b and 2c is focussed around two clusters at the towns of Beaufort West and Leeu Gamka. There has been extensive long term groundwater level monitoring in both clusters.

Long term groundwater level records for the Beaufort West cluster extend as far back as 1963. Four representative locations were selected, two marked with alluvium as the surface geology (029946B and 029855F), and two located on Beaufort Group sediments (3222BC00137 and 029935A). 029946B and 3222BC00137 are located close to a registered water use. These two boreholes show wider variations in water levels than the two locations situated away from water use. There are distinct periods of water levels which are much lower than average, namely 1984, 1993 and 2010, and these are expected to correlate with dry periods, when recharge was lower and water use possibly more intensive. The range in water levels during these dry periods appears to be becoming larger and longer. The effect is less noticeable at boreholes away from registered water use. Long term groundwater levels appear to be declining, but by less than 5 m over 50 years. This may be related to the aquifer transitioning to a new equilibrium in response to abstraction, and is not necessarily a cause for concern (section **Error! Reference source not found.**). Additional investigation would be required to determine the cause.

The water level record for Leeu Gamka is less extensive than for Beaufort West, beginning only in 2001. However, similar trends are noted, with large drops in water levels at some locations (e.g. 3221DB00068 for which there is no nearby registered water use). The other selected boreholes are less affected, but also show seasonal variations, although the range in annual water level is generally less than 5 m. A long term water level decrease is evident at 3221DB00068. This may be related to the aquifer transitioning to a new equilibrium in response to abstraction, and is not necessarily a cause for concern (section **Error! Reference source not found.**). Additional investigation would be required to determine the cause.

Despite the extensive water level record, there are long term water chemistry records for just two locations. 3222BC00023 is a spring in the Beaufort West cluster which is located close to a registered water use. The spring has an EC between 20 and 100 mS/m. The water chemistry fluctuates between Mg- HCO_3 and Ca- SO_4 dominated. As this is not a trend, it is presumed this is a seasonal fluctuation. The EC of water in borehole 3221DD00017 is much higher, ranging from 150 to 400 mS/m and showing great variability. The groundwater has unusually high fluoride concentrations, ranging from 1.3 – 3 mg/L. The water

chemistry is quite different to that at Beaufort West, with relatively higher levels of Na and Cl. The water quality also shows a change with time of higher relative sulphate concentrations since 2000.

Status Quo assessment for GGa-3

GRU name, main town	GGa-3, Calitzdorp.
GRU Boundary description	The northern boundary follows the contact between the Witteberg Group and overlying Karoo Supergroup. The unit forms the western flank of the Klein Karoo Basin. The valley floor surrounding Calitzdorp consists of Tertiary to Quaternary sand deposits of the Uitenhage Group. The Rooiberg Mountain Range was formed by a large anticlinal fault, while the Klein Swartberg and Groot Swartberg mountain range are characterised by folds and overturned beds. These mountain ranges consist predominantly of the Peninsula Formation and Nardouw sub-group. The unit is bounded by the Olifants sub-catchment to the east.
Catchments	J24F; J25A to J25E
IUAs covered	Most of the GRU falls within the Gouritz-Olifants IUA, with a small portion in the north falling within the Gamka-Buffels IUA
Domestic Groundwater use	Calitzdorp and Zoar use 100% surface water supply. The Klein Karoo RWSS relies a 100% on groundwater, which totals 1.27 Mm3/a, and supplies Dysselsdorp, Vlakteplaas, Lategansvlei, Volmoed, Kliplokasie, and De Hoop (within GO-4). Several wellfields situated between the Kammanassie Mountains (GO-4) and Calitzdorp (GGa-3) supply the scheme.

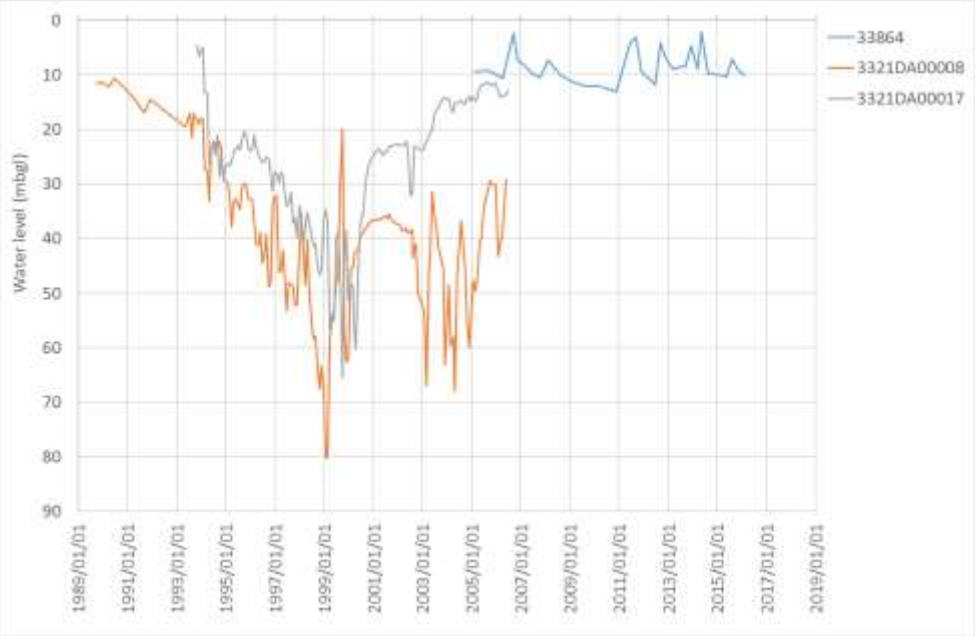
Water use clusters for trend analysis

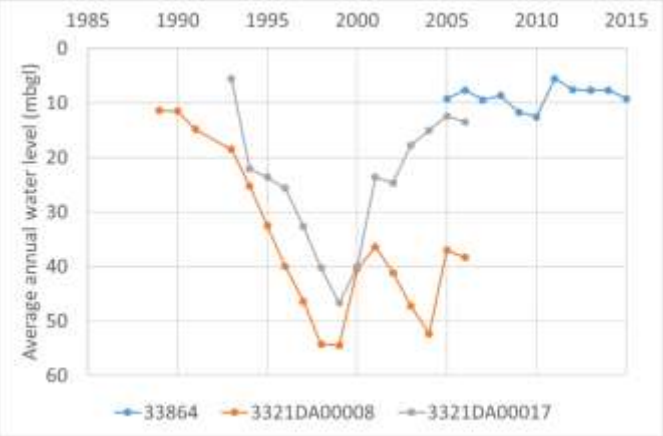
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Middlepos	TMG, Bokkeveld	3	0.1	Agriculture – irrigation	None	None
Calitzdorp	TMG, Cango, Quaternary, Bokkeveld	11	0.2	Agriculture – irrigation Water supply	3321DA00017 (production well) 3321DA00008 033864 (away from water use)	3321DA00017 (production well) 177395

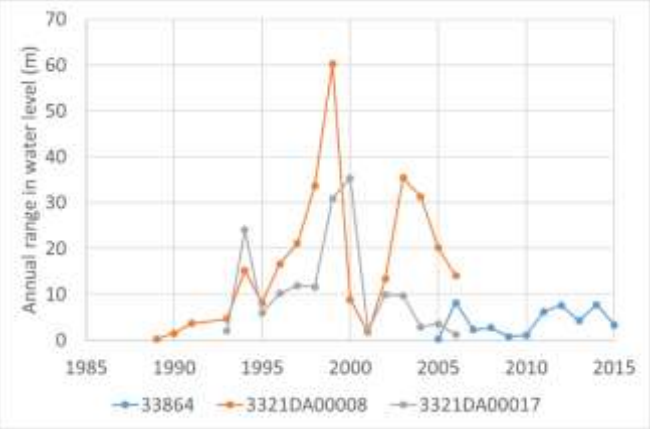
Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of datapoints (>5 only)	Surface geology	Depth
033864	WL	Borehole	2005/02/20	2016/02/17	36	TMG	
3321DA00010	WL	Borehole	1993/10/30	2007/06/11	125	TMG	209
3321DA00018	WL	Borehole	1993/10/30	2007/03/08	116	Bokkeveld	137
3321DA00017	WL	Borehole	1993/10/30	2006/06/30	146	Bokkeveld	187
3321DA00009	WL	Borehole	1993/10/30	2006/06/30	137	Bokkeveld	249
3321DA00008	WL	Borehole	1989/09/25	2006/05/31	167	Bokkeveld	165
3321DA00006	WL	Borehole	1989/08/15	2005/12/29	183	TMG	250
3321DA00004	WL	Borehole	1989/08/15	2005/12/29	183	Quaternary	
3321DA00074	WL	Borehole	1994/07/31	2004/09/29	113	Uitenhage	85
3321DA00007	WL	Borehole	1987/11/18	1997/04/03	126	TMG	180
3321AD00002	WL	Borehole	1972/02/04	1982/09/30	114	Quaternary	
3321AD00003	WL	Borehole	1972/02/11	1981/04/07	1468	Bokkeveld	
177395	Qual	Borehole	1999/04/08	2008/04/27	6	Bokkeveld	
3321DA00017	Qual	Borehole	1996/01/31	2004/11/25	6	Bokkeveld	187

Water Level Graphs



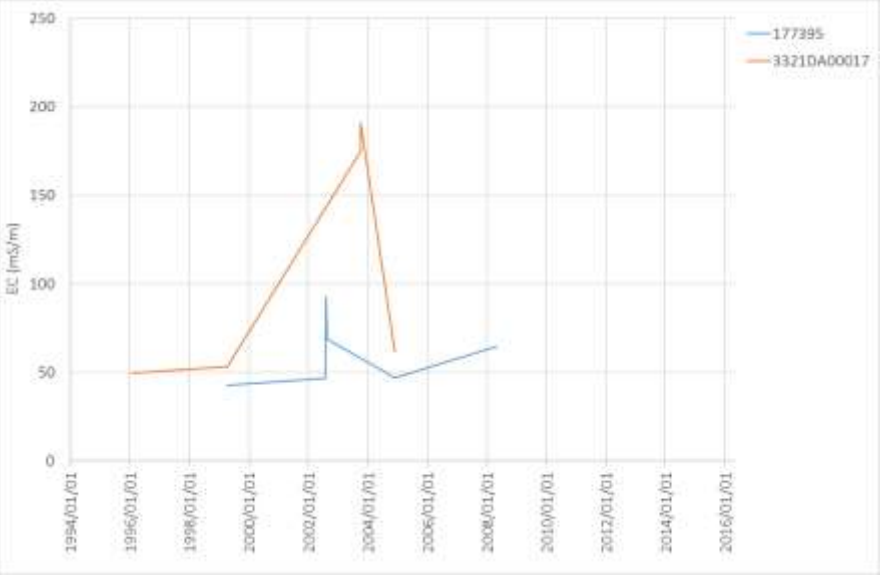




Response to Bulk Abstraction

Wellfields supplying the Klein Karoo Rural Water Supply Scheme are situated in this GRU, and part within GRU GO-4. Some data for the KKRWSS is presented here, and significantly more data is available in consulting reports conducted for the municipality. This data will be reviewed should this GRU be prioritised for further investigation.

Water quality graphs



Comments

Registered water use in GRU GGa-3 is sparse, with a few locations along the Gamka River near Calitzdorp and a few locations east of Ladismith.

Long term water level monitoring has been conducted at the western wellfield of the KKRWSS and two representative locations within the KKRWSS are assessed, namely 3321DA00017 and 3321DA00008. A third water level monitoring borehole (33864), located on faulted TMG to the east of Ladismith, is also selected. Water levels within the KKRWSS showed a steady decline from 1989 to 1999, following which there has been a stabilisation and recovery in water levels. Unfortunately the data in the database continues to 2007 only, and the current water level status is not known from this dataset. Water levels at 33864, assumed to be away from any water use, show seasonal variation of less than 10 m but no long term trends in groundwater level.

There is only limited water chemistry data in the database, which shows variable EC levels of between 50 and 200 mS/m, with higher ECs measured at 3321DA00017 than at 177395. Both boreholes are located within the western KKRWSS wellfield.

Status Quo assessment for GGa-4

GRU name, main town	Gouritz Gamka sub-catchment Unit 4, GGa-4. Prince Albert.
GRU Boundary description	The unit comprise of the central parts of the Swartberg Mountain range and is bounded to the south by the Peninsula Formation outcrop and the remaining rocks of the TMG (closely associated with the catchment boundary). The lower lying area of rolling hills is towards the north of the TMG outcrop is dominated by Witteberg Group, with minor Bokkeveld Group. The northern parts of the unit comprise of the Dwyka and Ecca Groups of the Karoo Supergroup. The Peninsula Formation outcropping within unit GO-4 will recharge deep Peninsula groundwater within this GRU.
Catchments	J23C TO J23J
IUAs covered	The north of the GRU falls within the Gamka-Buffels, and the south lies within the Gouritz-Olifants IUA
Domestic Groundwater use	Prince Albert receives 33% of its supply from groundwater at 0.229 million m3/a

Water use clusters for trend analysis

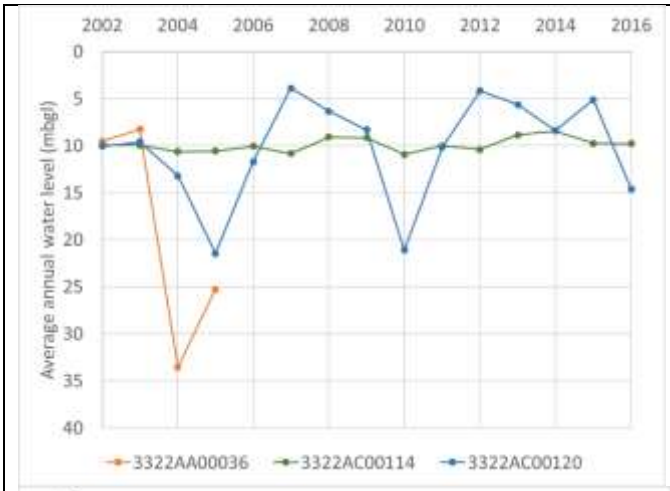
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Prince Albert	Witteberg, Dwyka, Ecca, Beaufort, alluvium	21	0.8	Water supply	3322AA00036 (Witteberg, at water supply) 3322AC00114 (Bokkeveld, away from water supply)	3321BB00023 (Beaufort/Ecca, away from water use)

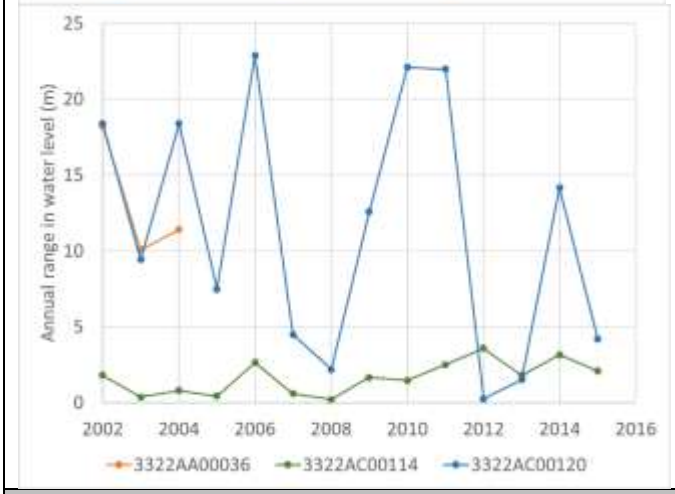
					3322AC00120 (Bokkeveld, away from water supply)	

Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3322AC00114	WL	Borehole	1978/08/10	2016/02/18	52	Bokkeveld	61
3322AC00120	WL	Borehole	1978/08/25	2016/02/18	51	Bokkeveld	49
3322AC00113	WL	Borehole	1978/08/10	2016/02/18	31	Quaternary	60
3322AC00118	WL	Borehole	1978/08/10	2016/02/18	29	Bokkeveld	60
3322AA00036	WL	Borehole	2002/05/07	2005/03/02	12	Witteberg	72
3322AC00119	WL	Borehole	1978/08/25	2004/12/08	8	Bokkeveld	49
3321BB00023	Qual	Borehole	1992/06/06	2015/04/15	27	Quaternary	122

Water Level Graphs

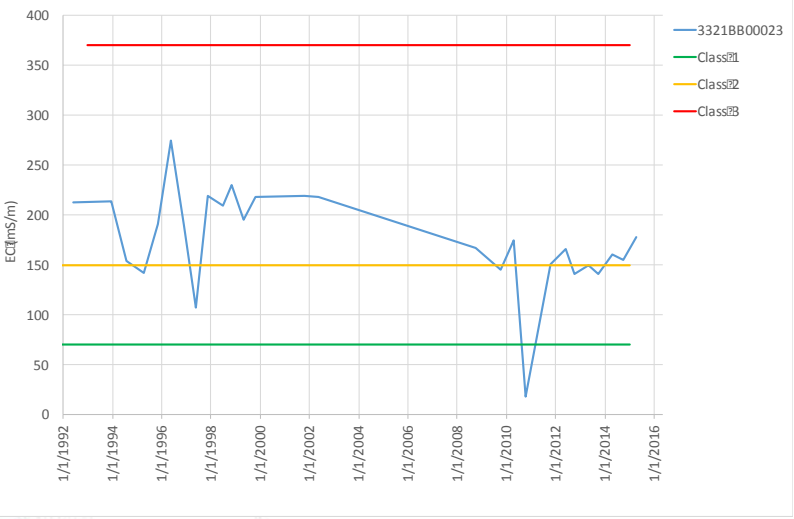


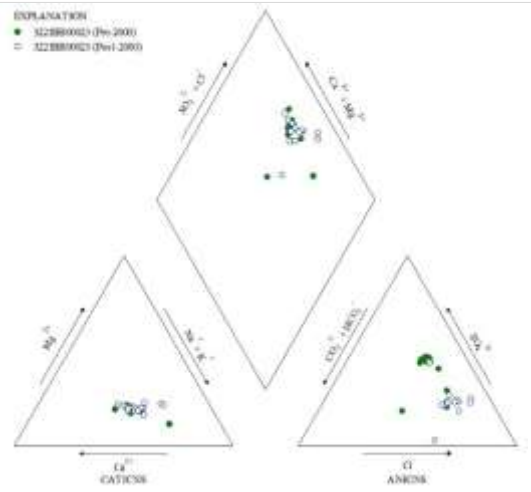


Response to Bulk Abstraction

Some consultant reports supporting municipal abstraction at Prince Albert are known of, which contain additional monitoring data and recommended abstraction rates. This data will be reviewed should this GRU be prioritised for further investigation.

Water quality graphs





Comments

Registed water use in GRU GGa-4 is sparse, occuring more in the south of the GRU. There is a registered water supply in Prince Albert, and most water level monitoring is associated with this water supply.

Long term water level monitoring of two boreholes which appear to be affected by pumping (3322AC00120, 3322AC00036) indicates large seasonal fluctuations (up to 25 m) compared to 3322AC00114, which shows much smaller seasonal fluctuations (<5 m), potentiall associated with seasonal pumping. Long term average annual water levels for 3322AC00014 do not show a declining or increasing trend. There is too much variability in 3322AC00120 and 3322AA00036 to determine whether there is any trend long term trend in water levels.

The only long term groundwater quality monitoring data for the GRU is from 3321BB00023, which is located north of Prince Albert and away from registered water use. The water quality appears to improve with time, from an EC of generally 150 – 250 mS/m in the 1990s to an EC closer to 150 mS/m since 2010. The ion composition also appears to have changed, with more chloride and less sulphate in groundwater in samples collected since 2010.

Status Quo assessment for GGa-5

GRU name, main town	Gouritz Gamka sub-catchment Unit, GGa-5. (East of Van Wyksdorp).
GRU Boundary description	The northern boundary coincides with the Rooiberg Mountain Range, while the east and west is associated with J13C and J35C catchment boundaries. The unit is dominated with TMG outcrop in the east and the Bokkeveld Group in the west. The Outeniqua Mountain Range bounds the unit to the south. Deep groundwater flow of the TMG will be linked to the Peninsula Formation outcrop within unit GC-1 and GGo-1.
Catchments	J40A; J40B
IUAs covered	The GRU falls within the Gouritz-Olifants IUA
Domestic Groundwater use	There are no settlements with municipal water supply in the GRU

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
East of Van Wyks Dorp	TMG, Bokkeveld, Grahamstown	7	0.2	Agriculture – irrigation	None	None

Available monitoring locations for trend analysis (recent data highlighted yellow)

None

Water Level Graphs

No water level data available

Response to Bulk Abstraction

There is no bulk /point abstraction in the GRU.

Water quality graphs

No recent water quality data.

Comments

This GRU is very small and predominantly underlain by TMG. There is little registered water use, and no long term water level or water quality monitoring data.

Status Quo assessment for GGo-1

GRU name, main town	Gouritz sub-catchment Unit 1, GGo-1. Mossel Bay, Albertinia
GRU Boundary description	The northern boundary deviates from the quaternary catchment boundary and follows the contact between the TMG and the overlying Bokkeveld Group. It is bounded in the south by the Atlantic Ocean with Vlees Bay in the west and Hartenbos in the east. The eastern boundary is deviates from the catchment boundary in the north and follows the contact zone of the Cape Granite Suite north of Brak River. Mesozoic Uitenhage Group deposits occur in the north east and overlie the TMG. The TMG outcrops west of Mossel Bay and together with the Bokkeveld Group underlie the Bredasdorp Cenozoic cover to the southwest.
Catchments	J40C to J40E; K10A; K10B
IUAs covered	The west of the GRU falls within the Lower Gouritz, and the east within the Groot Brak IUA.
Domestic Groundwater use	Only the settlement of Albertinia relies solely on groundwater, which contributes 100% of the supply at a yield of 0.50 million m^3/a. Herbertsdale, Klein Brak, Rheebok, Tergniet and Mossel Bay are 100% supplied by surface water.

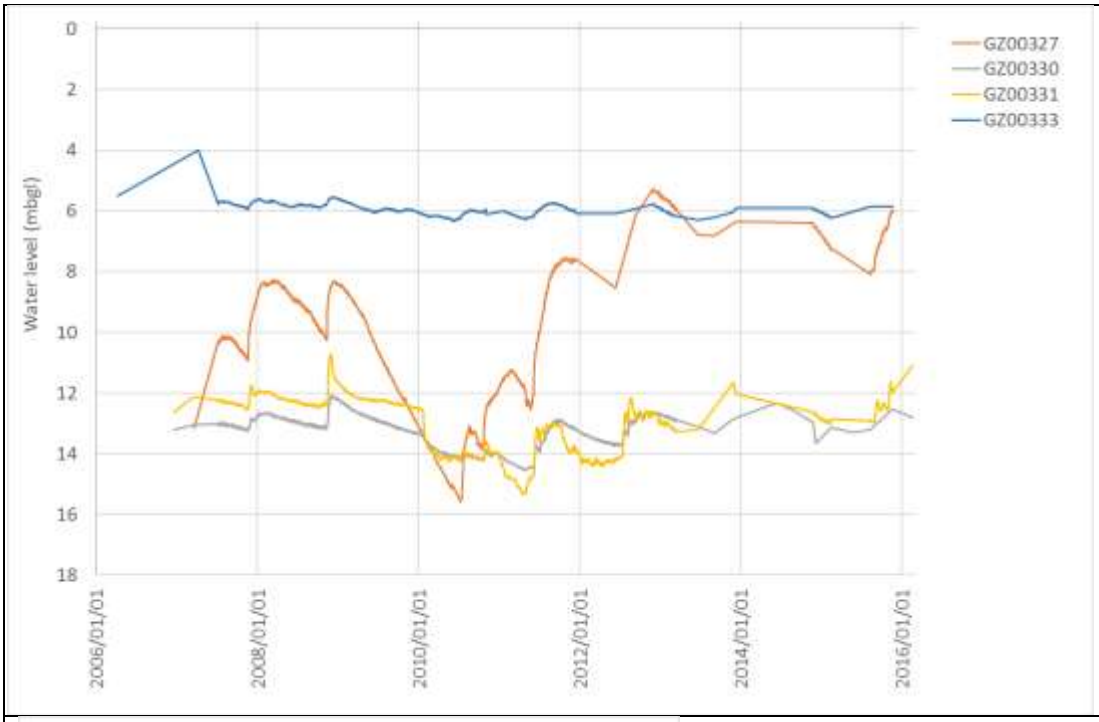
Water use clusters for trend analysis

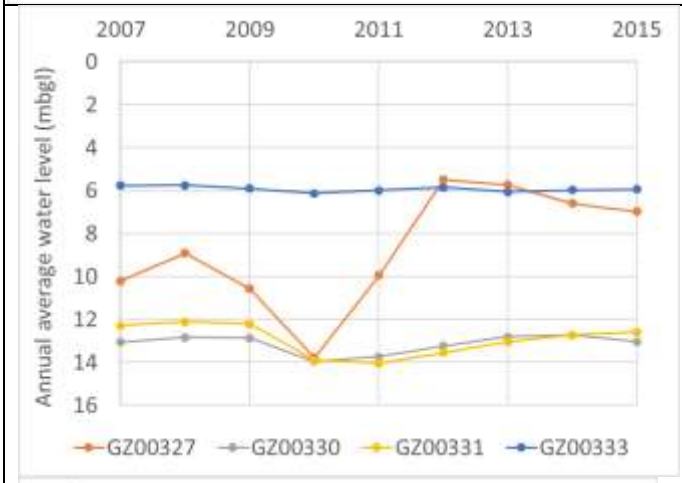
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Herbertsdale	Bokkeveld, Tertiary, Alluvium	11	0.9	Agriculture – irrigation	None	None
Albertinia/ Mossel Bay	TMG, Alluvium	16	1.3	Agriculture – irrigation Water supply Industry (urban)	GZ00333 (Quaternary, close to water use) GZ00330/331 (Tertiary/TMG, away from water use) GZ00327 (TMG, away from water use)	None
Vleesbaai	Bredasdorp, Strandveld, Tertiary, Alluvium	11	0.2	Agriculture – irrigation Industry (urban)	None	None

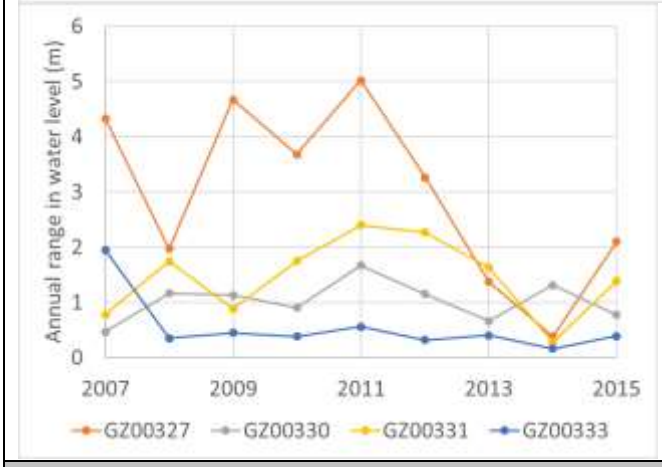
Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
GZ00331	WL	Borehole	2006/12/21	2016/02/22	2268	Tertiary	
GZ00330	WL	Borehole	2006/12/21	2016/02/22	2091	Tertiary	
GZ00328	WL	Borehole	2006/12/21	2016/02/22	1710	Tertiary	
GZ00329	WL	Borehole	2006/12/21	2016/02/22	1269	Tertiary	
GZ00332	WL	Borehole	2006/12/21	2016/02/22	121	Quaternary	
GZ00327	WL	Borehole	2007/03/22	2015/11/24	1916	TMG	
GZ00333	WL	Borehole	2006/04/10	2015/11/24	1839	Quaternary	
GZ00334	WL	Borehole	2007/07/09	2015/11/24	118	Quaternary	
040116	WL	Borehole	2002/05/13	2010/05/31	30	Quaternary	
040119	WL	Borehole	2002/05/13	2010/03/15	27	Quaternary	
040118	WL	Borehole	2002/05/13	2010/03/15	27	Quaternary	
3421BA00030	WL	Borehole	1981/10/27	1987/05/15	1218	Quaternary	

Water Level Graphs







Response to Bulk Abstraction

The extent of municipal groundwater monitoring for abstraction at Albertinia is not known, and will be investigated should this GRU be prioritised for further investigation. Groundwater monitoring is carried out at the PetroSA facility near Mossel Bay, and this data will be reviewed should this GRU be prioritised for further investigation.

Water quality graphs

No water quality data available.
Comments
GGo-1 is geologically complex, and registered water use is associated with three distinct geological systems, namely Bokkeveld Group sediments in the north to the west of Herbertsdale, TMG Group rocks in an east-west band stretching from Albertinia to Mossel Bay, and Bredasdorp and Strandveld Group rocks in the remaining areas. Long term water level monitoring is only available for the Albertinia-Mossel Bay cluster. Four boreholes were selected, three located away from registered water use (GZ00327, 330 and 331), and one located away from water use (GZ00333). The data suggest that water use affects GZ00327, possibly GZ00330 and 331, and not GZ00333. GZ00333 shows very small seasonal variations (<1m), a shallower water table (6 mbgl) and no long term trends compared to the other three locations which have larger seasonal variations (1 – 5 m), deeper water tables (6 – 14 mbgl) and long term variability, although no clear long term trends. There are no long term groundwater quality monitoring data.

Status Quo assessment for GGo-2a and 2b

GRU name, main town	Gouritz sub-catchment Unit 2a and 2b, GGo-2a and 2b. Heidelberg, Riversdale and Stilbaai.
GRU Boundary description	The unit comprise largely of the H80 and H90 catchment. It is bounded to the south by the Atlantic Ocean with Still Bay in the southeast. The northern boundary deviates from the quaternary catchment boundary and follows the contact between the Peninsula Formation outcrop and the remaining rocks of the TMG and the overlying Bokkeveld Group. Mesozoic Uitenhage Group deposits also occur in the north of this area. Towards the south, the TMG and mainly the Bokkeveld Group rocks underlie Cenozoic cover. Groundwater discharge will occur to rivers and to the ocean.
Catchments	H80A to H80F; H90A to H90E
IUAs covered	The north of the GRU falls within the Duiwenhoks, and a small portion of the south coastal area falls within the Hassequa IUA.
Domestic Groundwater use	Several of the settlements in this sub-catchment rely solely on groundwater. • Melkhoutfontein: has 100% GW supplied at 0.16 Mm^3/a • Jongensfontein: has 100% GW supplied at 0.16 Mm^3/a • Gouritzmond: has 100% GW supplied at 0.15 Mm^3/a • Stilbaai: has 79% GW supplied at 0.94 Mm^3/a Heildelberg and Riversdale reply 100% on surface water.

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Heidelberg/ Riversdale	TMG, Bokkeveld, Uitenhage, Quaternary	56	2.4	Agriculture – irrigation Agriculture – stock watering	None	None
Stilbaai	Uitenhage, Bokkeveld, Quaternary	62	3.7	Agriculture – irrigation Water supply	None	3421AD00014 (Spring, away from water use)

Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3421AD00014	Qual	Spring	1994/11/23	2015/06/23	35	Bokkeveld	

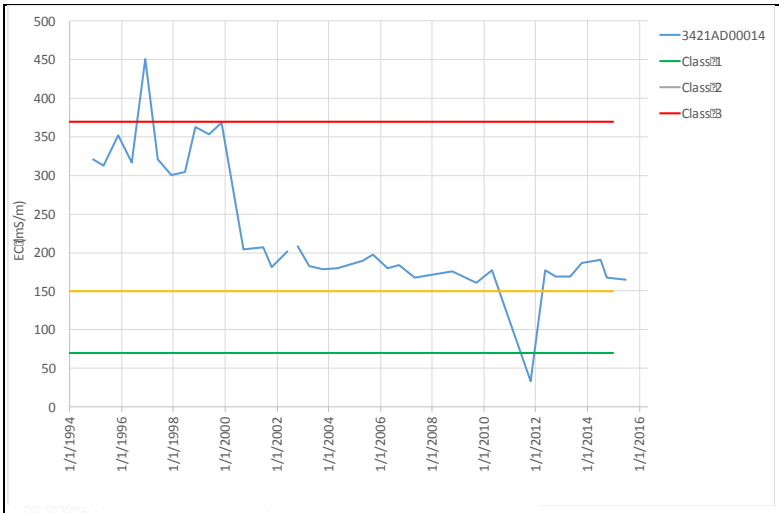
Water Level Graphs

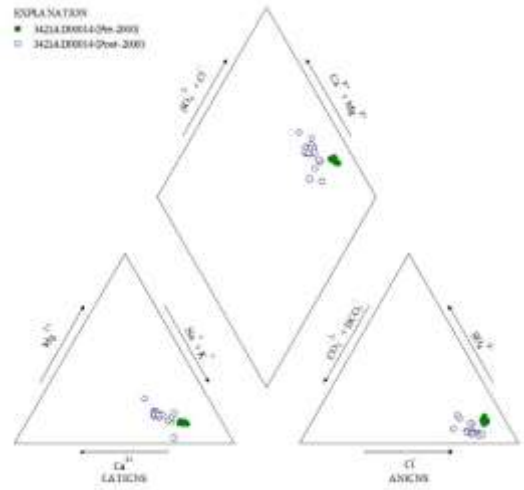
No water level data available.

Response to Bulk Abstraction

Several consultant reports that support municipal abstraction (monitoring reports, borehole siting reports, wellfield management repots etc), are known of for the area (at least for Riversdale, Stilbaai). This data will be reviewed should this GRU be prioritised for further investigation.

Water quality graphs





Comments

Water use in GRU GGo-2a and 2b is clustered in two areas, around Heidelberg/Riversdale in a variety of geologies, and along the Goukou River close to Stilbaai.

Despite the relatively high registered groundwater use in the GRU, there is no long term groundwater monitoring data. Long term monitoring data does exist for a spring originating from Bokkeveld Group rocks near Stilbaai. This data shows a step-change in EC from 300 – 400 mS/m to 150 -200 mS/m between 1999 and 2000. This step-change is associated with a change in ion composition, with an increase in relative bicarbonate and Ca/Mg compared to pre-2000. The reason for this change is not known.

Status Quo assessment for GO-1

GRU name, main town	Gouritz Olifants sub-catchment Unit 1, GO-1. Klaarstroom.
GRU Boundary description	The unit comprise of the Upper Olifants catchment and is bounded to the north and east by the Gouritz WMA catchment boundary. To the south the Peninsula Formation outcrop and the remaining rocks of the TMG forms the unit boundary (closely associated with the catchment boundary). The lower lying area of rolling hills is towards the north of the TMG outcrop is dominated by the Bokkeveld and Witteberg Group, with the overlying Dwyka and Ecca Groups of the Karoo Supergroup further to the north. Deep groundwater flow of the TMG will be connected to / recharged from unit GO-2.
Catchments	J32A to J32E
IUAs covered	The north of the GRU falls within the Gamka-Buffels, and the south within the Gouritz-Olifants.
Domestic Groundwater use	Klaarstroom is the only settlement in this GRU and relies solely on groundwater, which contributes 100% of the supply totalling 0.03 Mm^3/a.

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Klaarstroom	TMG, Bokkeveld, Witteberg, Dwyka, Ecca, Beaufort	25	0.9	Agriculture – irrigation	None	None

Available monitoring locations for trend analysis

None

Water Level Graphs

No water level data available.

Response to Bulk Abstraction

The extent of municipal groundwater monitoring for abstraction at Klaarstroom is not known. This will be investigated should this GRU be prioritised for further investigation.

Water quality graphs

No recent water quality data.

Comments

There is little registered groundwater use within this GRU. Most registered groundwater use locations are within the Ecca Group rocks across the centre of the GRU.
There is no long term water quality or water level data.

Status Quo assessment for GO-2

GRU name, main town	Gouritz Olifants sub-catchment Unit 2, GO-2. Rooirivier.
GRU Boundary description	The unit represents largely the middle Olifants catchment and bounded in the south and north along the contact zone of the Peninsula Formation. The unit is limited to the east and west by catchment boundaries. Towards the southeast the boundary deviates from the catchment boundary follows the northern contact zone of the Peninsula Formation (coinciding with the Kammanassie Mountain Range). Buried TMG may discharge deep groundwater towards the Olifants River Basin. Deep groundwater flow of the TMG will be recharged by the Peninsula Formation outcrops within unit GO-3.
Catchments	J31A to J31D; J33A; J33B
IUAs covered	The GRU falls within the Gouritz-Olifants.
Domestic Groundwater use	There are no settlements with municipal water supply in the GRU

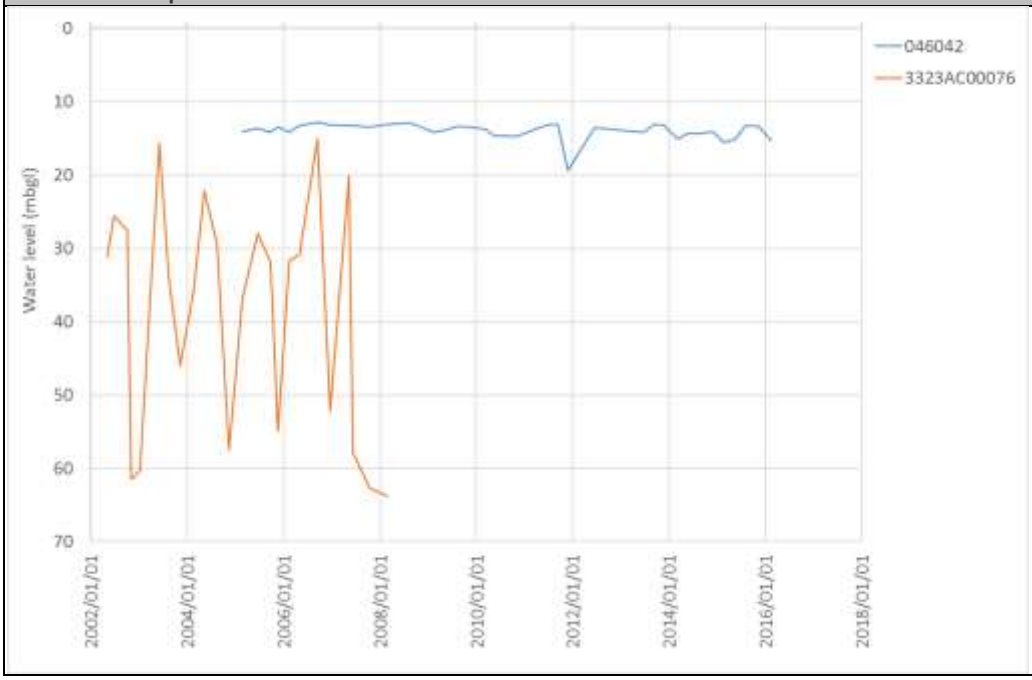
Water use clusters for trend analysis

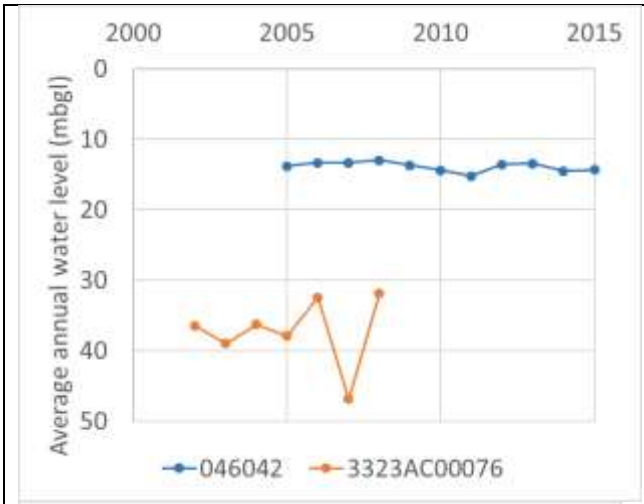
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Rooirivier	Cango, TMG, Bokkeveld, Grahamstown, alluvium	73	2.6	Agriculture – irrigation	046042 (close to water use) 3323AC00074 (TMG, close to water use and quality monitoring)	3323AD00034 (Uitenhage into TMG?, away from water use) 3323AC00074 (TMG, close to water use) 101210 (spring, close to water use)

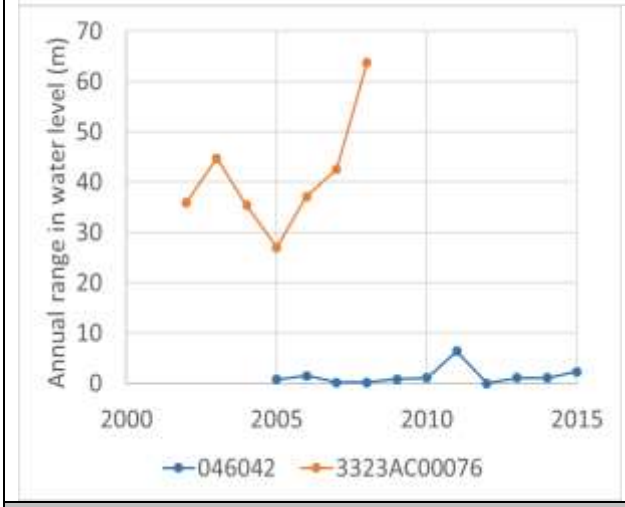
Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
046042	WL	Borehole	2005/02/24	2016/02/15	36	TMG	
3323AC00076	WL	Borehole	2002/05/05	2009/02/17	26	TMG	
3322DA00107	WL	Borehole	1961/05/29	1962/12/11	26	Bokkeveld	
3323AC00074	Qual	Spring	2002/05/05	2009/03/26	14	TMG	
3323AD00034	Qual	Borehole	1994/10/19	2014/09/09	56	Uitenhage	91
101210	Qual	Spring/Eye	1993/10/10	2015/06/15	19	TMG	

Water Level Graphs



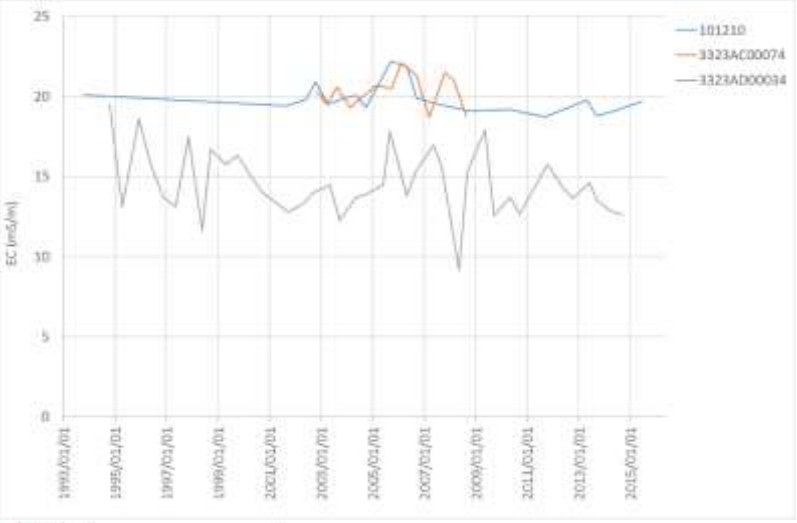


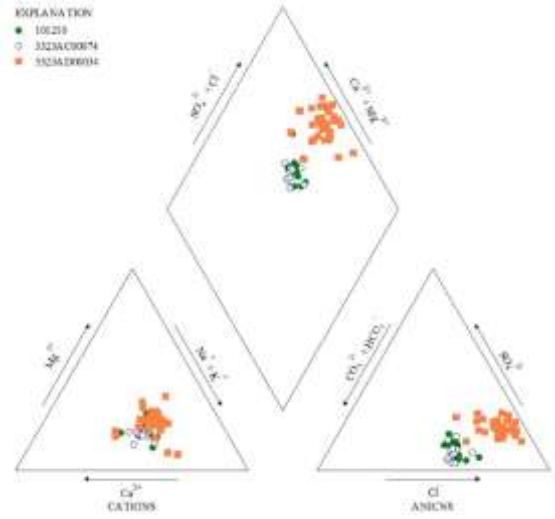


Response to Bulk Abstraction

There is no bulk /point abstraction in the GRU.

Water quality graphs





EC data lies well below the DWAF 1996 drinking water quality guideline Class 1 (70 mS/m).

Comments

Registered groundwater use is largely within the Olifants River valley in Bokkeveld Group sediments, however there are a few locations along a large fault in the north of the GRU.

There are two locations with long term water level data, 046042 and 3323AC00076, both located within the TMG and both located close to registered water use. 3323AC00076 shows a large seasonal variation of up to 65 m and a deeper average water annual level (30 – 50 mbgl) likely related to seasonal pumping, whereas there is a very low amplitude seasonal variation at 046042 (generally <2 m) and the average annual water level is around 14 mbgl. 046042 is located on the TMG-Bokkeveld contact, and 3323AC00076 is located close to a large fault on the TMG-Uitenhage contact. No long term water level trends are visible.

Long term water quality data is available for three locations, 3323AD00034, 3323AC00074 and 101210, all located near 3323AC00076 along the TMG-Uitenhage contact. The water quality of spring 101210 and borehole 3323AD00034 is very similar, and the EC shows a slight decrease with time from approximately 20 mS/m in 1993 to 18-19 mS/m currently. The EC at 3323AD00034, which is close to water use, is lower (10 – 18 mS/m) but more variable. The water at 3323AD00034 also has relatively higher levels of chloride and sulphate than the other two monitoring locations.

Status Quo assessment for GO-3

GRU name, main town	Gouritz-Olifants sub-catchment Unit 3, GO-3. Uniondale.
GRU Boundary description	The unit is dominated by the TMG and Bokkeveld Group and lies west of the Gouritz WMA catchment boundary. Towards the south the unit is limited to the northern contact zone of the Peninsula Formation. The unit is limited to the east and west by catchment boundaries. Deep groundwater flow of the TMG will be linked between unit GC-2, GO-3 and GO-2.
Catchments	J34A to J34C; K60A
IUAs covered	Most of the GRU falls within the Gouritz-Olifants IUA, with a portion of the south of the GRU falling within the Coastal IUA.
Domestic Groundwater use	There are no settlements within the GRU using groundwater for domestic supply (Uniondale is 100% supplied by surface water).

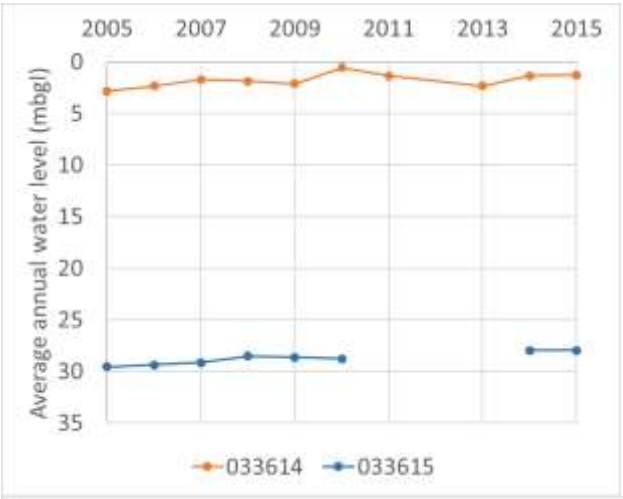
Water use clusters for trend analysis

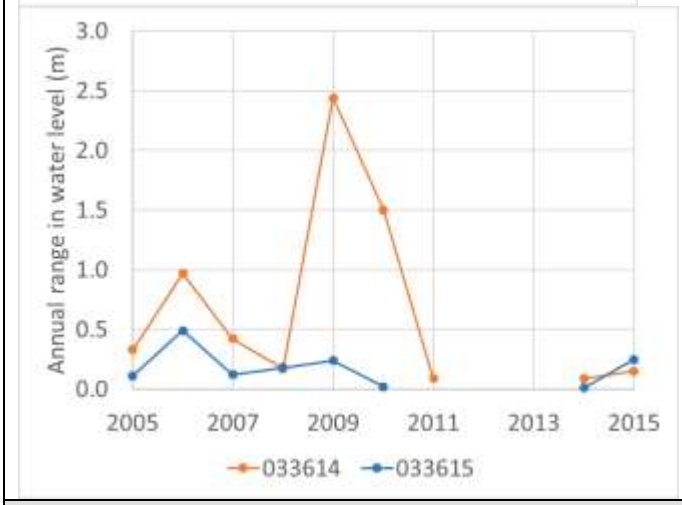
Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Uniondale	TMG, Bokkeveld	36	1.9	Agriculture – irrigation	033614, 033615 (TMG, away from water use)	172705 (close to 033614, away from water use)

Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
033614	WL	Borehole	2005/02/24	2016/02/17	33	TMG	
033615	WL	Borehole	2005/02/24	2016/02/15	28	TMG	
172705	Qual	Borehole	1994/07/04	2008/08/22	14	TMG	

Water Level Graphs

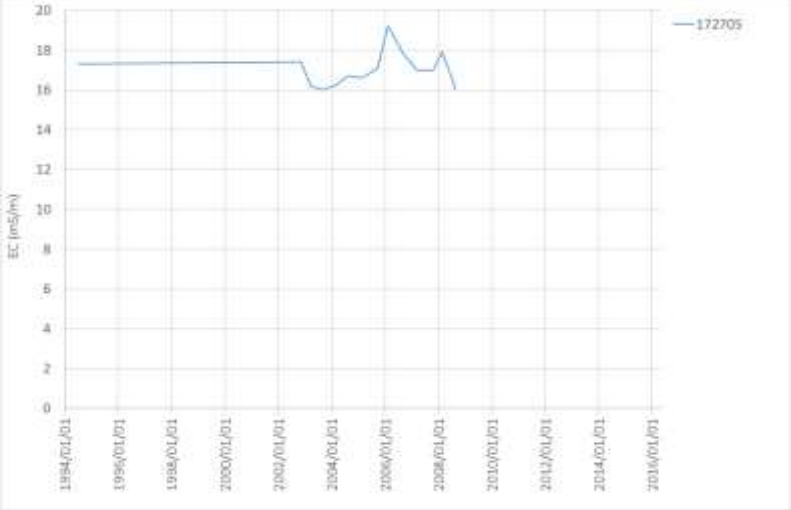




Response to Bulk Abstraction

There is no bulk /point abstraction in the GRU.

Water quality graphs



EC data lies well below the DWAF 1996 drinking water quality guideline Class 1 (70 mS/m).

Comments

There is sporadic registered groundwater use, most within the TMG rocks in the southern part of the GRU, but a few locations in the Kammanassie River valley, underlain by Bokkeveld Group sediments.

There are two locations with long term water level data, 033614 and 033615, both located within the TMG near to Uniondale. Both are located away from registered water use. Water levels at the two locations are quite different, with water levels at 033614 less than 5 mbgl, while at 033615 water levels are close to 30 mbgl. There are no notable seasonal fluctuations, and long term trends suggest an slight increase in water levels since 2005.

Long term water quality data is available for 172705, which is located close to 033614. The EC at this borehole was consistently between 16 and 20 mS/m from 1994 until 2008. There is no recent data and the current status quo is not known.

Status Quo assessment for GO-4

GRU name, main town	Gouritz Olifants sub-catchment Unit 4, GO-4. Oudtshoorn.
GRU Boundary description	The unit is characterized as the Central and Eastern Karoo Basin with deposits of the Uitenhage Group overlying rocks of the Cape Supergroup. Smaller groundwater resource units may be appropriate here, but it will be difficult to subdivide the Olifants River Basin without compromising the surface water balance. The contact zone between the Peninsula Formation and remaining TMG Formations closely associated with the catchment boundary and the Outeniqua Mountain Range bounds the unit to the south. The catchment divide associated with the Rooiberg Mountain Range limits the unit in the southwest. The northern boundary deviates from the catchment boundary and follows similarly the contact zone between the Peninsula Formation and remaining TMG Formations. The remaining boundaries coincide with catchment boundaries. Deep groundwater flow of the Peninsula Formation within the GRU will be recharged by / linked to the Peninsula Formation within unit GC-1.
Catchments	J35A to J35E; J34D to J34F; J33E;J33F; J34D; J34E
IUAs covered	The GRU falls almost entirely within the Gouritz-Olifants IUA, with a very small portion of the south of the GRU falling within the Coastal IUA
Domestic Groundwater use	The Klein Karoo RWSS relies a 100% on groundwater, which totals 1.27 Mm^3/a, and supplies Dysselsdorp, Vlakteplaas, Lategansvlei, Volmoed, Kliplokasie, and De Hoop (within GO-4). Several wellfields situated between the Kammanassie Mountains (GO-4) and Calitzdorp (GGa-3) supply the scheme. De Rust and Oudtshoorn (currently) receive 100% of their domestic supply form surface water. Oudtshoorn Local Municipality has however received a licence to abstract up to 8 million m^3/a of groundwater from up to two wellfields ("C1" or "Blossoms" and "C2" or "Mistkraal"), targeting the confined Peninsula aquifer developed south of the town. However, the infrastructure to connect wellfield to supply has not been developed.

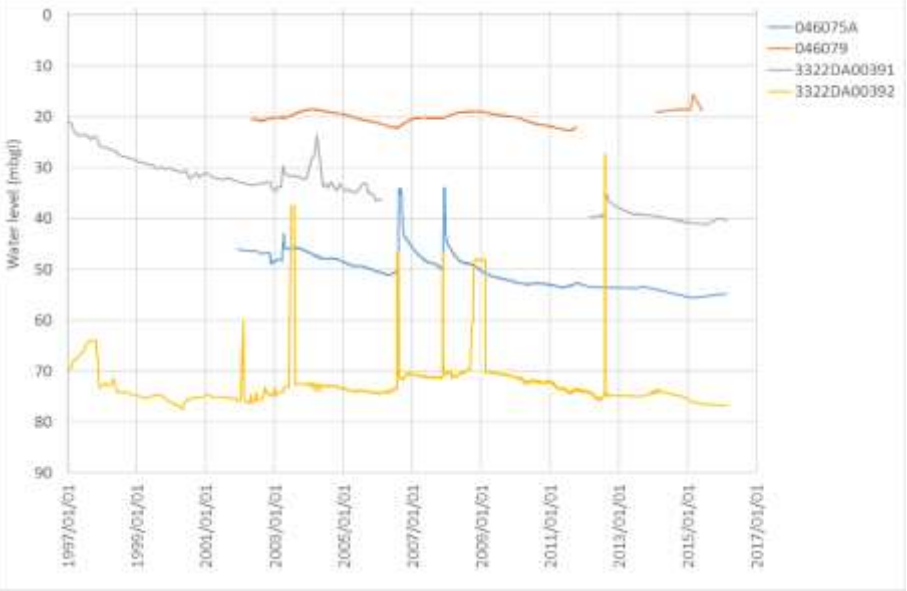
Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Kammanassie	TMG, Bokkeveld	7	0.8	Agriculture – irrigation	3322DA00391; 046075A (within production wellfield); 3322DA00392; 046079 (away from wellfield)	3322DA00109 (close to production wellfield); 3322DA00346 (away from wellfield)
Cango	Cango, TMG	24	1.4	Agriculture – irrigation	3322AD00063, GZ00037 (fault); 033803	3322AC00011 (Quaternary, near water use)
Outeniqua	TMG, Bokkeveld	88	2.4	Agriculture – irrigation	GZ00034 (TMG, upgradient of water use); 3322CD00060 (TMG, close to water use) 3322CD00063 (TMG, close to water use), GZ00336 (TMG, away from water use)	3322CD00053 (close to water use), 20000775
Klein Karoo	Bokkeveld, Uitenhage, Quaternary	62	3.8	Agriculture – irrigation	3322CB00085 (Quaternary, near Dysselsdorp, away from water use); 040156 (Quaternary, away from water use), 046041 (Bokkeveld, away from water use)	3322CB00166

Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
GZ00035	WL	Borehole	2004/11/17	2016/02/25	18	Bokkeveld	204
GZ00034	WL	Borehole	2005/07/18	2016/02/24	2625	TMG	140
GZ00029	WL	Borehole	2006/02/26	2016/02/24	1444	TMG	

3322CD00060	WL	Borehole	2005/04/14	2016/02/24	301	TMG	
3322CD00061	WL	Borehole	2005/04/14	2016/02/24	107	TMG	
GZ00161	WL	Borehole	2005/11/25	2016/02/24	103	TMG	
GZ00032	WL	Borehole	2005/07/14	2016/02/24	29	TMG	
033803	WL	Borehole	2005/02/23	2016/02/17	2006	Quaternary	
033800A	WL	Borehole	1995/12/27	2016/02/17	69	Quaternary	28
033802	WL	Borehole	2005/02/23	2016/02/17	40	Quaternary	
046041	WL	Borehole	2005/02/23	2016/02/17	39	Bokkeveld	
3322AD00063	WL	Borehole	2005/09/23	2016/02/17	38	Cango	
040156	WL	Borehole	2005/02/23	2016/02/17	36	Quaternary	
GZ00037	WL	Borehole	2005/11/29	2016/02/17	36	Cango	144
046075A	WL	Borehole	2001/12/11	2016/02/16	3225	TMG	101
3322DA00391	WL	Borehole	1996/07/31	2016/02/16	581	TMG	
GZ00339A	WL	Borehole	2008/03/02	2016/02/16	284	TMG	
3322BC00016	WL	Borehole	2001/11/01	2016/02/16	54	Cango	145
046043	WL	Borehole	2005/02/23	2016/02/16	40	TMG	
046076	WL	Borehole	2006/01/23	2016/02/16	11	TMG	
3322DA00392	WL	Borehole	1996/12/31	2016/02/15	3490	Quaternary	
3322CB00085	WL	Borehole	2003/03/01	2016/02/15	3360	Quaternary	12
GZ00028	WL	Borehole	2004/12/08	2015/11/26	9	TMG	
GZ00162	WL	Borehole	2006/02/20	2015/11/26	8	Bokkeveld	249
3322CD00063	WL	Borehole	2005/10/18	2015/11/25	180	TMG	
GZ00033	WL	Borehole	2005/07/29	2015/11/25	102	TMG	
3322CD00064	WL	Borehole	2005/04/13	2015/11/25	30	TMG	
GZ00336	WL	Borehole	2009/11/19	2015/11/24	848	TMG	
046080	WL	Borehole	2002/05/02	2015/11/17	3872	TMG	
GZ00164	WL	Borehole	2006/09/13	2015/11/17	1803	Quaternary	210
046078	WL	Borehole	2003/11/20	2015/11/17	109	TMG	
3322DA00145	WL	Borehole	2002/05/01	2015/08/04	94	TMG	
046079	WL	Borehole	2002/05/09	2015/06/10	3508	TMG	
3322CD00062	WL	Borehole	2005/10/18	2015/06/10	9	TMG	
3322DA00009	WL	Borehole	1993/05/30	2015/05/20	236	TMG	225
040173	WL	Borehole	2001/01/24	2015/05/20	24	TMG	
040171	WL	Borehole	2000/04/05	2015/02/24	41	TMG	
GZ00335	WL	Borehole	2008/11/20	2015/02/19	183	TMG	
GZ00031	WL	Borehole	2005/07/14	2014/11/27	10	Bokkeveld	
046081	WL	Borehole	2005/02/22	2012/02/28	25	TMG	
GZ00036	WL	Borehole	2005/05/19	2012/02/22	26	TMG	55
3322DA00329	WL	Borehole	1995/08/01	2011/09/27	14	TMG	
3322DA00346	WL	Borehole	1995/08/02	2011/09/27	13	TMG	
GZ00163	WL	Borehole	2006/09/13	2011/03/11	16	Quaternary	247
033800B	WL	Borehole	1995/12/27	2010/09/07	52	Quaternary	90
3322DA00012	WL	Borehole	1993/10/30	2010/06/02	186	TMG	177
3322CD00053	Qual	Borehole	1996/05/21	2015/06/15	28	TMG	
3322DA00109	Qual	Borehole	1994/01/07	2015/06/15	35	TMG	
3322AC00011	Qual	Borehole	1994/07/20	2011/10/27	17	Quaternary	
3322DA00346	Qual	Borehole	1998/03/31	2008/08/23	14	TMG	
3322DA00329	Qual	Borehole	1996/01/31	2008/08/23	14	TMG	
3322DA00146	Qual	Spring	2002/05/02	2008/02/27	10	TMG	
3322CB00166	Qual	Borehole	1994/08/05	2008/04/09	9	Quaternary	17
3322DA00012	Qual	Borehole	1992/10/13	2008/04/09	12	TMG	177
200000274	Qual	Borehole	2001/12/13	2007/10/22	10	TMG	
Water Level Graphs							
Kammanassie							


Water level (mbgl)
0
10
20
30
40
50
60
70
80
90
1997/01/01
1999/01/01
2001/01/01
2003/01/01
2005/01/01
2007/01/01
2009/01/01
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2013/01/01
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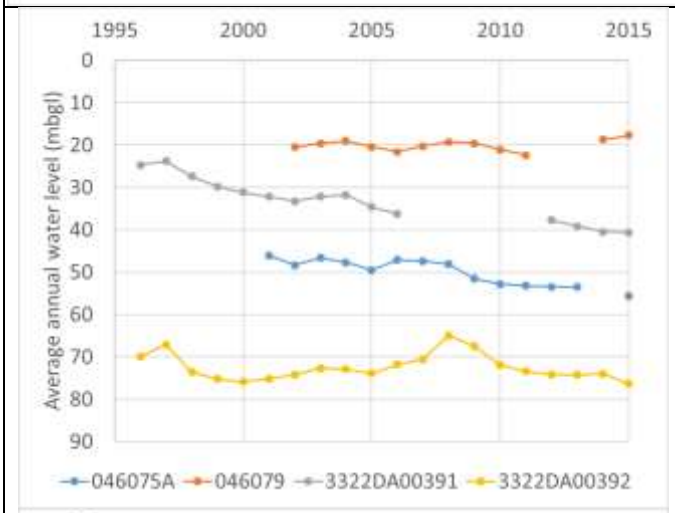
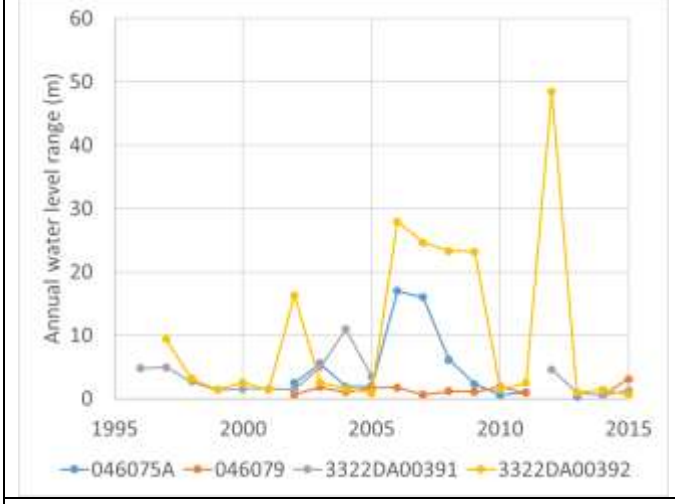
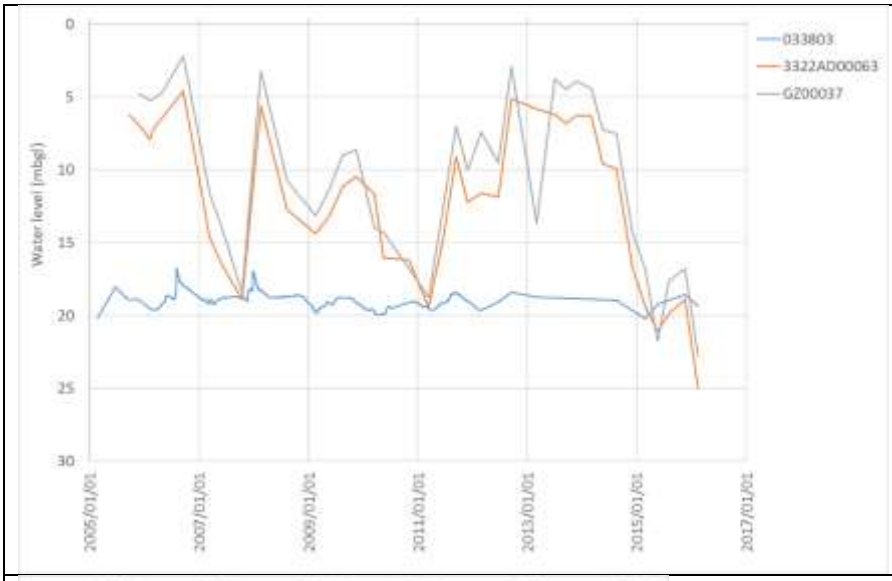
2017/01/01
046075A
046079
3322DA00391
3322DA00392


1995
2000
2005
2010
2015
Average annual water level (mbgl)
0
10
20
30
40
50
60
70
80
90
046075A
046079
3322DA00391
3322DA00392


Annual water level range (m)
60
50
40
30
20
10
0
1995
2000
2005
2010
2015
046075A
046079
3322DA00391
3322DA00392

Cango


Water level (mbgl)
0
5
10
15
20
25
30
2005/01/01
2007/01/01
2009/01/01
2011/01/01
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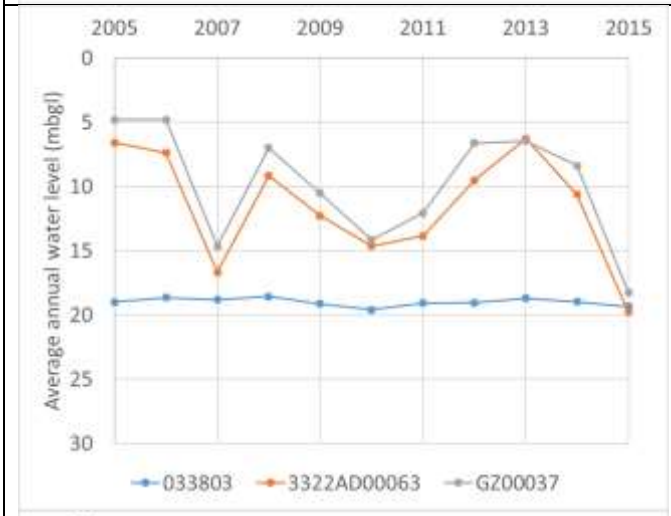
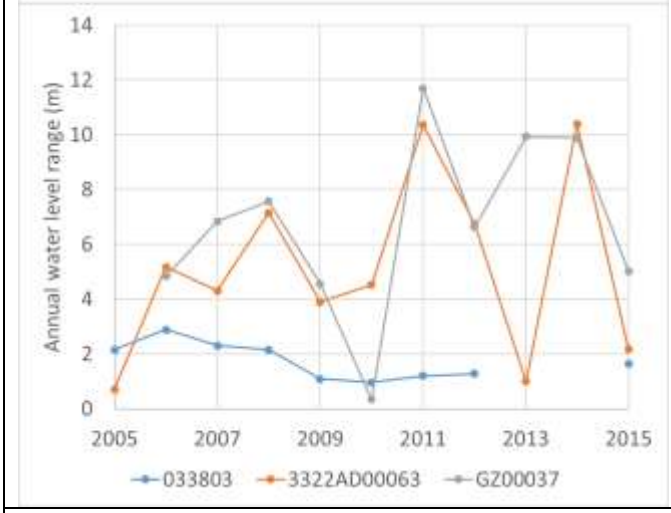
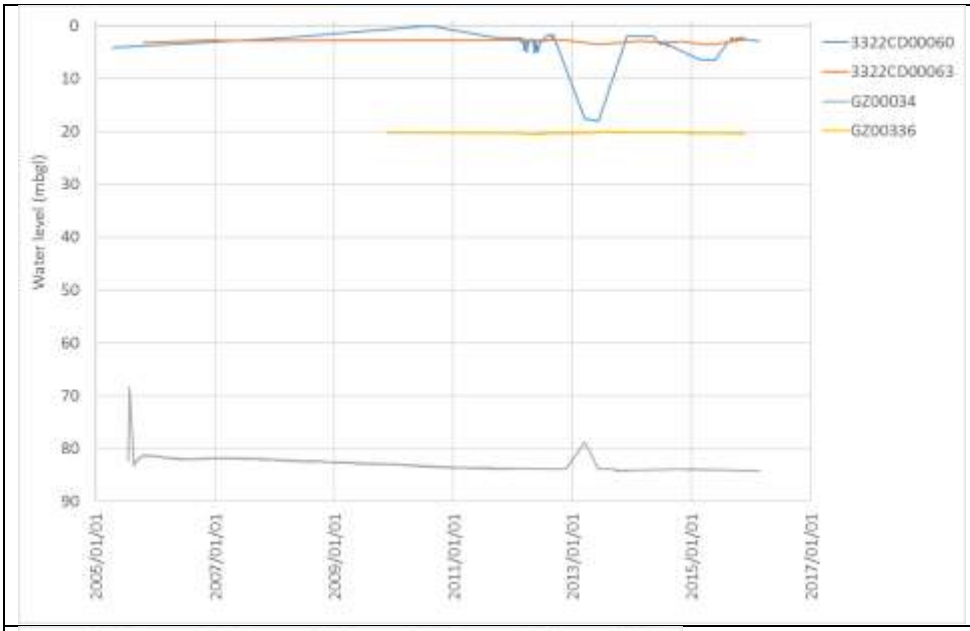
2017/01/01
033803
3322AD00063
GZ00037


2005
2007
2009
2011
2013
2015
Average annual water level (mbgl)
0
5
10
15
20
25
30
033803
3322AD00063
GZ00037


Annual water level range (m)
14
12
10
8
6
4
2
0
2005
2007
2009
2011
2013
2015
033803
3322AD00063
GZ00037

Outeniqua


Water level (mbgl)
0
10
20
30
40
50
60
70
80
90
2005/01/01
2007/01/01
2009/01/01
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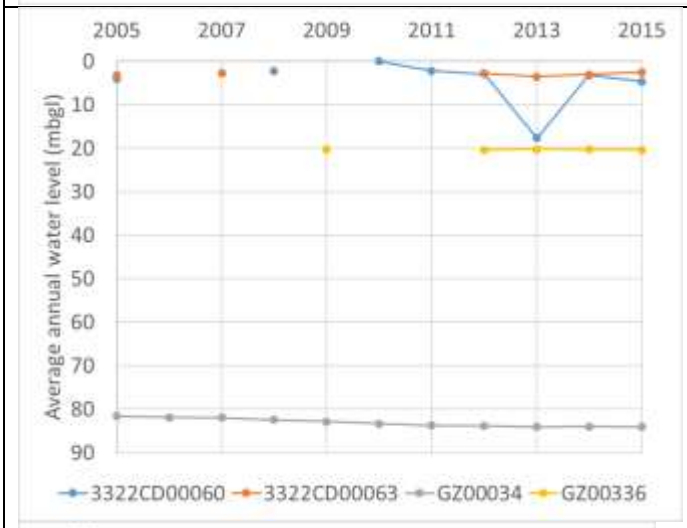
GZ00034
GZ00336


2005
2007
2009
2011
2013
2015
Average annual water level (mbgl)
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30
40
50
60
70
80
90
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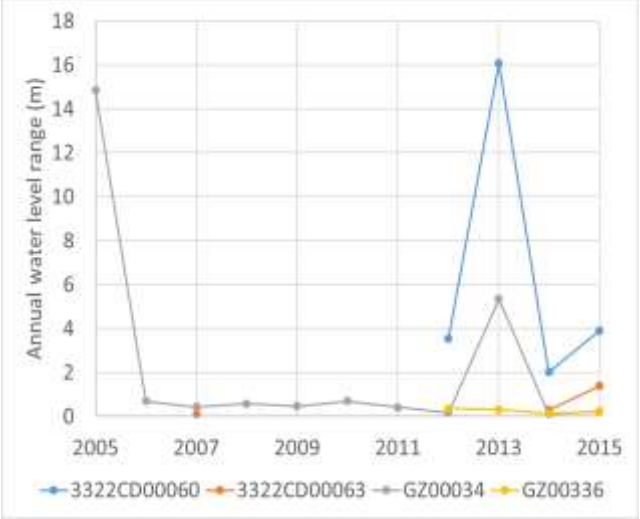
GZ00034
GZ00336


Annual water level range (m)
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16
14
12
10
8
6
4
2
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2007
2009
2011
2013
2015
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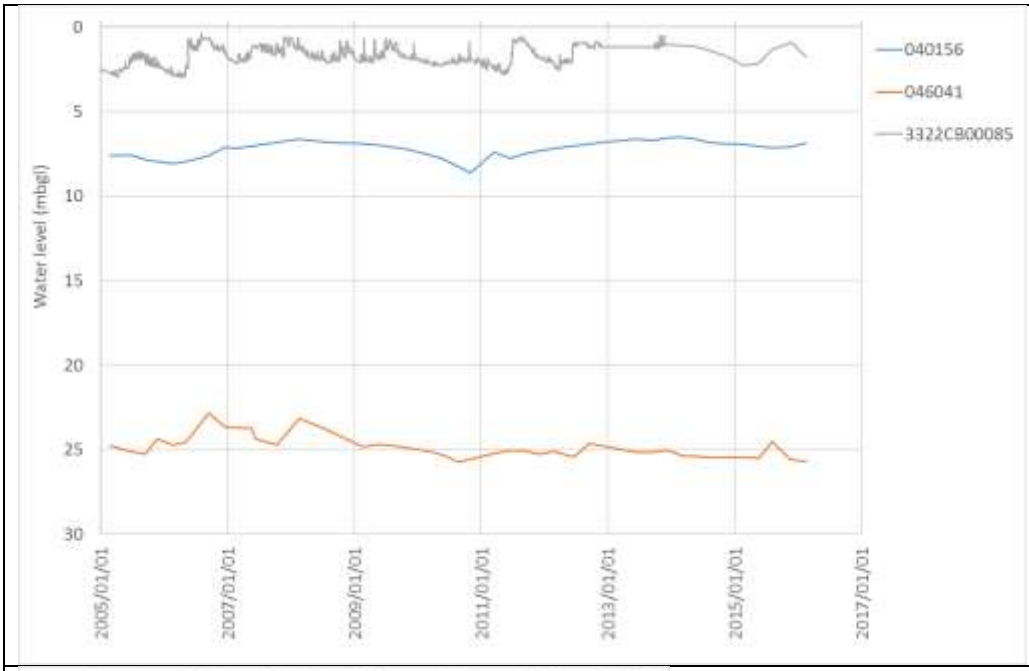
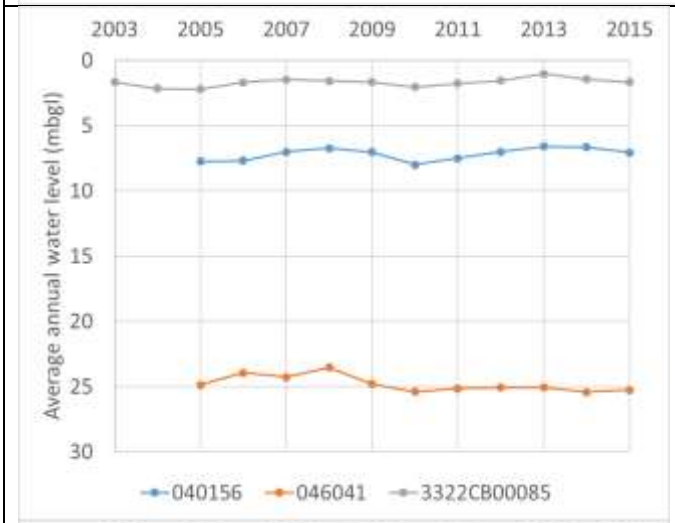
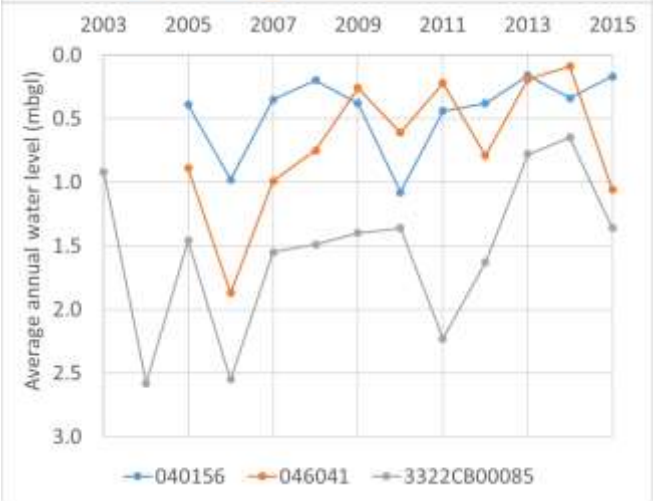
GZ00034
GZ00336

Klein Karoo





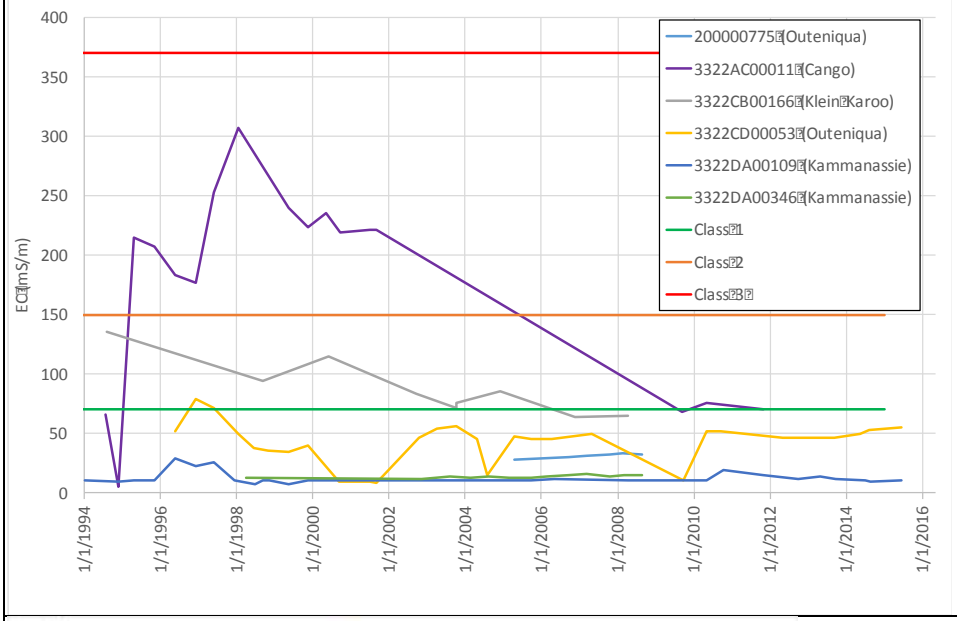


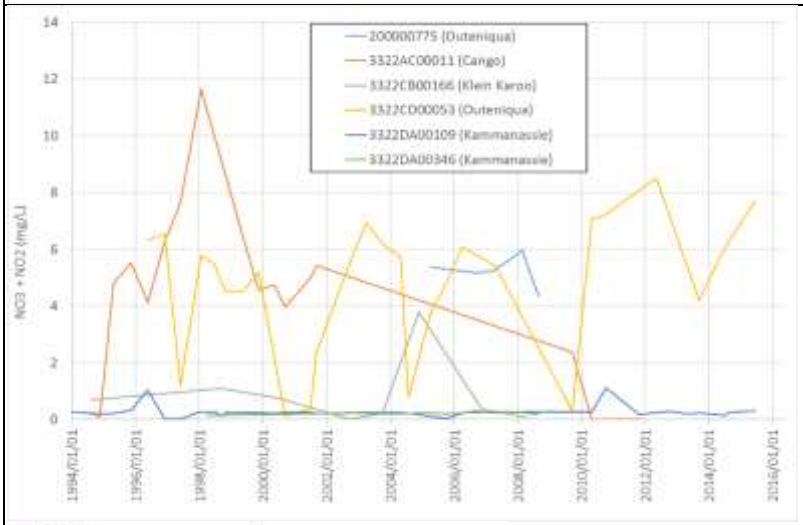
Response to Bulk Abstraction

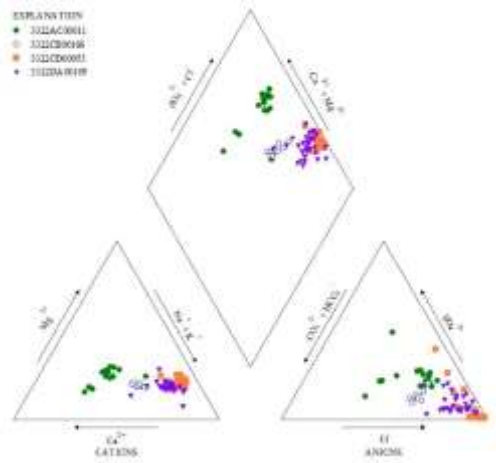
Wellfields supplying the Klein Karoo Rural Water Supply Scheme are situated in this GRU, and part within GRU GGa-3. Some data for the KKRWSS is presented here, and significantly more data is available in consulting reports conducted for the municipality. In addition, significant data has been collated for background trends in and around planned

wellfields for Oudtshoorn supply, and monitoring the responses to various hydraulic tests conducted. These datasets will be reviewed should this GRU be prioritised for further investigation.

Water quality graphs







Comments

GO-4 is a large GRU. Groundwater use is clustered into several groups, namely in the TMG Outeniqua mountains in the south of the GRU, within Bokkeveld sediments in the Klein Karoo valley, in Cango Group rocks to the north of the GRU, and in the TMG Kammanassie Mountains on the eastern side of the GRU (related to the KKRWSS wellfield). There has been extensive long term water level monitoring in these clusters. Representative boreholes for each of the clusters are discussed below:

- Kammanassie – 3322DA00391 and 046075A are within the KKRWSS production wellfield and 3322DA00392 and 046079 are away from the production wellfield. Many of the locations show occasional sharp spikes in water level but no strong seasonal fluctuations. 046079, located away from the production wellfield, has a relatively stable water level of around 20 m bgl. A noticable long term decreasing water level trend is noted in boreholes close to the production wellfield. This is not observed away from the production wellfield. The decline may be related to the aquifer transitioning to a new equilibrium in response to abstraction, and is not necessarily a cause for concern (section **Error! Reference source not found.**). Additional investigation would be required to determine the cause.
- Cango – 3322AD00063, GZ00037 and 033803 are all located away from registered water use. 3322AD00063 and GZ00037 are located on the fault contact of the Cango and the Uitenhage Group and show very similar water level trends, with large (15 – 20 m) fluctuations in water level. In contrast, 033803 has small seasonal fluctuations (<3 m) and a more stable average annual water level. No long term trend is observed in water levels at 033803, and the data at 3322AD00063 and GZ00037 is too variable to observe long term trends.
- Outeniqua – GZ00034 and GZ00336 are located away from water use, while 3322CD00060 and 3322CD00063 are located close to water use, all within the TMG. The water levels are shallower in 3322CD00060 and 3322CD00063 (<10 mbgl) compared to GZ00336 (20 mbgl) and GZ00034 (80 – 90 mbgl). Water levels are not generally seasonally variable, however some variability is noted in 3322CD00060 and GZ00034. GZ00034 shows a slight long term decrease in water level, but no decrease is observed for the other locations.
- Klein Karoo – 3322CB00085, 040156 and 046041 are all located away from registered water use. 3322CB00085 is a relatively shallow borehole (12 m deep) located in Quaternary sediments. It shows seasonal changes in water level and a profile indicative of rapid response to recharge. Water levels in 040156 and 046041 are deeper and the data show less variability, but this could be due a much lower sampling frequency. Seasonal variation in all boreholes is less than 3 m, and the water levels do not show any long term increasing or decreasing trends.

There is less long term groundwater quality data than groundwater level data. Groundwater from the Cango Group has the highest EC (variable, but generally >150 mS/m), followed by the Klein Karoo (150 – 50 mS/m), then the Outeniqua (10 – 50 mS/m) and the lowest EC water is found in the Kammanassie (<20 mS/m). EC measurements are generally consistent, but decreasing EC has been noted in 3322AC00011 (Cango) and 3322CB00166 (Klein Karoo). The TMG boreholes (Kammanassie and Outeniqua) are generally more Na-Cl dominant, whereas the Cango and Klein Karoo samples have higher levels of bicarbonate and Ca.

Status Quo assessment for GC-1

GRU name, main town	Gouritz Coastal sub-catchment Unit 1, GC-1. George.
GRU Boundary description	The GRU is bounded in the south by the Atlantic Ocean with Groot Brakrivier in the west and Wilderness in the east. To the north the boundary deviates from the catchment and follows the contact between the Peninsula Formation and the remaining rocks of the TMG. The George batholith outcrops west and south of George, which intruded into the Kaaimans Group. The western boundary deviates from the catchment boundary and follows the contact zone of the Cape Granite Suite north of Brak River. The argillaceous character of the Kaaimans Group renders it less favourable for groundwater development than other aquifer types in the study area. Cape Granite Suite aquifers owe their water-bearing properties to both fracturing and weathering, and typical drilling targets include zones of deep weathering, contact zones with the Kaaimans Group and dyke contacts. The Peninsula Formation outcropping to the north is considered to have the most groundwater potential. Groundwater is expected to flow southwards and toward the nearest surface water bodies and to the coast.
Catchments	K10C to K10F ; K20A, K30A to K30D
IUAs covered	The GRU falls almost entirely within the Coastal IUA, with a small portion of the north falling within the Gouritz-Olifants IUA.
Domestic Groundwater use	• Great Brak and Friemersheim are supplied by surface water. • George has boreholes that can provide 24% of its supply (2.958 million m^3/a), which were developed in 2010/2011 in response to water shortages, although they have not been routinely used and require licensing.

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations

George	Kaaimans, TMG, Cape Granite	68	2.4	Agriculture – irrigation Industry - urban	None	3322CD00052 (spring; 1.5 km from water use)

Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
3422AB00029	WL	Borehole	1998/02/21	1998/02/21	6	Cape Granite	30
3322CD00017	WL	Borehole	1971/02/12	1971/02/12	6	Cape Granite	97
3422AB00014	WL	Borehole	1961/08/18	1961/08/18	7	Cape Granite	123
3322CD00052	Qual	Spring	1994/07/20	2015/06/22	38	Kaaimans	-

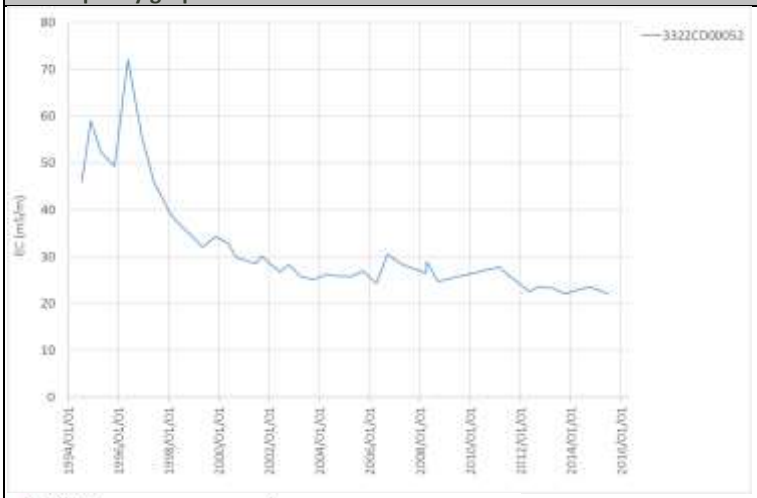
Water Level Graphs

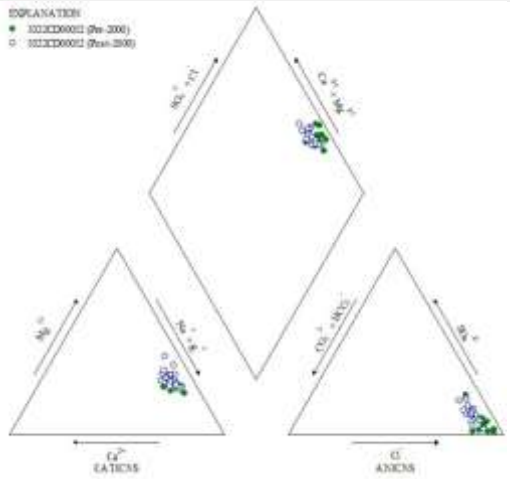
No water level data available.

Response to Bulk Abstraction

It is understood that some monitoring data was collated in association with the development of the municipal supply at George, available in consulting reports, and that additional investigations are currently underway to licence these boreholes. This data will be reviewed should this GRU be prioritised for further investigation.

Water quality graphs





EC data mostly lies well below the DWAF 1996 drinking water quality guideline Class 1 (70 mS/m).

Comments

Water use is distributed throughout the southern parts of the GRU, which are underlain by Granite and rocks of the Kaaimans Group, with little registered groundwater use within the TMG in the northern section of the GRU. The boreholes supplying George target the TMG although are not currently registered, nor is any data yet avaialble for these boreholes.

There is no long term groundwater level monitoring within the GRU. Long term groundwater quality monitoring data is available for 3322CD00052, a spring located on the granite/Kaaimans Group contact to the west of George. Water quality at this spring has shown an improvement in EC, from 50 – 70 mS/m in the 1990s to current levels of <25 mS/m. The ionic composition of the water has not changed notably over the monitoring period and remains Na/Mg/Cl dominated.

Status Quo assessment for GC-2

GRU name, main town	Gouritz Coastal sub-catchment Unit, GC-2. Knysna, Sedgefield.
GRU Boundary description	The unit can be divided for management reasons between the K40 and K50 catchment boundaries. Similar to unit GS-1 the boundary north is associated with the northern contact of the Peninsula Formation. Its southern half is bounded by the Atlantic Ocean with Rondevlei in the west and Plettenberg Bay in the east.
Catchments	K40A to K40E; K50A to K50B; K60F; K60G
IUAs covered	The GRU falls almost entirely within the Coastal IUA, with a small portion of the north falling within the Gouritz-Olifants IUA
Domestic Groundwater use	• Buffelsbaai, Karatara, Rheenendal are supplied by surface water • Knysna has some boreholes making up 7% of the supply source (0.37 million m3/a). • Plettenberg Bay has boreholes capable of providing ~10% of the supply to the town (0.439 million m^3/a), and groundwater is used when required in peak season. • Sedgefield also has a wellfield with a current operational yield of just less than 50% of the water requirements for Sedgefield. The wellfield is only used during summer/ peak demand when surface water resources are constrained. However, numerical modelling has shown that the aquifer (from these boreholes) could supply 100% of the supply for at least 3-months (DWS, 2016). The wellfield is not (yet) registered in WARMS and a registration is currently in progress.

Water use clusters for trend analysis

Water use cluster	Geology	Approx no. water use locations	Total water use (Mm^3)	Predominant Water use	Representative WL locations	Representative Chemistry locations
Knysna-Sedgefield	Kaaimans, Bredasdorp, Alluvium	58	3.4	Agriculture – irrigation Water supply Industry - urban	RNDE2 (TMG, away from water use)	None
Plettenberg Bay	TMG, Bredasdorp, Uitenhage, Alluvium	27	1.3	Agriculture – irrigation Water supply Industry – urban/non-urban	None	None

Available monitoring locations for trend analysis (recent data highlighted yellow)

Identifier	Water level/ Quality	Geosite Type	First monitoring date	Most recent monitoring date	Number of data points (>5 only)	Surface geology	Depth
RNDE2	WL	Borehole	2014/08/21	2016/02/25	7	TMG	212
3423AB00032	WL	Borehole	2006/04/12	2007/06/15	6	TMG	

Water Level Graphs

Water level monitoring is of insufficient duration to illustrate trends.

Response to Bulk Abstraction

Significant monitoring data is available for the area, collated in support of municipal abstraction, and not (yet) integrated to DWS monitoring systems:

- Plettenberg Bay: an analysis of the response to abstraction has suggested that groundwater resources are under-utilised and the aquifers could support increased abstraction (All Towns Reconciliation Strategy)
- Sedgefield: reports analysing the response to groundwater abstraction show that the aquifer can sustain the rates currently achievable by the wellfield infrastructure (Parsons, 2013), furthermore recent numerical modelling suggests that the wellfield (and aquifer as a whole) is under-utilised (DWS, 2016).

This data will be reviewed should this GRU be prioritised for further investigation.
Water quality graphs
No recent water quality data.
Comments
A large part of the GRU is underlain by mountainous TMG and there is little registered water use in these areas, except around Plettenberg Bay (Sedgefield municipal wellfield is currently undergoing registration). A second water use cluster is noted within Kaaimans and Bredasdorp Groups in the vicinity of Sedgefield and Knysna. There has been little long term water level monitoring for this GRU. Two locations have some data, namely 3423AB00032 in the TMG near Plettenberg Bay, and RNDE2, in the TMG to the east of Karatara. The water levels are very different for the two locations, and no seasonal trends are evident, but there is very little data available to assess any trends.

Status Quo assessment for GC-3

GRU name, main town	Gouritz Coastal sub-catchment Unit 3, GC-3.
GRU Boundary description	The unit is bounded by the coast line to the south and the Gouritz catchment boundary.
Catchments	K60B to K60E; K70A; K70B
IUAs covered	The GRU falls entirely within the Coastal IUA
Domestic Groundwater use	The settlements within the GRU (Kurland and Nature's valley) are supplied 100% by surface water.

Water use clusters for trend analysis						
Water use cluster	**Geology**	**Approx no. water use locations**	**Total water use (Mm^3)**	**Predominant Water use**	**Representative WL locations**	**Representative Chemistry locations**
Nature's Valley	TMG, alluvium	4	0.09	Agriculture – irrigation	None	None

Available monitoring locations for trend analysis (recent data highlighted yellow)
None
Water Level Graphs
No water level data available.
Response to Bulk Abstraction
There is no bulk /point abstraction in the GRU.
Water quality graphs
No recent water quality data.
Comments
A large part of the GRU is underlain by mountainous TMG and there are only 4 registered water users in this GRU. There is no long term water level or water quality data.

Appendix B: Water Quality

Breede WMA Rivers Present Water Quality Status (Data period 2010 – present)

		Cl			TDS			EC			NH3-N			NO3+NO2-N			pH			PO4-P			SAR			SO4		
Station	IUA	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	9	N	50	95
H1H003Q01	A1	57	48.6	92.8	38	188.0	563.2	59	33.8	72.1	58	0.002	0.019	58	0.66	1.95	59	7.8	8.4	59	0.098	1.031	44	1.9	6.0	59	20.5	42.1
H1H006Q01	A1	61	22.8	40.1	41	74.6	127.0	61	15.0	23.4	61	0.001	0.005	61	0.26	0.89	61	7.5	7.9	61	0.035	0.159	46	1.4	1.9	58	6.5	18.7
H1H007Q01	A1	61	6.2	8.6	45	18.4	29.7	62	3.7	7.0	62	0.000	0.001	60	0.03	0.09	64	5.4	7.4	64	0.008	0.066	48	0.4	1.0	63	1.5	3.0
H1H012Q01	A1	59	13.4	32.9	38	41.9	123.5	58	8.8	21.5	58	0.000	0.001	57	0.32	3.85	59	6.6	7.4	59	0.005	0.041	45	0.8	1.3	59	3.4	33.8
H1H013Q01	A1	59	8.4	10.8	37	26.1	38.8	56	5.4	7.8	56	0.000	0.001	60	0.42	0.75	61	6.7	7.6	61	0.005	0.012	47	0.6	1.1	59	1.5	3.0
H1H018Q01	A1	65	6.1	7.7	40	19.7	32.7	61	3.8	6.1	61	0.000	0.000	65	0.06	0.18	65	6.6	7.2	65	0.010	0.067	45	0.5	1.1	65	1.5	3.0
H1H033Q01	A1	48	5.3	9.4	27	17.0	24.0	48	3.4	5.9	48	0.000	0.000	49	0.06	0.23	52	6.2	7.0	52	0.013	0.070	35	0.3	1.1	50	1.5	3.0
H2H015Q01	A1	62	8.7	12.2	39	24.5	42.6	62	5.7	8.3	62	0.000	0.001	62	0.05	0.12	62	6.8	7.4	62	0.005	0.014	46	0.6	1.1	62	1.5	3.8
H2H016Q01	A1	61	21.1	26.2	39	68.3	83.3	58	12.4	16.4	58	0.001	0.004	62	0.05	0.24	62	7.5	7.7	62	0.006	0.017	46	0.9	1.2	62	3.8	10.2
H1H015Q01	A2	59	18.7	31.9	36	53.0	87.7	59	10.8	17.7	59	0.000	0.002	58	0.16	0.85	60	7.2	7.7	60	0.005	0.030	46	0.9	1.4	58	4.8	10.6
H2H005Q01	A2	60	4.4	7.5	35	16.9	27.4	60	3.3	6.7	60	0.000	0.000	64	0.03	0.10	64	6.1	7.2	64	0.010	0.024	46	0.4	1.2	60	1.5	3.0
H2H006Q01	A2	61	17.4	47.9	41	52.9	137.9	59	15.0	38.9	59	0.000	0.001	60	0.78	1.96	61	7.2	7.6	61	0.006	0.034	48	0.9	1.3	61	17.4	51.2
H2H010Q01	A2	56	####	468.2	28	1303.4	1552.6	59	208.5	246.0	58	0.004	0.010	60	0.86	1.70	60	8.4	8.7	59	0.065	0.176	38	6.0	7.3	59	219.8	307.9
H3H005Q01	A2	21	####	520.8	8	1324.3	1598.3	20	208.2	260.8	20	0.005	0.011	19	0.07	1.38	21	8.5	8.6	21	0.010	0.011	10	4.5	5.5	21	210.2	280.8
H3H015Q01	A2	16	####	161.5	8	403.7	579.3	16	64.9	88.9	16	0.003	0.013	16	0.05	6.25	16	8.2	8.5	15	0.010	0.167	9	2.6	3.2	15	35.0	50.4
H4H019Q01	A2	48	####	1384.0	30	1763.4	2514.3	49	287.7	358.8	49	0.004	0.011	49	0.08	0.57	50	8.4	8.7	50	0.006	0.020	36	5.7	8.1	49	170.0	224.1
H7H004Q01	A2	46	72.5	125.2	31	261.5	419.6	47	42.9	67.1	47	0.001	0.004	47	0.03	0.15	47	7.9	8.2	47	0.010	0.029	35	2.9	3.8	45	21.5	58.4
H3H011Q01	A3	57	####	1062.0	30	1597.6	2585.0	57	263.1	409.0	57	0.005	0.058	55	0.77	1.82	60	8.3	8.7	60	0.109	0.691	41	8.4	11.1	59	175.2	277.0
H4H015Q01	A3	60	17.3	21.4	35	35.7	45.3	62	7.9	9.2	62	0.000	0.000	61	0.03	0.12	62	5.1	6.8	62	0.008	0.049	45	1.2	1.8	60	1.5	3.0
H4H016Q01	A3	52	####	516.1	29	856.1	1658.0	52	145.6	255.0	50	0.004	0.011	50	0.05	0.88	53	8.3	8.9	51	0.010	0.081	35	6.0	11.3	52	94.3	184.0
H4H017Q01	A3	58	37.9	77.1	35	89.0	200.6	59	20.3	39.1	59	0.001	0.002	56	0.14	0.88	59	7.4	7.8	59	0.012	0.053	39	1.7	2.4	59	12.8	30.2
H4H018Q01	A3	59	####	2223.3	35	2923.7	4886.5	59	468.0	764.0	59	0.004	0.022	58	0.12	1.04	60	8.3	8.6	60	0.010	0.062	43	10.6	13.6	58	352.4	552.3
H4H020Q01	A3	54	####	1721.5	31	2957.1	4203.5	57	455.0	679.0	57	0.004	0.013	58	0.05	0.54	58	8.4	8.6	58	0.022	0.118	40	9.3	13.2	58	375.2	646.0
H5H003Q01	A3	61	29.0	44.7	36	61.1	99.8	61	12.5	18.8	61	0.000	0.001	61	0.03	0.08	62	6.5	7.5	62	0.005	0.024	44	1.7	2.8	61	1.5	7.3
H5H004Q01	A3	59	####	426.5	33	453.9	1117.2	60	92.8	210.6	60	0.002	0.009	59	0.30	0.98	62	8.0	8.5	61	0.025	0.110	40	4.2	7.0	62	54.1	120.0

		Cl			TDS			EC			NH3-N			NO3+NO2-N			pH			PO4-P			SAR			SO4		
Station	IUA	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	9	N	50	95
H5H005Q01	A3	59	####	405.8	35	530.6	1124.8	59	97.3	188.3	59	0.003	0.009	60	0.12	0.90	60	8.1	8.5	60	0.010	0.097	43	4.4	7.3	59	60.2	125.8
H6H005Q01	B4	43	17.1	20.3	25	35.4	55.6	42	7.4	9.6	42	0.000	0.000	44	0.03	0.10	44	5.4	6.7	44	0.008	0.015	28	1.3	2.1	44	1.5	1.5
H6H012Q01	B4	60	26.9	68.0	40	72.7	144.5	60	10.9	29.1	60	0.000	0.002	59	0.21	1.05	60	6.9	7.6	60	0.006	0.027	43	1.7	3.1	59	3.2	9.2
H6H015Q01	B4	18	10.7	18.5	14	32.8	42.5	16	7.4	10.5	16	0.000	0.001	18	0.34	0.71	17	7.1	7.6	18	0.005	0.015	14	0.8	1.6	18	1.5	1.5
G4H005Q01	B5	41	26.7	37.2	26	83.6	126.5	41	15.4	22.8	41	0.000	0.003	42	0.48	2.75	42	7.2	7.6	42	0.010	0.046	28	1.4	1.8	42	2.5	16.2
G4H007Q01	B5	61	30.4	40.9	36	65.2	92.2	60	14.2	18.7	60	0.000	0.002	57	0.12	0.68	61	6.9	7.6	60	0.005	0.019	43	1.5	2.2	59	1.5	4.8
G4H014Q01	B5	62	####	149.3	35	236.2	318.9	63	47.8	62.7	63	0.001	0.002	62	0.45	3.44	63	7.3	7.8	64	0.116	0.480	47	3.6	4.2	61	18.5	39.6
G4H029Q01	B5	59	21.3	28.8	37	62.9	92.2	59	11.9	15.1	59	0.000	0.001	59	0.43	1.04	60	7.2	7.7	61	0.010	0.026	43	1.2	2.0	60	1.5	7.4
G4H006Q01	F10	45	####	496.0	25	624.8	976.6	46	124.7	178.1	46	0.001	0.004	45	0.18	6.55	46	7.7	8.0	46	0.010	0.108	30	7.0	8.8	43	46.9	61.8
G5H008Q01	F10	22	####	4223.2	9	5048.6	5917.5	23	858.0	1353.0	23	0.010	0.068	22	0.05	3.81	23	8.3	8.6	23	0.070	0.363	11	20.2	24.7	22	315.6	513.5
H7H005Q01	F11	57	9.2	14.2	35	24.4	40.7	56	5.9	8.7	56	0.000	0.000	59	0.05	0.15	57	4.6	7.2	59	0.010	0.031	43	0.6	1.0	56	1.5	5.1
H7H006Q01	F11	63	####	348.4	37	312.8	804.3	64	69.8	179.5	64	0.002	0.006	61	0.11	1.08	64	7.9	8.5	64	0.010	0.031	44	3.6	5.9	62	39.3	90.4
H7H007Q01	F11	60	12.1	20.1	41	26.8	39.9	57	7.0	11.5	57	0.000	0.000	60	0.03	0.06	60	4.3	6.5	60	0.013	0.039	45	0.8	1.3	60	1.5	4.9
H7H013Q01	F11	50	42.8	73.8	35	100.3	191.9	51	17.5	35.5	51	0.000	0.001	51	0.03	0.47	51	7.1	7.7	51	0.010	0.027	39	1.8	3.0	51	1.5	22.1
H6H009Q01	F9	61	64.0	258.1	39	147.4	413.3	61	27.8	86.6	61	0.000	0.001	61	0.10	0.57	61	7.4	7.8	61	0.005	0.016	46	2.7	5.5	60	9.6	42.0

Gouritz WMA Rivers Present Water Quality Status (Data period 2010 – present)

		Chloride			TDS			EC			NH3-N			NO3+NO2-N			pH			PO4-P			SAR			SO4		
Station	IUA	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95
J1H028Q01	C6	61	78	140	39	426	670	59	62	94	59	0.004	0.018	61	0.102	0.713	61	8.3	8.6	60	0.022	0.132	44	2.2	2.8	59	0.2	0.2
J2H018Q01	C6	56	11	15	31	228	596	57	31	60	56	0.003	0.013	58	0.264	1.143	58	8.2	8.6	58	0.015	0.049	41	0.6	0.7	51	0.1	0.2
J2H005Q01	D7	55	201	410	37	767	1294	56	117	199	56	0.004	0.031	56	0.422	2.792	56	8.3	8.7	56	0.070	0.524	41	3.7	4.6	55	0.2	0.2
J2H006Q01	D7	35	65	146	22	262	405	35	43	69	35	0.002	0.005	35	0.025	0.123	35	8.1	8.4	35	0.006	0.022	26	1.8	2.4	31	0.1	0.2
J2H007Q01	D7	45	78	302	30	264	1089	45	46	171	44	0.003	0.008	44	0.050	0.132	45	8.2	8.6	44	0.005	0.021	33	2.0	4.2	42	0.1	0.2
J2H010Q01	D7	63	69	133	40	410	636	63	61	89	63	0.003	0.020	61	0.050	0.386	64	8.2	8.5	64	0.023	0.076	46	2.2	3.0	61	0.1	0.2
J2H016Q01	D7	61	54	71	39	376	492	60	53	71	60	0.003	0.010	62	0.404	0.962	62	8.3	8.5	62	0.058	0.173	45	2.0	2.4	58	0.2	0.2
J3H011Q01	D7	45	1861	3788	24	7878	9236	52	1229	1891	51	0.012	0.042	49	0.050	0.514	54	8.2	8.4	54	0.010	0.232	32	24.5	34.7	42	0.3	0.5
J3H012Q01	D7	3	48	54	3	225	321	3	36	53	3	0.002	0.008	3	0.025	0.025	3	8.1	8.5	3	0.005	0.005	3	1.5	1.6	3	0.1	0.1
J3H013Q01	D7	58	5	9	36	30	45	61	6	9	61	0.000	0.001	60	0.025	0.112	61	7.4	7.7	61	0.011	0.037	43	0.3	0.7	55	0.1	0.1
J3H014Q01	D7	63	15	24	38	214	407	63	29	46	63	0.003	0.009	60	0.232	0.785	64	8.2	8.6	64	0.010	0.039	44	0.4	0.5	61	0.0	0.1
J3H015Q01	D7	59	10	31	38	60	162	60	10	26	59	0.001	0.006	54	0.025	0.097	60	7.7	8.1	60	0.005	0.126	44	0.6	1.1	57	0.1	0.1
J3H016Q01	D7	46	28	52	31	109	326	46	18	47	46	0.001	0.003	46	0.196	0.752	46	7.5	8.0	46	0.012	0.056	32	1.6	2.0	45	0.1	0.2
J3H017Q01	D7	32	116	234	17	329	1016	31	64	139	30	0.002	0.007	31	0.050	0.290	32	8.0	8.4	32	0.010	0.040	18	3.1	4.4	30	0.2	0.3
J3H018Q01	D7	58	22	35	37	156	245	60	25	38	60	0.002	0.007	55	0.059	0.346	60	8.1	8.4	60	0.005	0.020	44	0.6	0.9	55	0.1	0.1
J3H020Q01	D7	48	37	66	31	193	279	50	30	51	50	0.002	0.007	49	0.025	0.143	50	8.1	8.3	50	0.005	0.018	35	1.2	1.8	45	0.1	0.1
J1H015Q01	E8	60	3	6	40	15	23	55	3	4	55	0.000	0.000	62	0.025	0.106	63	6.2	7.0	63	0.005	0.018	49	0.3	1.0	57	0.2	0.4
J1H016Q01	E8	43	203	275	22	706	830	44	110	138	44	0.003	0.009	44	0.025	0.101	44	8.2	8.5	44	0.005	0.010	27	3.7	4.4	37	0.2	0.3
J1H017Q01	E8	41	1297	1902	23	2594	3679	41	435	598	41	0.004	0.013	43	0.025	0.541	43	8.2	8.5	43	0.027	0.080	26	7.4	10.7	39	0.1	0.2
J1H018Q01	E8	20	1642	3643	5	4771	5431	23	873	1440	23	0.008	0.037	22	0.050	0.146	23	8.2	8.5	23	0.010	0.024	8	14.1	20.4	19	0.2	0.3
J1H019Q01	E8	50	1348	2049	28	3625	4560	52	571	888	52	0.004	0.011	54	0.025	0.245	54	8.4	8.7	54	0.017	0.140	33	13.6	17.5	50	0.1	0.3
J1H022Q01	E8	57	117	269	33	344	571	58	64	105	58	0.002	0.008	58	0.025	0.505	59	8.1	8.5	59	0.006	0.070	43	2.4	3.0	53	0.0	0.1
J1H031Q01	E8	29	172	275	18	440	894	29	88	148	29	0.002	0.005	29	0.025	0.379	29	8.0	8.4	29	0.010	0.064	20	4.3	5.5	27	0.1	0.2
H8H001Q01	F12	49	176	551	33	396	859	48	78	240	48	0.001	0.005	49	0.050	0.712	49	7.6	8.2	49	0.014	0.062	37	4.8	6.5	46	0.1	0.2
H8H003Q01	F12	63	35	49	43	74	95	63	15	21	62	0.000	0.002	63	0.050	0.207	64	6.4	7.2	63	0.006	0.040	49	1.9	3.0	60	0.0	0.2
H9H002Q01	F12	54	30	47	35	63	91	55	13	19	55	0.000	0.000	54	0.062	0.323	55	5.9	7.2	55	0.010	0.031	38	2.0	2.9	54	0.0	0.1
H9H004Q01	F12	47	27	44	30	51	78	46	11	19	46	0.000	0.000	47	0.050	0.105	47	5.3	6.8	47	0.010	0.032	34	2.0	3.0	46	0.0	0.1
H9H005Q01	F12	49	106	330	32	286	737	48	42	139	47	0.001	0.002	49	0.025	0.167	49	7.4	8.0	49	0.005	0.110	39	4.1	7.5	43	0.1	0.2
H9H010Q01	F12	60	25	34	37	56	74	55	11	14	55	0.000	0.000	56	0.106	0.364	60	6.1	7.3	60	0.010	0.043	40	1.6	1.9	57	0.0	0.1
J4H002Q01	F13	59	556	1443	36	1535	3748	61	307	605	61	0.004	0.011	62	0.025	0.267	62	8.3	8.6	62	0.010	0.041	44	8.7	16.2	59	0.2	0.3

		Chloride			TDS			EC			NH3-N			NO3+NO2-N			pH			PO4-P			SAR			SO4		
Station	IUA	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95
J4H003Q01	F13	58	43	145	36	87	184	57	18	43	57	0.000	0.001	59	0.025	0.085	59	6.7	7.4	59	0.005	0.017	40	2.2	3.4	57	0.0	0.1
K1H004Q01	G14	58	90	128	34	204	280	57	38	53	57	0.001	0.001	59	0.050	0.353	59	7.4	7.7	59	0.005	0.021	40	3.5	4.0	56	0.1	0.1
K1H005Q01	G14	62	70	113	41	154	229	60	32	54	60	0.001	0.003	62	0.050	0.203	62	7.4	7.8	62	0.005	0.022	46	3.0	3.7	60	0.1	0.1
K1H017Q01	G14	60	236	341	37	497	723	60	97	130	60	0.001	0.003	61	0.050	0.416	61	7.7	8.0	61	0.010	0.113	42	5.6	6.7	59	0.1	0.1
K2H002Q01	G14	58	143	2049	36	540	13063	58	61	2577	58	0.001	0.040	58	0.025	0.181	58	7.6	8.4	58	0.005	0.066	46	6.0	40.1	54	0.1	0.3
K2H006Q01	G14	59	61	182	40	145	451	58	26	84	58	0.000	0.002	59	0.050	0.389	59	7.2	8.0	59	0.010	0.106	43	2.8	4.1	58	0.0	0.1
K6H019	G15	61	27	47	40	59	93	59	12	18	59	0.000	0.001	61	0.025	0.102	61	6.1	8.0	61	0.005	0.015	47	1.7	2.7	58	0.0	0.1
K3H001Q01	G15	63	41	112	38	77	173	60	16	42	60	0.000	0.000	63	0.025	0.083	63	5.6	7.3	63	0.005	0.061	44	2.2	3.6	60	0.1	0.1
K3H002Q01	G15	57	27	46	37	51	85	55	15	19	55	0.000	0.000	58	0.050	0.288	58	4.0	5.8	58	0.013	0.121	42	1.4	2.0	55	0.0	0.2
K3H003Q01	G15	54	182	399	35	344	834	54	66	182	54	0.000	0.002	53	0.050	0.821	54	7.0	7.9	54	0.010	0.040	38	5.0	7.7	53	0.0	0.1
K3H004Q01	G15	53	30	45	31	62	105	54	15	24	53	0.000	0.000	52	0.257	2.071	55	5.7	7.3	55	0.010	0.550	38	1.6	2.4	50	0.0	0.3
K3H005Q01	G15	60	43	51	38	79	102	60	17	22	60	0.000	0.000	59	0.025	0.190	60	5.5	6.9	60	0.005	0.063	45	2.4	3.5	57	0.0	0.1
K3H007Q01	G15	55	73	113	34	166	257	56	31	48	56	0.000	0.006	55	0.025	3.247	56	7.2	7.8	55	0.017	0.418	43	3.1	4.2	50	0.0	0.1
K3H011Q01	G15	51	272	637	34	639	1240	52	121	234	52	0.001	0.004	52	0.095	0.954	52	7.6	8.1	52	0.028	0.135	37	6.2	9.0	50	0.0	0.1
K4H001Q01	G15	51	59	1816	32	104	640	49	25	1510	48	0.000	0.005	48	0.025	0.188	51	6.2	7.9	50	0.010	0.037	37	2.6	31.0	51	0.1	0.2
K4H002Q01	G15	61	24	34	34	46	58	58	12	15	58	0.000	0.000	62	0.025	0.077	63	4.2	7.5	62	0.017	0.053	41	1.3	2.6	58	0.0	0.1
K4H003Q01	G15	60	57	69	35	104	125	60	23	27	60	0.000	0.000	56	0.050	0.291	60	6.4	7.0	59	0.005	0.015	39	2.9	3.9	58	0.0	0.1
K5H002Q01	G15	57	36	44	36	67	81	57	14	18	57	0.000	0.000	57	0.050	0.508	57	5.3	6.5	57	0.010	0.048	41	2.2	2.7	55	0.0	0.1
K6H001Q01	G15	49	57	90	30	136	230	49	26	42	49	0.000	0.001	50	0.025	0.153	50	7.4	7.7	50	0.005	0.028	35	2.8	3.4	45	0.1	0.2
K7H001Q01	G15	61	21	28	37	41	64	61	10	12	61	0.000	0.000	59	0.025	0.066	63	4.6	6.2	63	0.010	0.037	46	1.3	2.3	57	0.0	0.1

Breede Gouritz WMA Reservoirs Present Water Quality Status (Data period 2010 – present)

		Chloride			TDS			EC			NH3-N			NO3+NO2-N			pH			PO4-P			SAR			SO4		
Station	IUA	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95	N	50	95
H1R001Q01	A1	65	15	18	43	39	56	66	8	12	66	0.000	0.001	67	0.050	0.207	67	7.0	7.6	67	0.005	0.025	54	1.0	1.6	67	3.0	6.0
H2R002Q01	A1	58	26	30	40	79	94	57	15	17	57	0.001	0.005	58	0.050	0.182	59	7.5	7.8	59	0.005	0.021	47	1.0	1.2	58	8.0	11.0
H4R003Q01	A3	61	78	154	41	166	328	61	36	60	61	0.001	0.002	61	0.050	0.179	62	7.4	7.7	62	0.005	0.011	48	3.6	4.7	60	14.3	27.1
H4R004Q01	A3	62	17	21	41	45	68	61	9	13	61	0.000	0.001	60	0.050	0.191	63	7.1	7.4	63	0.010	0.019	45	1.2	2.0	63	3.6	6.4
H6R001Q01	B4	63	16	19	39	41	56	63	8	11	62	0.000	0.001	65	0.190	0.484	66	6.9	7.5	65	0.005	0.014	44	1.0	1.5	64	2.5	4.7
H6R002Q01	B4	53	12	16	37	37	55	54	8	9	54	0.000	0.002	55	0.309	0.601	55	7.1	7.4	55	0.010	0.090	40	0.9	1.5	55	1.5	3.0
J2R001Q01	C6	64	15	28	43	118	262	67	18	34	66	0.002	0.013	66	0.025	0.170	68	8.0	8.3	68	0.010	0.102	53	0.7	1.1	65	10.2	20.0
J2R002Q01	C6	67	16	52	42	253	479	67	32	62	66	0.004	0.092	67	0.506	2.129	67	8.2	8.6	68	0.060	0.217	50	1.1	1.9	65	16.5	85.1
J2R003Q01	D7	66	44	78	37	160	321	63	29	49	62	0.003	0.012	62	0.050	0.238	67	7.9	8.2	67	0.010	0.031	40	1.7	2.2	65	18.4	32.5
J2R006Q01	D7	69	52	84	45	371	506	68	53	72	67	0.003	0.011	69	0.364	0.917	68	8.2	8.6	69	0.049	0.225	51	2.1	2.4	67	43.7	62.7
J3R001Q01	D7	72	78	162	50	244	529	72	44	81	72	0.002	0.017	68	0.050	0.416	72	7.8	8.2	72	0.010	0.146	54	2.6	3.3	68	21.4	67.8
J3R002Q01	D7	74	96	142	51	469	638	73	65	93	73	0.005	0.045	74	0.150	0.907	74	8.2	8.5	73	0.014	0.369	58	2.5	3.2	72	47.3	92.5
J1R002Q01	E8	69	443	1603	44	1113	2782	70	189	327	70	0.006	0.090	70	0.050	0.741	70	8.5	8.8	70	0.018	0.329	52	5.7	8.4	67	87.0	118.5
J1R003Q01	E8	70	89	175	48	429	768	70	63	110	69	0.006	0.045	70	0.050	0.641	70	8.3	8.6	70	0.010	0.306	54	2.2	3.4	69	46.3	94.5
J1R004Q01	E8	57	202	308	39	546	917	58	94	151	58	0.002	0.022	58	0.050	0.249	58	8.0	8.5	58	0.010	0.109	41	4.4	5.5	57	60.7	122.5
J2R004Q01	E8	57	12	23	33	215	346	59	29	45	59	0.005	0.020	59	0.050	0.903	59	8.2	8.7	59	0.010	0.075	42	0.7	0.8	53	22.4	30.9
G4R002Q01	F10	61	13	16	38	29	38	62	7	8	62	0.000	0.000	65	0.050	0.153	65	5.1	7.1	65	0.010	0.030	45	0.9	1.3	64	1.5	3.7
H9R001Q01	F12	69	24	31	45	53	67	69	11	14	69	0.000	0.001	70	0.066	0.402	70	5.9	7.2	70	0.010	0.045	51	1.5	2.4	69	1.5	4.5
K1R001Q01	G14	68	247	333	43	518	691	68	97	125	68	0.001	0.033	69	0.064	0.851	69	7.7	8.0	69	0.010	0.339	51	5.6	6.6	66	37.8	49.7
K1R002Q01	G14	65	83	148	41	197	255	65	37	60	65	0.001	0.002	66	0.065	0.198	66	7.5	7.8	65	0.010	0.024	48	3.4	4.1	64	12.2	19.1
K2R001Q01	G14	63	23	34	43	45	63	63	11	16	63	0.000	0.000	64	0.025	0.056	64	4.2	6.0	64	0.027	0.202	46	1.3	1.9	63	1.5	8.4
K3R002Q01	G15	70	33	57	48	70	102	71	15	24	70	0.000	0.000	71	0.050	0.406	70	5.9	7.0	71	0.010	0.029	54	1.8	2.2	71	1.5	6.2
K3R003Q01	G15	65	2942	5858	36	5822	10358	67	1300	1627	67	0.006	0.067	66	0.038	1.309	67	7.9	8.4	66	0.130	0.860	44	24.0	30.3	64	498.1	662.8
K3R005Q01	G15	56	3792	6406	23	7067	9904	66	1444	1850	66	0.009	0.045	65	0.025	0.192	66	8.0	8.3	66	0.023	0.204	41	26.5	33.3	66	564.2	832.4
K4R001Q01	G15	42	1342	1686	20	2876	3357	41	465	504	41	0.006	0.014	43	0.050	0.225	43	8.6	8.7	43	0.005	0.015	28	15.0	17.8	37	141.0	165.7
K4R002Q01	G15	60	3217	12477	37	11967	22554	66	2280	3790	66	0.010	0.029	66	0.025	0.061	67	7.8	8.1	67	0.005	0.044	45	36.9	59.7	66	#####	#####

Appendix C: Estuaries

Delineation of significant estuaries
Palmiet
Delineation of the Palmiet estuary was based on the National Estuary Layer (http://bgis.sanbi.org/). The size of the estuary functional zone (EFZ) is 28.5 ha, and much of this is open water area as the estuary is located in a steep sided gorge for most of its length.

Extent of the Palmiet Estuary.

Bot/Kleinmond
Delineation of the Bot/Kleinmond estuary was based on the National Estuary Layer. The area of the EFZ was estimated at 2 039.2 ha and open water area at 1229.2 ha, making it one of the largest estuaries in the Breede-Gouritz WMA.

Extent of the Bot/Kleinmond Estuary.

Onrus

Delineation of the Onrus estuary was based on the National Estuary Layer. The EFZ was estmated at 15.1 ha and the open water area at 3.5 ha, making it one of the smallest estuaries in the Brede-Grouritz WMA.

Extent of the Onrus Estuary.

Klein

Delineation of the Klein estuary was based on the National Estuary Layer. The EFZ was estmated at 1802.3 ha and the open water area at 113.6 ha, making it one of the larger estuaries in the Brede-Grouritz WMA.

Extent of the Klein Estuary.

Uikraals

Delineation of the Uilkraals estuary was based roughly on the National Estuary Layer, but boundaries were adjusted to exclude some areas that were clearly not functionally linked to the estuary. The EFZ was estmated at 702.3 and the open water area at 55.7 ha.

Extent of the Uikraals Estuary (yellow shading) and the 5 m contour (blue line).

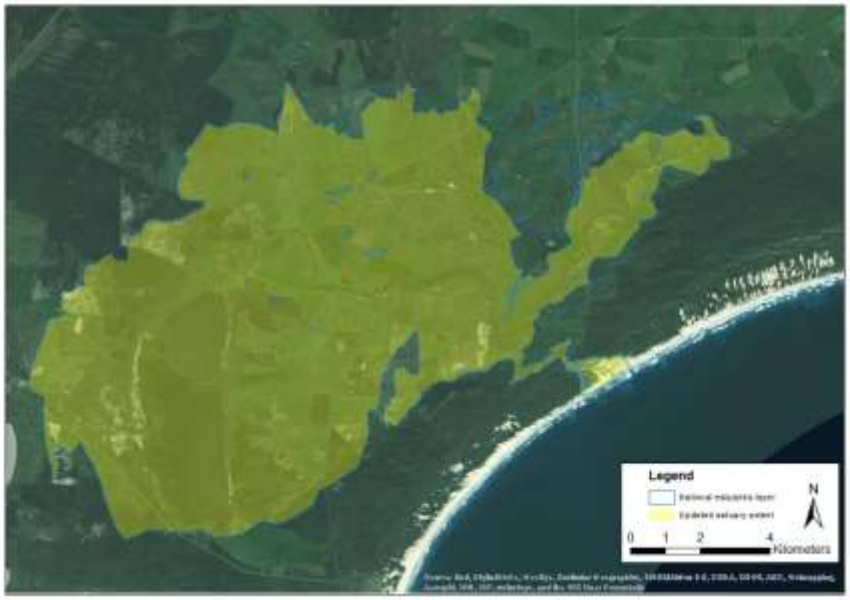
Haelkraal

The Haelkraals Estuary was previously not delineated on the National Estuary Layer. The Aurecon 5m inundation layer was used to delineate the estuary for this study. The estuary is 59 ha in size with approximately 12 ha of open water area.

Extent of the Haelkraals Estuary.

Heuningnes

Delineation of the Heuningnes estuary was based roughly on the National Estuary Layer, but boundaries were adjusted to exclude some areas that were clearly not functionally linked to the estuary. The area surrounding the Heuningnes estuary is mostly very low lying and is flooded during periods of high rainfall or river flow. The EFZ for this estuary is thus very large, 13 125.8 h (by far the largest in the Breede-Gouritz WMA) but the open water area is more modest (1351.5), the second largest in the WMA after the Knysna estuary.



Extent of the Heuingnes Estuary (yellow shading) and the 5 m contour (blue line).

Breede

Delineation of the Breede estuary was based on the National Estuary Layer. The EFZ was estmated at 2079.4 ha and the open water area at 1147.6 ha, making it one of the larger estuaries in the Brede-Grouritz WMA.

Extent of the Breede Estuary.

Duiwenhoks

Delineation of the Duiwenhoks estuary was based on the National Estuary Layer. The EFZ was estmated at 419.3 ha and the open water area at 108.3 ha.

Extent of the Duiwenhoks Estuary.

Goukou

Delineation of the Goukou estuary was based on the National Estuary Layer. The EFZ was estmated at 372.3 ha and the open water area at 122.4 ha.

Extent of the Goukou Estuary.

Gouritz

Delineation of the Gouritz estuary was based on the National Estuary Layer. The EFZ was estmated at 1049.4 ha and the open water area at 319.0 ha, making it one of the largest estuaries in the Breede-Gouritz WMA.

Extent of the Gouritz Estuary.

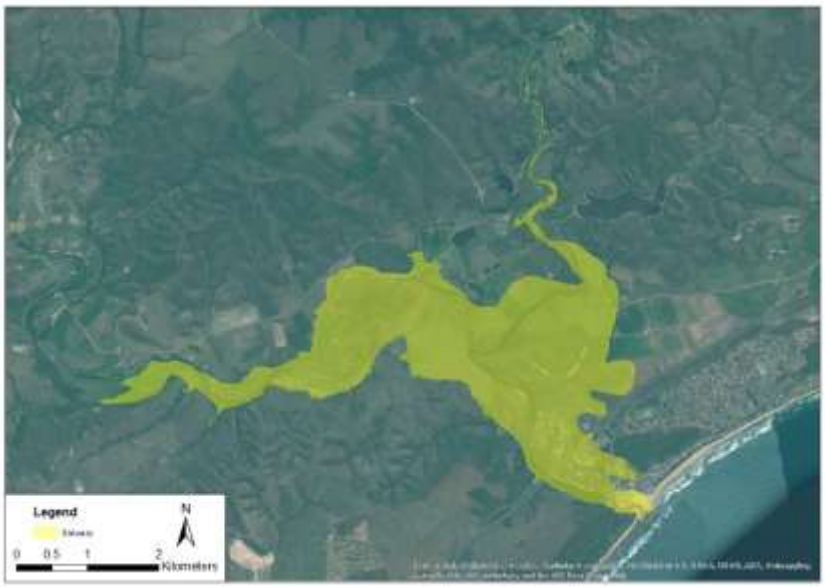
Hartenbos

Delineation of the Hartenbos estuary was based roughly on the National Estuary Layer, but boundaries were adjusted to exclude some areas that were clearly not functionally linked to the estuary. The EFZ was estmated at 236.9 ha and the open water area at 30.5 ha.

Extent of the Hartenbos Estuary (yellow shading) and 5 m contour (blue line).

Klein Brak

Delineation of the Klein Brak estuary was based on the National Estuary Layer. The EFZ was estmated at 976.9 ha and the open water area at 89.4 ha.



Extent of the Klein Brak Estuary.

Groot Brak

Delineation of the Groot Brak estuary was based roughly on the National Estuary Layer, but boundaries were adjusted to exclude some developed areas that were clearly not functionally linked to the estuary any more. The EFZ was estmated at 205.1 ha and the open water area at 65.6 ha.

Extent of the Groot Brak Estuary (yellow shading) and 5 m contour (blue line).

Maalgate

Delineation of the Maalgate estuary was based on the National Estuary Layer. The EFZ was estmated at 22.2 ha and the open water area at 17.0 ha, making it one of the smallest estuaries in the Breede Gouritz WMA.

Extent of the Maalgate Estuary.

Gwaing

Delineation of the Gwaing estuary was based on the National Estuary Layer. The EFZ was estmated at 10.6 ha and the open water area at 4.2 ha, making it the second smallest significant estuary in the Breede-Gouritz WMA.

Extent of the Gwaing Estuary.

Kaaimans

Delineation of the Kaaimans estuary was based on the National Estuary Layer. The EFZ was estmated at 20.6 ha and the open water area at 9.0 ha.

Extent of the Kaaimans Estuary.

Wilderness

Delineation of the Wildernesss estuary was based on the National Estuary Layer. The EFZ was estmated at 1091.7 ha and the open water area at 501.8 ha, making it one of the largest estuaries in the Breede-Gouritz WMA.

Extent of Wilderness Estuary.

Swartvlei

Delineation of the Swartvlei estuary was based roughly on the National Estuary Layer. The EFZ was estmated at 2037.9 ha and the open water area at 114.5 ha, making it the third largest estuary in the Breede-Gouritz WMA. Groenvlei, a freshwater lake to the east of the estuary, which was included as part of the EFZ on the National Estuaries Layer, was excised from the current delineation, along with some of the heavily built up areas near the mouth of the estuary.

Extent of Swartvlei Estuary.

Goukamma

Delineation of the Goukamma estuary was based on the National Estuary Layer. The EFZ was estmated at 213.1 ha and the open water area at 45.3 ha.

Extent of Goukamma Estuary.

Knysna

Delineation of the Knysna estuary was based roughly on the National Estuary Layer, but boundaries were adjusted to exclude some developed areas that were clearly not functionally linked to the estuary any more. The EFZ was estmated at 2284.1 ha and the open water area at 1691.7 ha, making it the second largest estuary in the Breede-Grouritz WMA.

Figure D Error! No text of specified style in document.**.1. Extent of Knysna Estuary (yellow shading) and 5 m contour (blue line).**

Noetsie

Delineation of the Noetsie estuary was based roughly on the National Estuary Layer, but boundaries were adjusted to incorporate additional habitat area around the mouth of the estuary which clearly forms part of the EFZ for this system. The EFZ was estmated at 14.8 ha and the open water area at 8.0 ha, making it one of the smallest significant estuaries in the Breede-Grouritz WMA

Extent of Noetsie Estuary (yellow shading) and 5 m contour (blue line).

Piesang

Delineation of the Piesang estuary was based roughly on the National Estuary Layer, but boundaries were adjusted to exclude some developed areas that were clearly not functionally linked to the estuary any more, and include estuarine habitat around the mouth of the system. The EFZ was estmated at 59.5 ha and the open water area at 4.9 ha.

Extent of Piesang Estuary (yellow shading) and 5 m contour (blue line).

Keurbooms

Delineation of the Keurbooms estuary was based roughly on the National Estuary Layer, but boundaries were adjusted to incorporate additional habitat area in the upper reaches of the system that are below the 5 m contour but were not included on the original layer. The EFZ was estmated at 1 523.4 ha and the open water area at 398.2 ha.

Extent of Keurbooms Estuary.

Groot (Wes)

Delineation of the Groot estuary was based roughly on the National Estuary Layer, but boundaries were adjusted to exclude some developed areas that were clearly not functionally linked to the estuary any more. The EFZ was estmated at 64.4 ha and the open water area at 30.2 ha.

Extent of Groot (Wes) Estuary (yellow shading) and 5 m contour (blue line).

Bloukrans

Delineation of the Bloukrans estuary was based roughly on the National Estuary Layer, but boundaries were adjusted to incorporate additional habitat area in the upper and lower reaches of the system that are below the 5 m contour but were not included on the original layer. The EFZ was estmated at 4.2 ha and the open water area at 2.3 ha, making it the smallest significant estuary in the Breede-Gouritz WMA.

Extent of Bloukrans Estuary.

Appendix D: Rivers

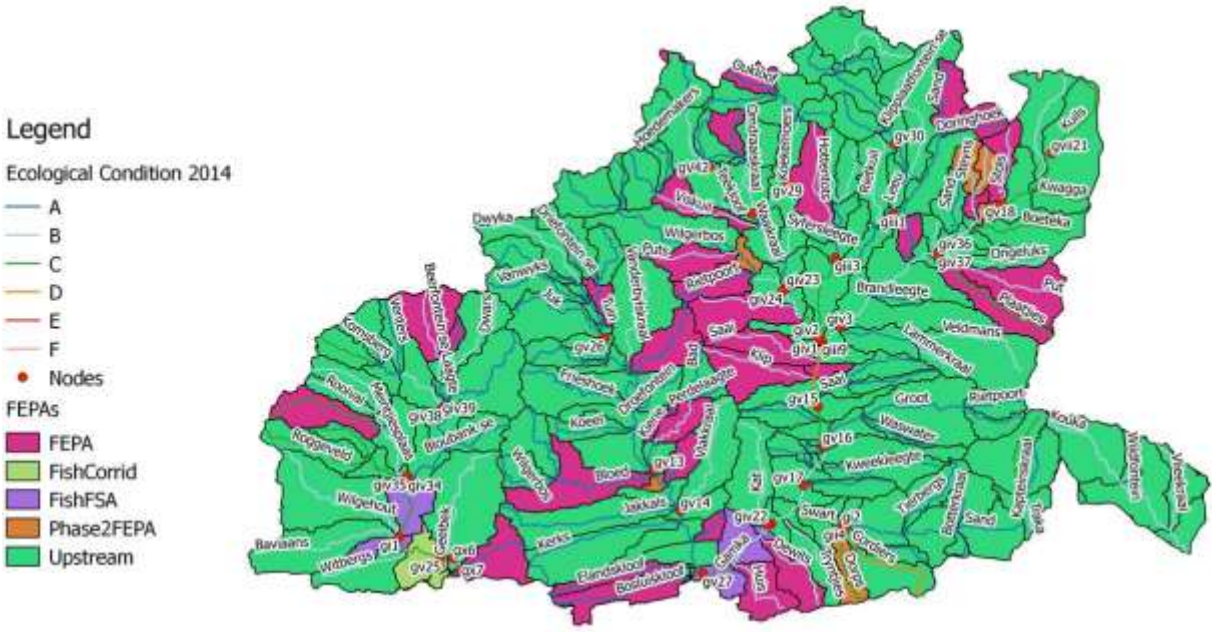


Figure D 1. **Ecological condition 2014 of nodes and location of river FEPAs in Gamka-Buffels IUA**

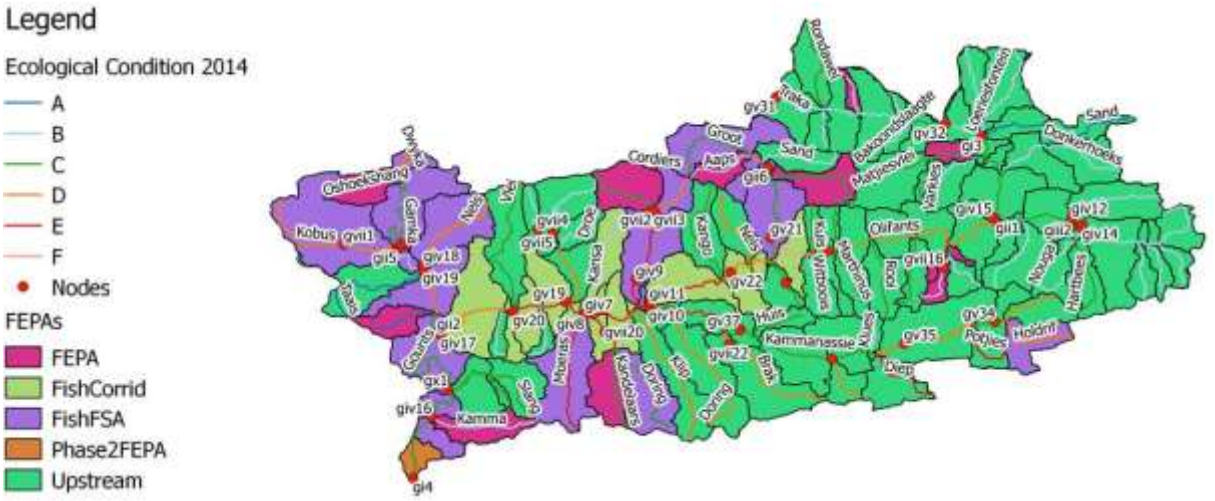


Figure D 2. **Ecological condition 2014 of nodes and location of river FEPAs in Gouritz-Olifants IUA**

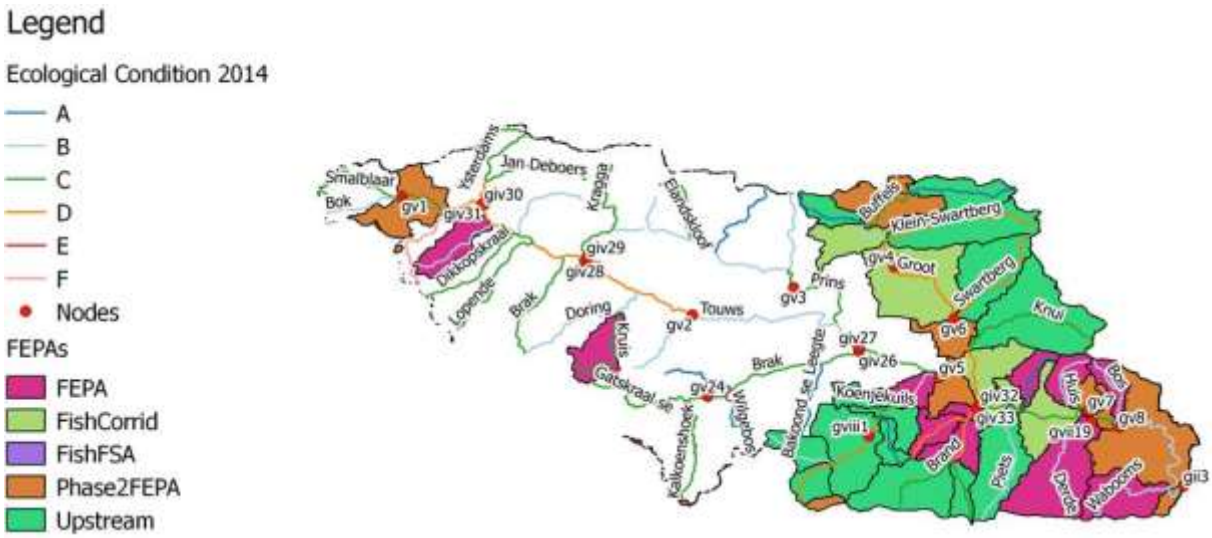


Figure D 3. Ecological condition 2014 of nodes and location of river FEPAs in Touws IUA

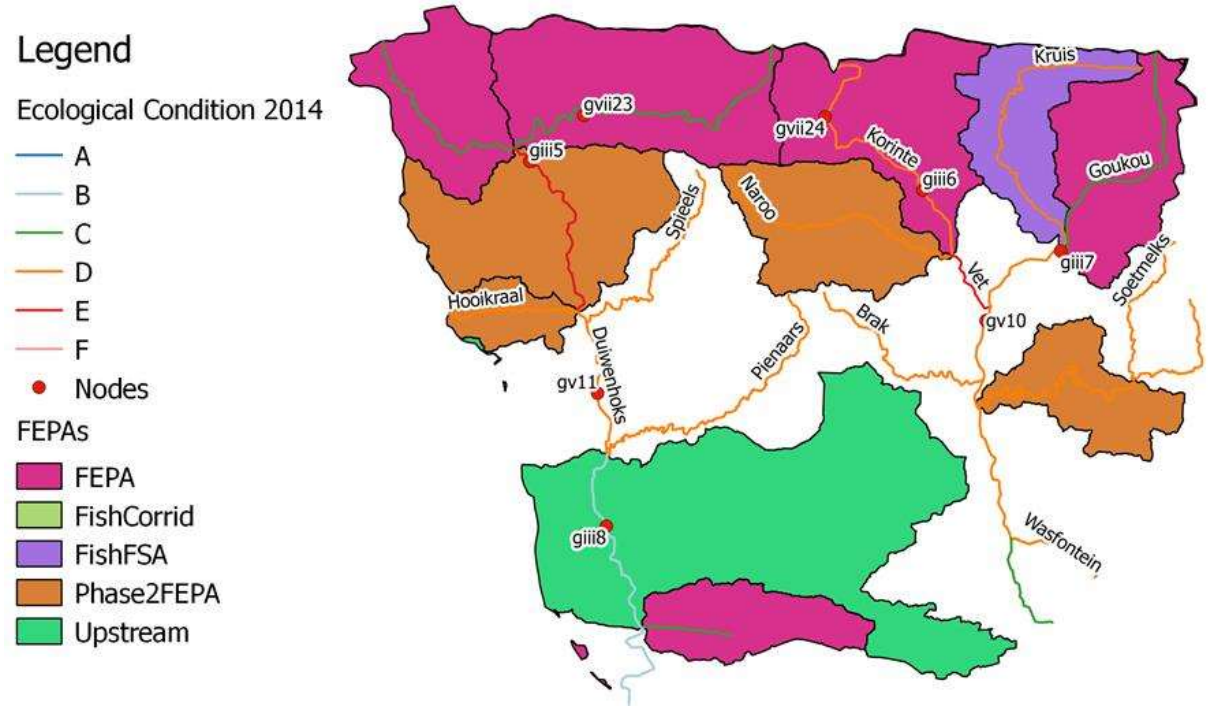


Figure D4. Ecological condition 2014 of nodes and location of river FEPAs in Duiwenhoks IUA

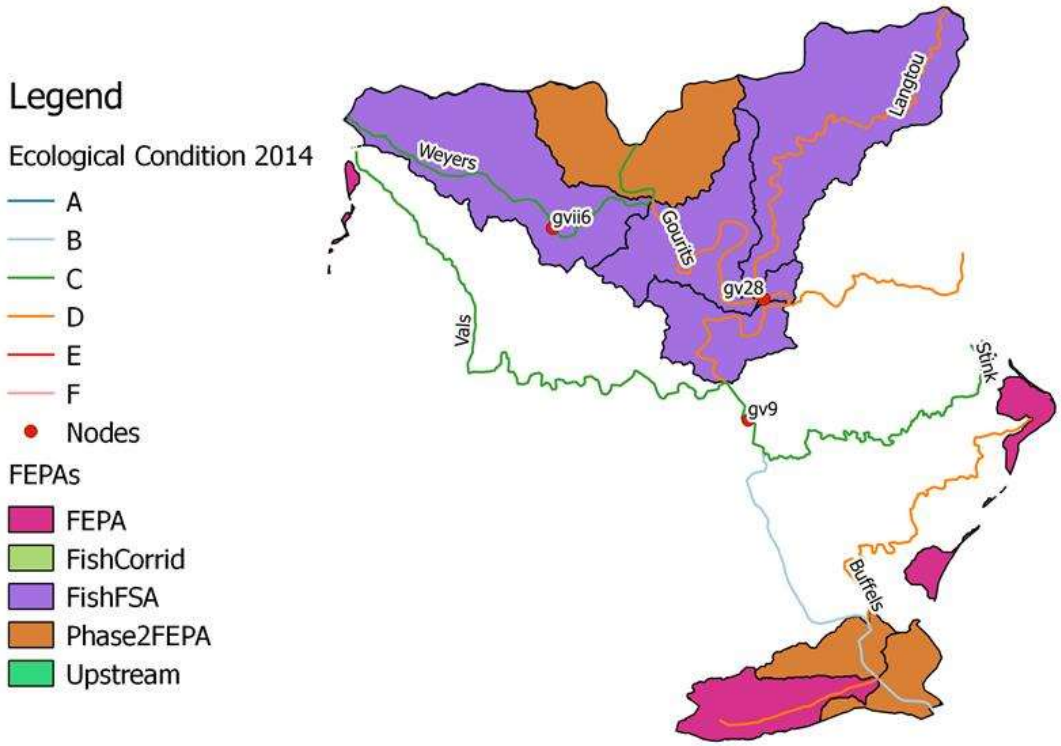


Figure D 5. **Ecological condition 2014 of nodes and location of river FEPAs in Lower Gouritz IUA**

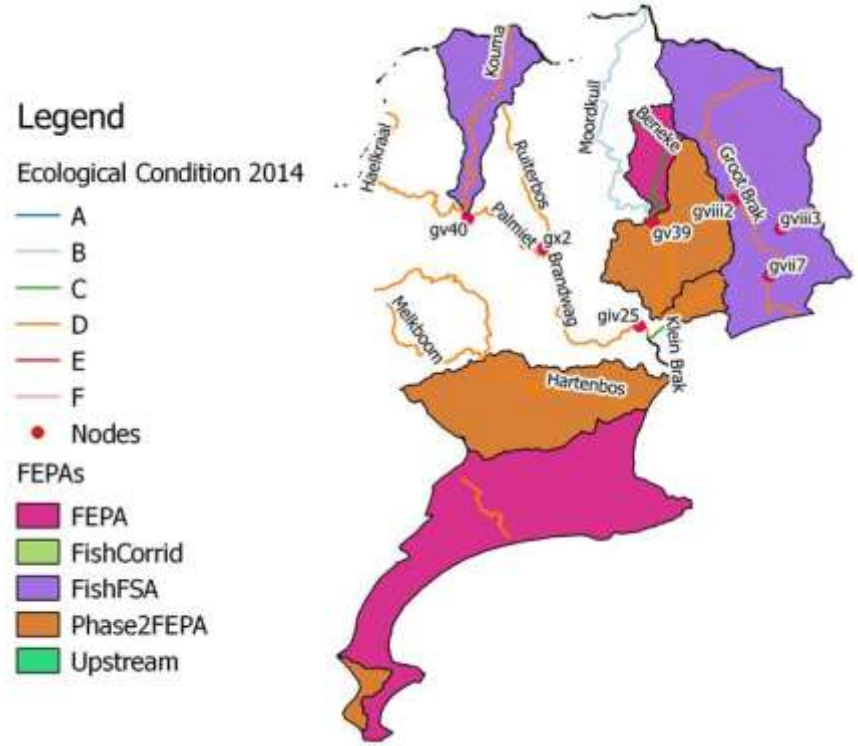


Figure D 6. **Ecological condition 2014 of nodes and location of river FEPAs in Groot Brak IUA**

Figure D 7. Ecological condition 2014 of nodes and location of river FEPAs in Coastal IUA

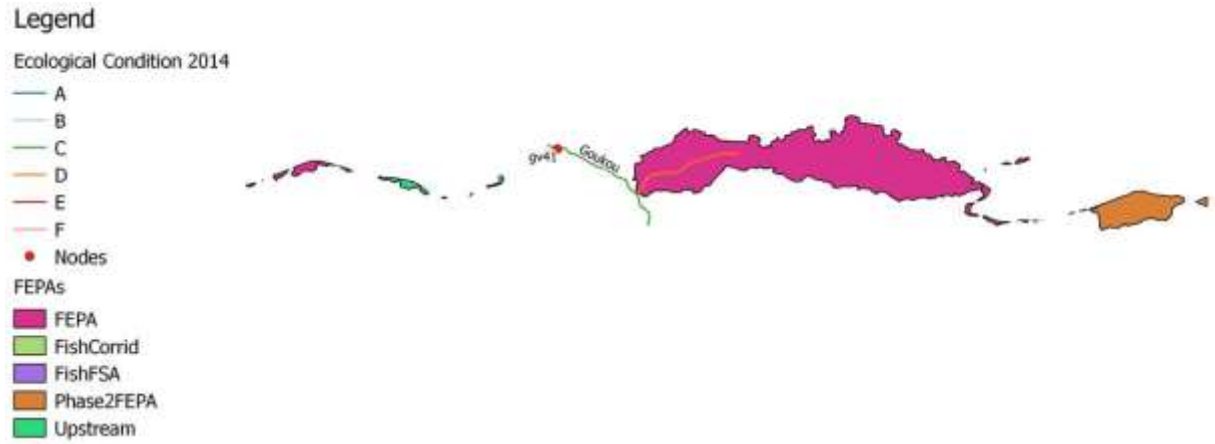


Figure D 8. Ecological condition 2014 of nodes and location of river FEPAs in Hessequa IUA

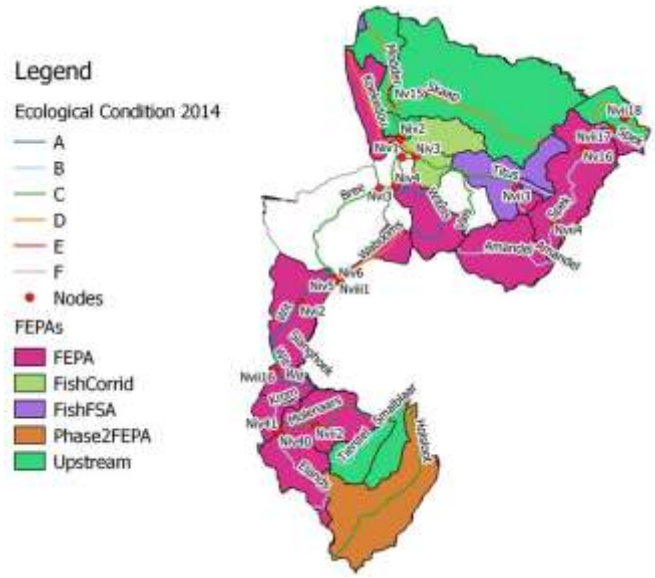


Figure D 9. Ecological condition 2014 of nodes and location of river FEPAs in Upper Breede Tributaries IUA

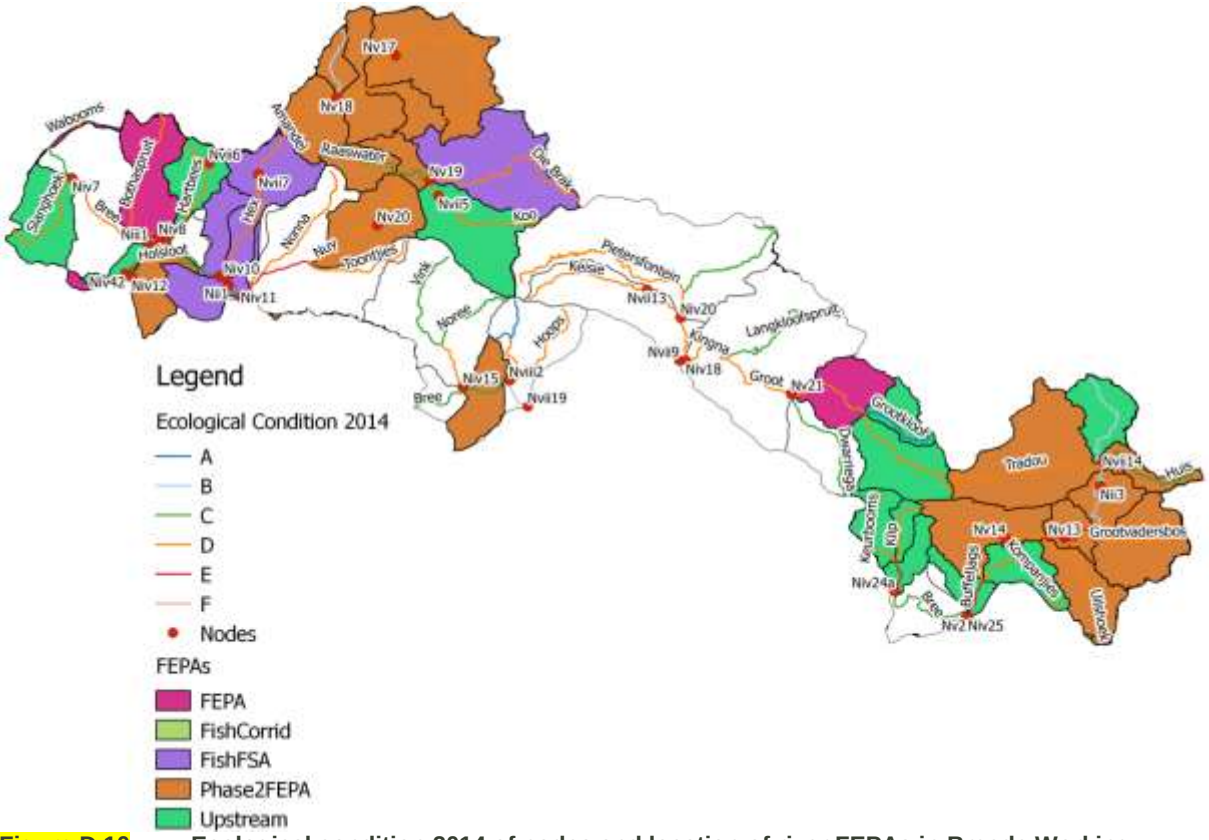


Figure D 10. Ecological condition 2014 of nodes and location of river FEPAs in Breede Working Tributaries IUA

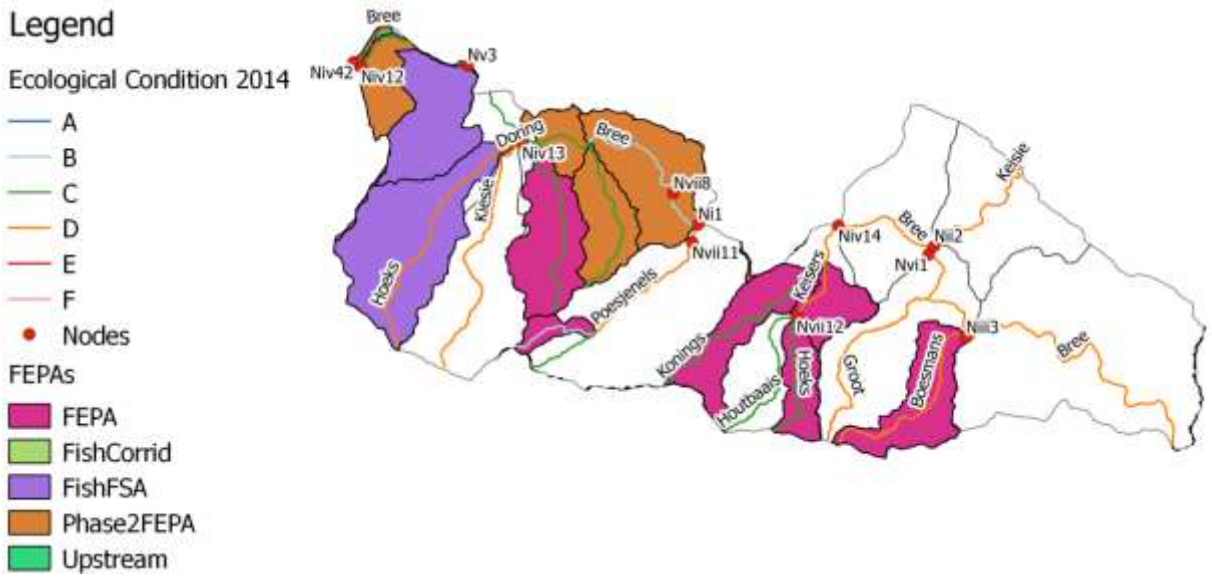


Figure D 11. Ecological condition 2014 of nodes and location of river FEPAs in Middle Breede Renosterveld IUA

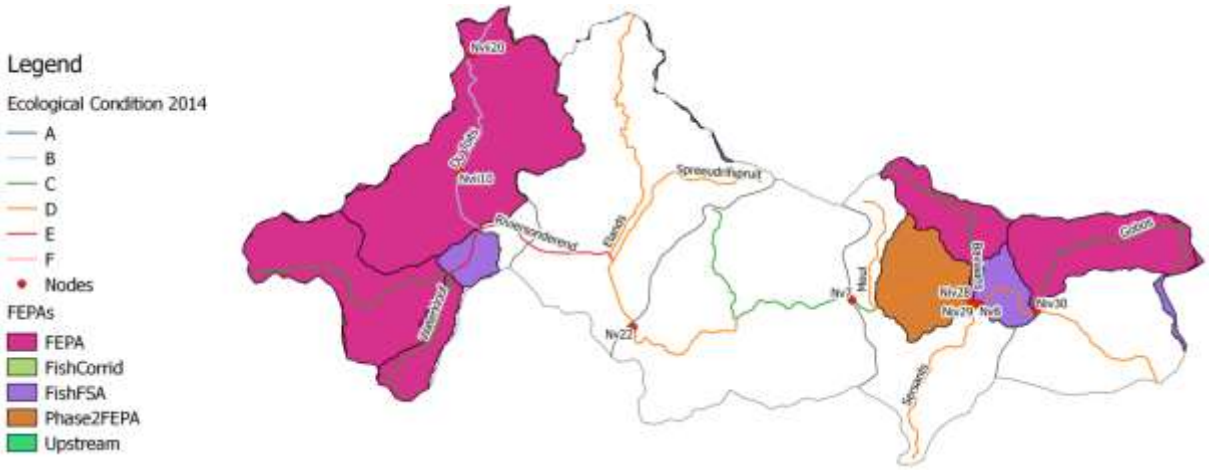


Figure D 12. Ecological condition 2014 of nodes and location of river FEPAs in Riversonderend Theewaters IUA

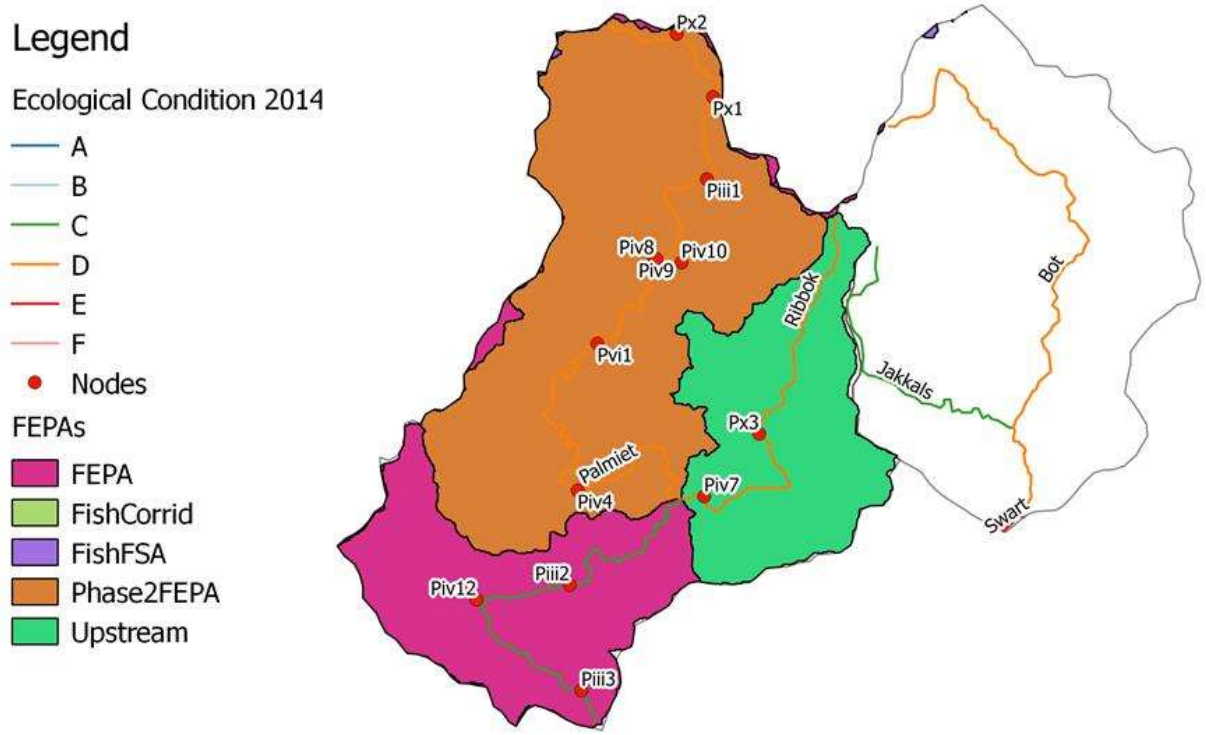


Figure D 13. Ecological condition 2014 of nodes and location of river FEPAs in Overberg West IUA

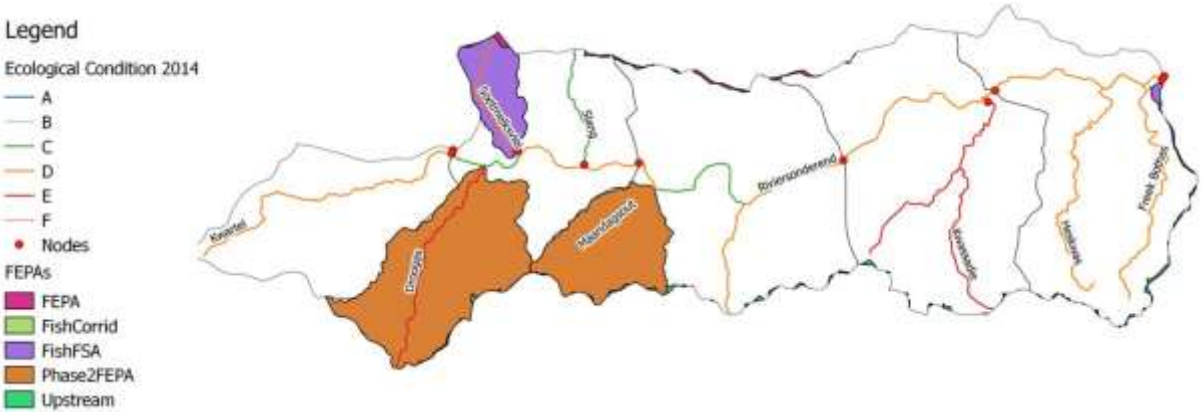


Figure D 14. Ecological condition 2014 of nodes and location of river FEPAs in Lower Riviersonderend IUA

Figure D 15. Ecological condition 2014 of nodes and location of river FEPAs in Overberg East Renosterveld IUA

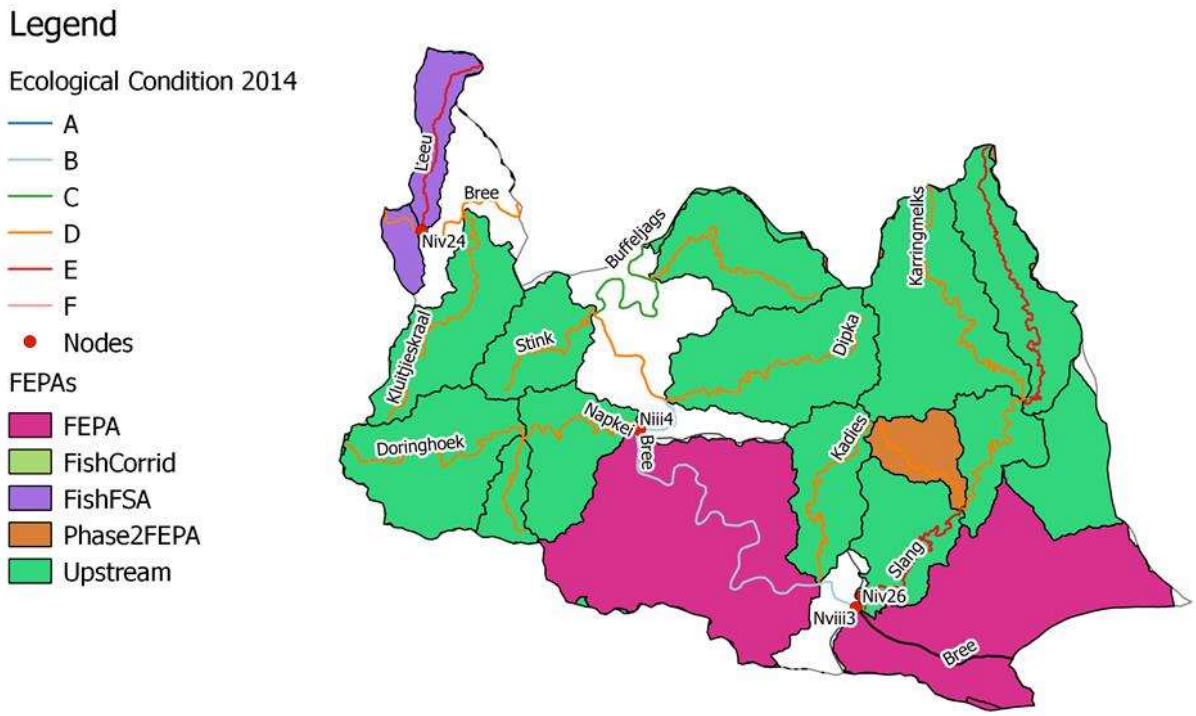


Figure D 16. Ecological condition 2014 of nodes and location of river FEPAs in Lower Breede Renosterveld IUA

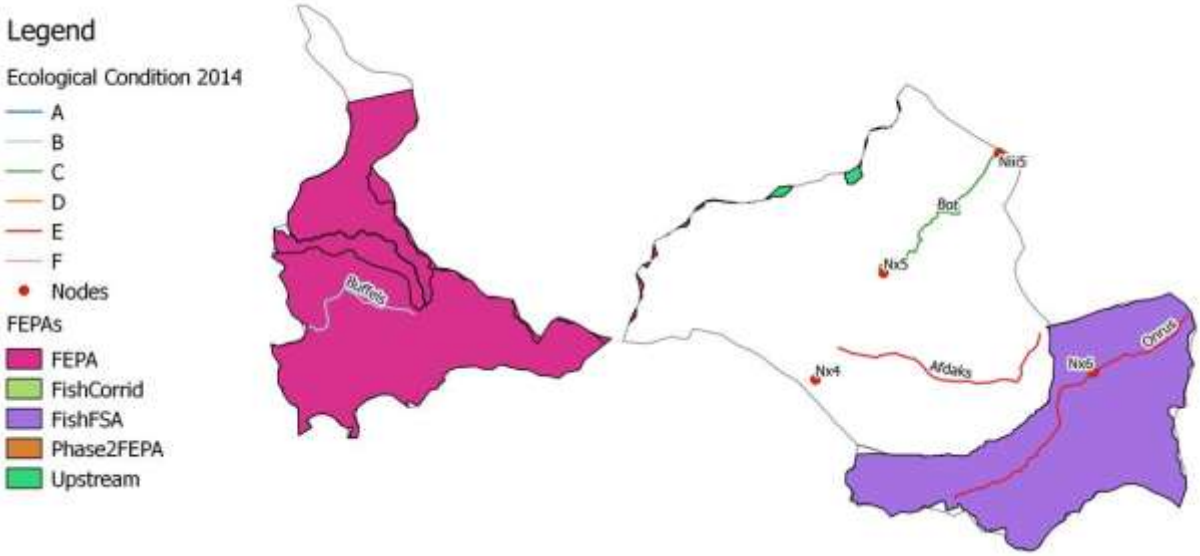


Figure D 17. Ecological condition 2014 of nodes and location of river FEPAs in Overberg West Coastal IUA

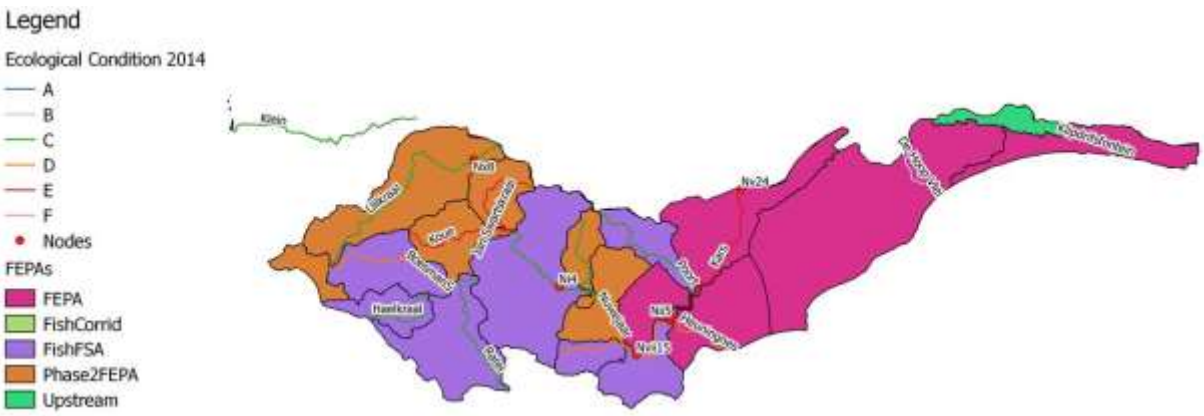


Figure D 18. Ecological condition 2014 of nodes and location of river FEPAs in Overberg East Fynbos IUA

Appendix E: Socio-economics

SEZ 1: Upper and Middle Breede

The two largest towns in the Upper and Middle Breede socio-economic zone are Worcester and Robertson (**Error! Reference source not found.**). This zone is an intensive fruit farming and wine growing region, with the main economic activities being agriculture and agriculture related manufacturing (Figure E 1, Table E 1). The wholesale trade, catering and accommodation sector is also economically important (Table E 1).

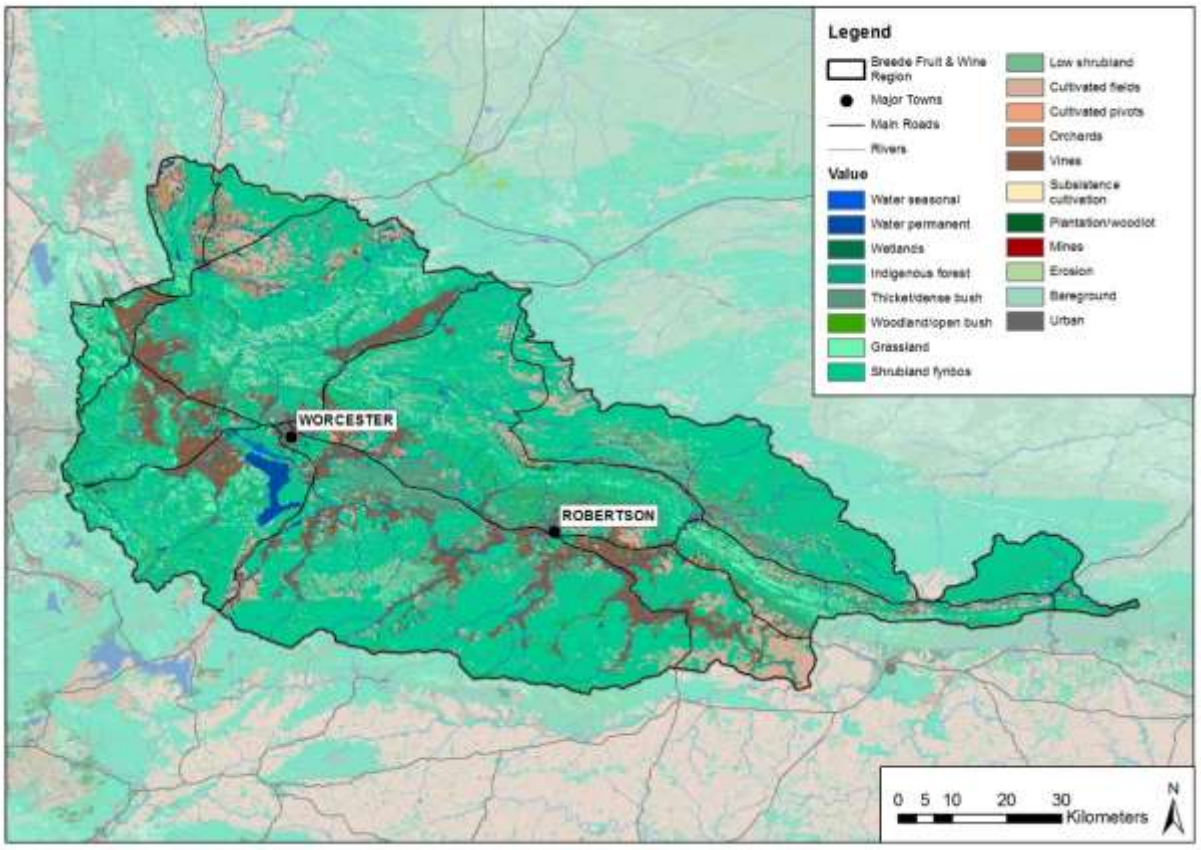


Figure E 1. Land use in the Upper and Middle Breede socio-economic zone (Source: DEA, National Land Cover 2013/14)

A total of 55% of all irrigated crop land in the WMA is located within this socio-economic zone. Wine grapes cover the largest area and represent 56% of the irrigated crop with stone fruit (15%) and pome fruit (13%) covering the next largest areas. Table grapes represent 9% of the irrigated crop area. Of the total area of wine grapes, 29% are located in IUA A3, 23% in IUA A2, and 4% in IUA A1 (Table E 2). In IUA A1, stone fruit and pome fruit are more important, covering over 9500 ha of land (Table E 2). There are approximately 32 400 ha of dryland crops in the Upper and Middle Breede, with grains and planted pasture accounting for 96% of this (Table E 2).

Table E 1. GVA per sector in 2015 (R million, nominal 2015 prices) for the Upper and Middle Breede socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	2 672	22.4%
Mining and Quarrying	29	0.2%
Manufacturing	2 565	21.5%
Electricity, Gas and Water	85	0.7%
Wholesale and Retail Trade, Catering and Accommodation	2 247	18.8%
Transport, Storage and Communication	859	7.2%
Finance, Insurance, Real Estate and Business Services	1 357	11.4%
Community, Social and Government Services	2 142	17.9%
Total	**11 956**	

Table E 2. The total area of irrigated crops within each IUA of the Upper and Middle Breede SEZ (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA A1: Upper Breede Tributaries	IUA A2: Breede Working Tributaries	IUA A3: Middle Breede Renosterveld	Total
Pome fruit (apples and pears)	6 899	1 087	316	8,303
Citrus / sub-tropical fruit	121	493	471	1,085
Other fruit crops	187	102	269	558
Grains	66	355	417	838
Vegetables	62	58	42	163
Stone fruit	2 655	3 980	3 445	10 079
Grapes - wine	2 702	15 360	18 852	36 914
Grapes - table	306	5 192	223	5 723
Planted pasture	187	695	1 145	2 028
Nuts & oil seeds	0.4	12	36	49
Total	**13 186**	**27 334**	**25 221**	**65 740**
Dryland Crop Type				
Flowers	15	109	81	205
Grains	5 254	2 677	3 827	11 759
Planted Pasture	4 526	3 597	11 120	19 244
Vegetables	224	250	193	667
Oil seeds	23	3	263	290
Other crops	12	12	214	238
Total	**10 054**	**6 649**	**15 699**	**32 402**

Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in Table E 3 and Table E 4. Population and income statistics are summarised in Table E 5.

Table E 3. Gross economic output (R million) in each IUA in the Upper and Middle Breede socio-economic zone in 2015 for each water affected economic activity

Economic activity	Breede Working Tributaries	Middle Breede Renosterveld	Upper Breede Tributaries	SEZ Total
Irrigated fruit	3 172	2 146	2 604	7 922
Irrigated crops	40	58	16	114
Tourism & recreation	300	168	211	679
Total	**3 513**	**2 373**	**2 830**	**8 715**

Table E 4. Direct value added, total valued added and total employment in 2015 for the Upper and Middle Breede socio-economic zone for water affected economic activities

Economic activity	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	3 893	6 326	53 955
Irrigated crops	48	80	650
Tourism & recreation	233	525	2 488
Total	**4 174**	**6 931**	**57 093**

Table E 5. Summary of population, income, living conditions and reliance on aquatic resources (Source: StatsSA Census 2011)

Total population	326 137
Average household income	R141 419
% poor households	13%
% unemployed	11%
% households with piped water	94%
% households dependant on river water	1.9%

SEZ 2: Upper Riviersonderend and Palmiet

The Upper Riviersonderend and Palmiet socio-economic zone is located in the south-west corner of the Breede-Gouritz WMA, with the town of Grabouw in the Elgin Valley regarded as the economic hub of this area (Golder Associates 2016) (Table E 6). Other economic hubs include Botrivier and Villiersdorp. The area around Botrivier and Grabour in the Elgin Valley accommodates the bulk of the Western Cape's pome fruit (apples and pears) growing industry (Table E 6) and is supported by a variety of fruit and beverage manufacturers and an established fruit packing industry (Golder Associates 2016). This region is also well-known for its cultivation of fresh flowers and in recent years the expansion of viticulture. Tourism has become an increasingly important part of the economy (Table E 6) with wilderness areas such as the Kogelberg Biosphere Reserve proving to be very popular amongst local and foreign tourists (Golder Associates 2016).

Dryland crops cover approximately 22 500 ha of land but represent only 3% of the total dryland crop area in the WMA. The most extensive dryland crops include grains, planted pastures and oil seeds. There are close to 16 000 ha of irrigated crop land in this zone, accounting for 13% of irrigated crops in the WMA (Table E 7). Pome fruit is the by far the most extensive and economically important crop grown in this region, making up 81% of the irrigated crop (Table E 7). Stone fruits account for 5% and wine grapes 8% of the irrigated crops in this zone.

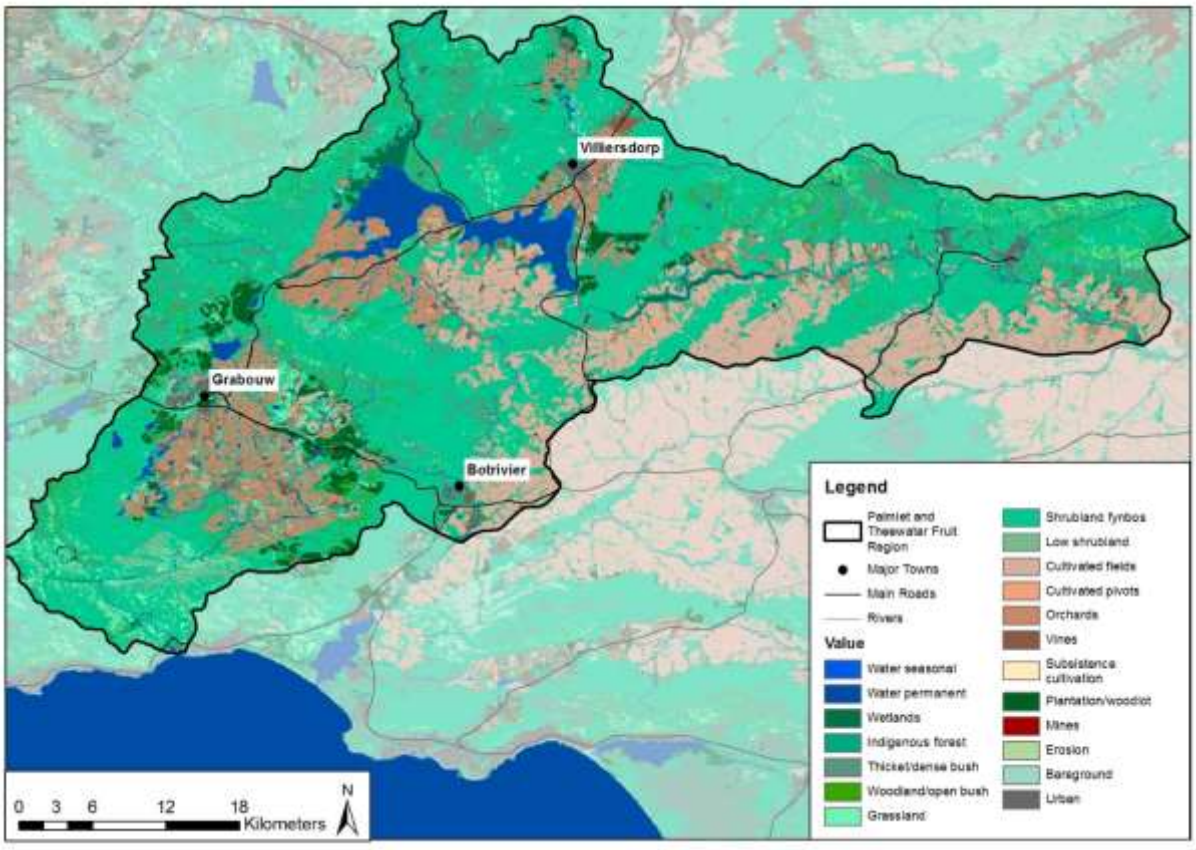


Figure E 2. Land use in the Upper Riviersonderend & Palmiet (Source: DEA, National Land Cover 2013/14)

Table E 6. GVA per sector in 2015 (R million, nominal 2015 prices) for the Upper Riviersonderend and Palmiet socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	789	21.9%
Mining and Quarrying	2	0.1%
Manufacturing	559	15.5%
Electricity, Gas and Water	81	2.2%
Wholesale and Retail Trade, Catering and Accommodation	421	11.7%
Transport, Storage and Communication	209	5.8%
Finance, Insurance, Real Estate and Business Services	1 106	30.7%
Community, Social and Government Services	437	12.1%
Total	**3 603**	

Table E 7. The total area of irrigated crops within each IUA of the Upper Riviersonderend and Palmiet SEZ (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA B4: Riviersonderend Theewaters	IUA B5: Overberg West	Total
Pome Fruit (apples and pears)	6 269	6 598	12 868
Citrus / sub-tropical Fruit	36	19	55
Other fruit crops	198	67	265
Grains	126	0	126
Vegetables	18	6	25
Stone Fruit	612	247	859
Grapes - Wine	244	1 069	1 313
Planted Pasture	313	0	313
Total	**7 815**	**8 006**	**15 821**
Dryland Crop Type			
Flowers	28	39	67
Grains	6 248	2 972	9 220
Planted Pasture	7 421	3 708	11 130
Vegetables	169	21	191
Oil seeds	1 215	640	1 855
Grapes - Wine	-	2	2
Total	**15 082**	**7 383**	**22 465**

Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in Table E 8 and Table E 9. Population and income statistics are summarised in Table E 10.

Table E 8. Gross economic output (R million) in each IUA in the Upper Riviersonderend and Palmiet socio-economic zone in 2015 for each water affected economic activity

Economic activity	Overberg West	Riviersonderend Theewaters	SEZ Total
Irrigated fruit	1 778	1 779	3 557
Irrigated crops	1	17	17
Plantation forestry	32	11	43

Tourism & recreation	185	151	336
Total	**1 995**	**1 959**	**3 954**

Table E 9. Direct value added, total valued added and total employment in 2015 for the Upper Riviersonderend and Palmiet socio-economic zone for water affected economic activities

Economic activity	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	1 719	2 836	23 701
Irrigated crops	7	12	99
Plantation forestry	19	31	270
Tourism & recreation	115	260	1 231
Total	**1 861**	**3 139**	**25 302**

Table E 10. Summary of population, income, living conditions and reliance on aquatic resources (Source: StatsSA Census 2011)

Total population	81 701
Average household income	R172 255
% poor households	15%
% unemployed	14%
% households with piped water	87%
% households dependant on river water	1.4%

SEZ 3: Overberg Coast

The Overberg Coast socio-economic zone is located along the south-western coastline of the WMA, extending as far inland as Bredasdorp (Figure E 3). The largest towns in this zone include Hermanus, Bredasdorp, Cape Agulhas, Struisbaai and Arniston.

There are a number of major tourist centres across this socio-economic zone. The town of Hermanus has grown significantly over recent years and as a range of businesses and services are now present here (Golder Associates 2016). The town is a popular retirement destination and is an extremely popular tourist destination. Other coastal towns along the Overberg Coast, such as Agulhas and Arniston are also popular seaside tourism destinations. During peak holiday season the populations of most of the coastal towns increase more than threefold (Golder Associates 2016). Other tourism drawcards include Cape Agulhas – Africa's southernmost point, De Hoop Nature Reserve, Cape Agulhas National Park, and wine tourism such as the Hemel en Aarde Valley wine route. GVA in 2015 was estimated to be R5.4 billion, representing 8.5% of total GVA in the Breede-Gouritz WMA.

Manufacturing, the fourth highest contributor to GVA in this region is focused around agriculture and the metal and machinery industry. Most of the manufacturing capacity is located in Bredasdorp and is an important employer in this area. Fishing has always been an important economic activity along this coast, but in recent years productivity in this sector has decreased significantly and has had a negative impact on employment and social stability in many of the coastal areas in this zone (Golder Associates 2016).

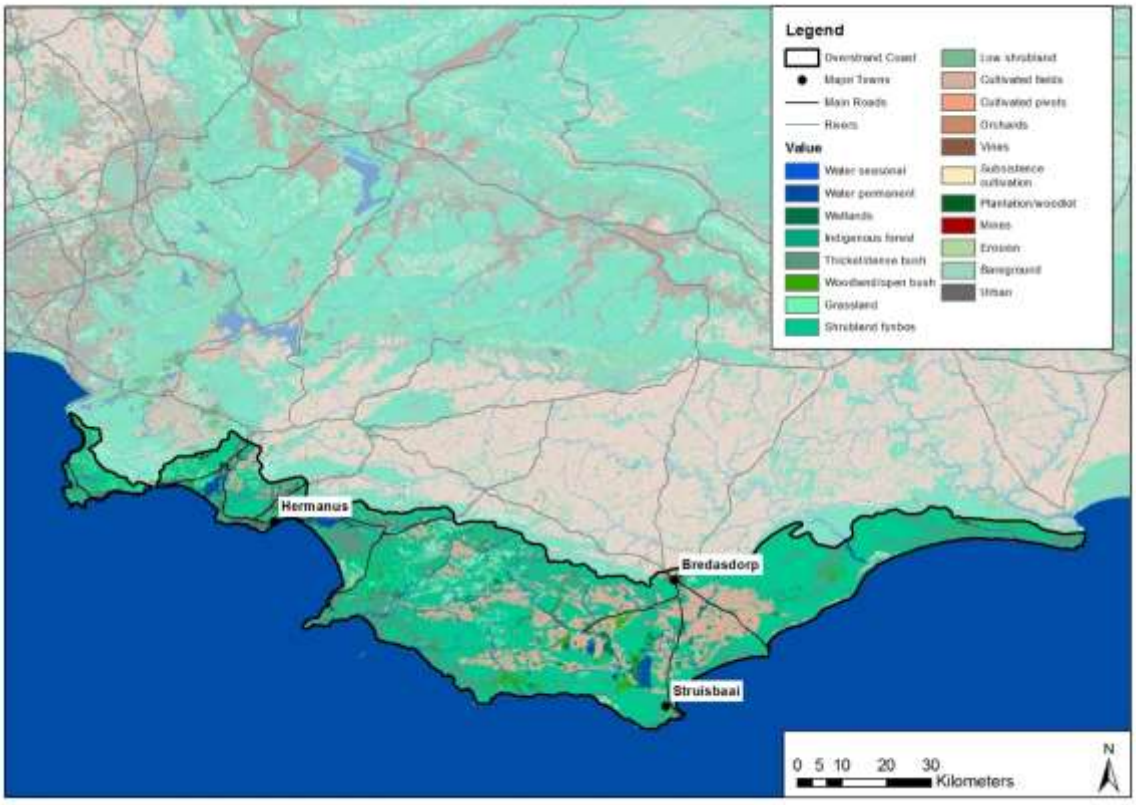


Figure E 3. Land use along the Overberg Coast (Source: DEA, National Land Cover 2013/14)

Table E 11. GVA per sector in 2015 (R million, nominal 2015 prices) for the Overberg Coast socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	218	4.1%
Mining and Quarrying	8	0.2%
Manufacturing	652	12.2%
Electricity, Gas and Water	63	1.2%
Wholesale and Retail Trade, Catering and Accommodation	1 178	22.0%
Transport, Storage and Communication	400	7.5%
Finance, Insurance, Real Estate and Business Services	1 744	32.5%
Community, Social and Government Services	1 099	20.5%
Total	**5 362**	

Approximately 51 500 ha of land is used for farming in this zone, with 97% of this being dryland crops and 3% irrigated crops (Table E 12). Grains such as barley and wheat are important, as are planted pastures which support livestock and dairy farming (Golder Associates 2016). Wine grapes represent 63% of the irrigated crop land. According to Golder Associates (2016) mixed farming in which farmers have both livestock and grain crops accounted for more than 98% of the agricultural activity in the area in 2003. Livestock and grain farming is most intense in the inland areas of this zone, around Bredasdorp.

Table E 12. The total area of irrigated and dryland crops within each IUA of the Overberg Coast (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA H16: Overberg West Coastal	IUA H17: Overberg East Fynbos	Total
Pome Fruit (apples and pears)	127	0	127
Other fruit crops	10	0	10
Grains	13	37	51
Stone Fruit	112	58	170
Grapes - Wine	547	570	1 118
Grapes - Table	6.4	26.1	32
Planted Pasture	71	184	255
Total	**887**	**876**	**1 763**
Dryland Crop Type			
Flowers	57	504	560
Grains	601	14 976	15 577
Planted Pasture	1 604	27 895	29 499
Oil seeds	168	3 665	3 832
Total	**2 429**	**47 040**	**49 469**

Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in Table E 13 and Table E 14. Population and income statistics are summarised in Table E15.

Table E 13. Gross economic output (R million) in each IUA in the Overberg Coast socio-economic zone in 2015 for each water affected economic activity

Economic activity	Overberg West Coastal	Overberg East Fynbos	SEZ Total
Irrigated fruit	50	92	143
Irrigated crops	8	3	11
Tourism & recreation	480	362	842
Fisheries	207	14	221
Total	**745**	**471**	**1 216**

Table E 14. Direct value added, total valued added and total employment in 2015 for the Overberg Coast socio-economic zone for water affected economic activities

Economic activity	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	70	114	1 030
Irrigated crops	5	8	68
Tourism & recreation	288	651	3 083
Fisheries	71	136	1 186
Total	**434**	**909**	**5 367**

Table E 15. Summary of population, income, living conditions and reliance on aquatic resources (Source: StatsSA Census 2011)

Total population	105 582
Average household income	R170 395
% poor households	18%
% unemployed	20%
% households with piped water	90%
% households dependant on river water	0.4%

SEZ 4: Wheat Belt

The Wheat Belt socio-economic zone is situated slightly inland from the coast and runs along the Langeberg Mountain range from the Overberg towards the Gouritz River (). This rural agricultural region produces some citrus fruit, stone fruit and pome fruit but is dominated by grain crops such as wheat and barley. Wool, dairy and livestock farming is also important. The main economically active towns in this region are Caledon, Swellendam, Riversdale, Riviersonderend and Heidelberg. Manufacturing is important (Table E16) and strongly reliant on the agricultural sector for value adding and agro-processing, such as milk, canning, spirits and wine) (Golder Associates 2016). The town of Caledon is an important agricultural centre with barley, canola and wheat being the dominant agricultural products here (Golder Associates 2016). A South African Breweries (SAB) malting plant which processes almost all of the local barley production is located in Caledon (Golder Associates 2016).

The Breede River Estuary, situated at Infanta falls within IUA F11 of this zone. The estuary is an important tourism attraction and is regarded as one of the best fishing estuaries in the country (Golder Associates 2016). Tourism is an important contributor to GVA and to employment in this region ().

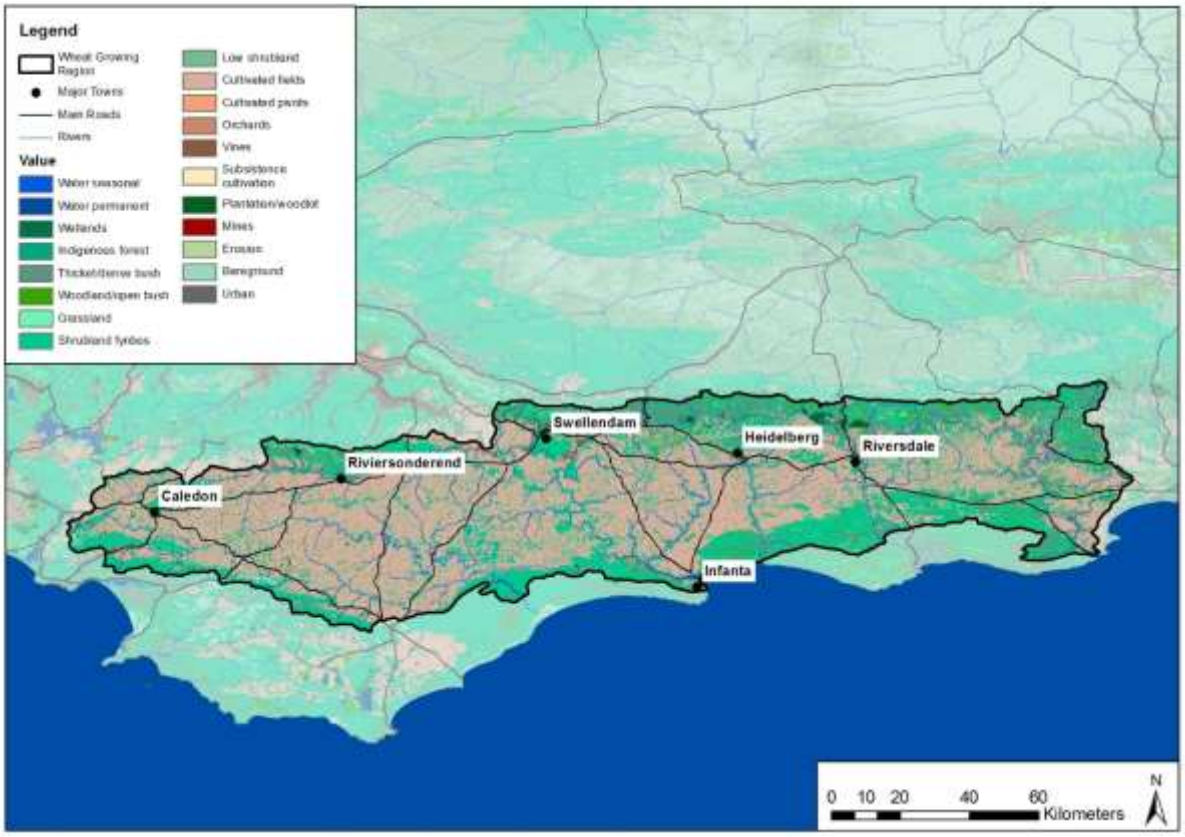


Figure E 4. Land use in the Wheat Belt socio-economic zone (Source: DEA, National Land Cover 2013/14)

Agricultural crops cover approximately 501 000 ha of land. Dryland crops represent 98% of this and irrigated crops only 2% (). Irrigated crops include planted pasture (45%), grains (16%), wine grapes (10%), stone fruit (10%), citrus fruit (10%) and pome fruit (7%). Planted pasture represents the largest contributor to dryland crops (50%), followed by grains (39%) and oil seed crops (10%) ().

Table E 16. GVA per sector in 2015 (R million, nominal 2015 prices) for the Wheat Belt socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	718	13.3%
Mining and Quarrying	12	0.2%
Manufacturing	881	16.3%
Electricity, Gas and Water	113	2.1%
Wholesale and Retail Trade, Catering and Accommodation	1 101	20.3%
Transport, Storage and Communication	513	9.5%
Finance, Insurance, Real Estate and Business Services	824	15.2%
Community, Social and Government Services	1 252	23.1%
Total	**5 413**	

Table E 17. The total area of irrigated and dryland crops within each IUA of the What Belt socio-economic zone (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA F9: Lower Riviersond-erend	IUA F10: Overberg East Renoster-veld	IUA F11: Lower Breede Renoster-veld	IUA F12: Duiwenhoks	IUA F13: Lower Gouritz	Total
Pome Fruit (apples and pears)	415	245	46	9	-	715
Other fruit crops	51	29	191	11	-	282
Citrus / sub-tropical fruit	195	-	663	132	16	1 006
Nuts and oil seeds	-	33	58	62	11	164
Grains	551	259	567	219	40	1 635
Stone Fruit	64	121	605	131	56	977
Grapes - Wine	108	527	62	26	63	786
Planted Pasture	1 061	480	1,992	651	389	4 573
Vegetables	25	13	-	45	-	83
Total	**2 471**	**1 707**	**4 184**	**1 286**	**574**	**10 222**
Dryland Crop Type						
Grains	25 177	80 038	53 728	23 896	9 057	191 895
Planted Pasture	32 043	78 893	58 260	43 095	34 881	247 173
Oil seeds	5 194	16 349	19 064	6 153	2 738	49 499
Other crops	733	105	904	417	39	2 197
Total	**63 147**	**175 386**	**131 956**	**73 560**	**46 715**	**490 764**

Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in Table E 18 and Table E 19. Population and income statistics are summarised in Table E 20.

Table E 18. Gross economic output (R million) in each IUA in the Wheat Belt socio-economic zone in 2015 for each water affected economic activity

Economic activity	Duiwenhoks	Lower Breede Renosterveld	Lower Gouritz	Lower Riviersonderend	Overberg East Renosterveld	SEZ Total
Irrigated fruit	63	349	19	179	127	737
Irrigated crops	36	90	17	54	25	221
Tourism & recreation	123	209	123	27	143	625
Fisheries	0	5	0	0	0	5

Total	**221**	**652**	**159**	**260**	**294**	**1 587**

Table E 19. Direct value added, total valued added and total employment in 2015 for the Wheat Belt socio-economic zone for water affected economic activities

Economic activity	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	357	587	4 951
Irrigated crops	93	154	1 300
Tourism & recreation	214	483	2 288
Fisheries	2	3	25
Total	**665**	**1 227**	**8 564**

Table E 20. Summary of population, income, living conditions and reliance on aquatic resources (Source: StatsSA Census 2011)

Total population	110 275
Average household income	R111 623
% poor households	10%
% unemployed	14%
% households with piped water	94%
% households dependant on river water	2.9%

SEZ 5: Hessequa Coast

The Hessequa Coast is the smallest of the nine socio-economic zones and is situated in between the Breede River Estuary in the west and the Gouritz Estuary in the east along the southern Cape coast (Figure E 5). GVA was estimated to be R625 billion in 2015, the smallest of all the zones in the WMA (Table E 21). The main towns, which are small and sparsely populated, are Stilbaai and Jongensfontein, both located on the coast. There are a number of private nature reserves and privately owned farm land along this stretch of coast with tourism being important in this region. Agriculture is also an important economic activity with the most abundant crop being planted pasture for livestock and dairy farming, grains and a small amount of stone fruit (Table E 22).

It is estimated that there are a total of 774 ha of land under crop agriculture in this zone (Table E 22). Dryland crops represent 94% of the crop cover and irrigated crops represent only 6%. Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in Table E 23 and Table E 24. Population and income statistics are summarised in Table E 25.

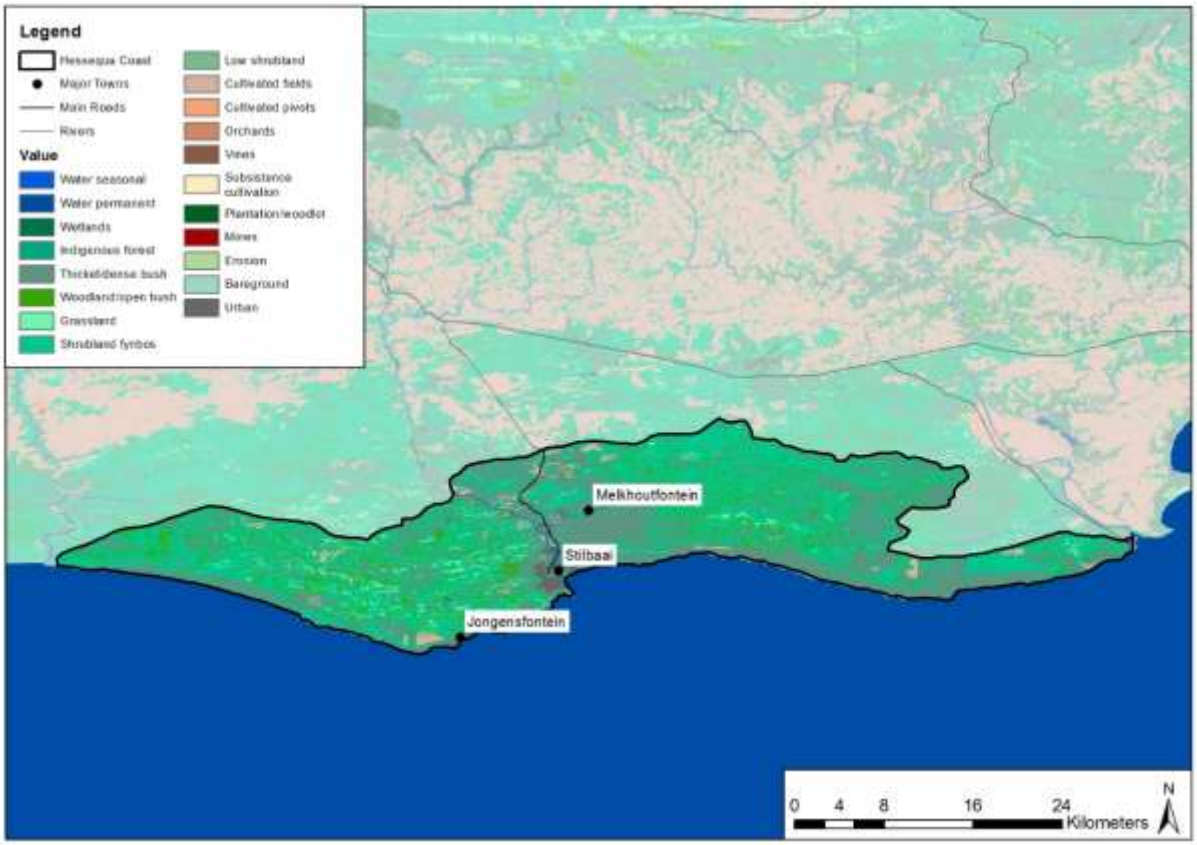


Figure E 5. Land use in the Hessequa Coast socio-economic zone (Source: DEA, National Land Cover 2013/14)

Table E 21. GVA per sector in 2015 (R million, nominal 2015 prices) for the Hessequa Coast socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	54	8.6%
Mining and Quarrying	0	0.0%
Manufacturing	11	1.8%
Electricity, Gas and Water	17	2.7%
Wholesale and Retail Trade, Catering and Accommodation	165	26.3%
Transport, Storage and Communication	6	1.0%
Finance, Insurance, Real Estate and Business Services	281	44.9%
Community, Social and Government Services	91	14.6%
Total	**626**	

Table E 22. The total area of irrigated and dryland crops within each IUA of the Hessequa Coast SEZ (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA I18: Hessequa
Stone Fruit	48
Planted Pasture	2
Total	**50**
Dryland Crop Type	
Grains	106
Planted pastures	555
Other crops	63
Total	**724**

Table E 23. Gross economic output (R million) per IUA in the Hessequa socio-economic zone in 2015 for each water affected economic activity

Economic activity	Hessequa
Irrigated fruit	10.8
Irrigated crops	0.1
Tourism & recreation	97
Fisheries	132
Total	**240**

Table E 24. Direct value added, total valued added and total employment in 2015 for the Hessequa Coast socio-economic zone for water affected economic activities

Economic activity	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	5.2	8.6	71
Irrigated crops	0.03	0.1	1
Tourism & recreation	33	75	357
Fisheries	42	82	710
Total	**81**	**166**	**1 138**

Table E 25. Summary of population, income, living conditions and reliance on aquatic resources (Source: StatsSA Census 2011)

Total population	8 487
Average household income	R167 908
% poor households	9%
% unemployed	4%
% households with piped water	94%
% households dependant on river water	1.1%

SEZ 6: Little Karoo West

The Little Karoo West socio-economic zone is situated in the north-central area of the WMA. The two main towns in this zone are Touwsrivier and Ladismith (Figure E 6). It was estimated that GVA in the Little Karoo West was R957 billion in 2015, contributing only 1.5% to total GVA in the WMA (Table E 26). The economy of the area is dominated by farming and agriculture related manufacturing. Sheep and game farming, dryland crops and some irrigated crops are farmed in this region.

There are an estimated 11 500 ha of crop land in the Little Karoo West (Table E 27). Approximately 70% of this is dryland agriculture and 30% is irrigated crop land. Stone fruit, wine grapes and planted pasture represent the bulk of irrigated crop land. Grains and planted pastures are the dominant dryland crops in this zone.

Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in Table E 28 and Table E 29. Population and income statistics are summarised in Table E 30.

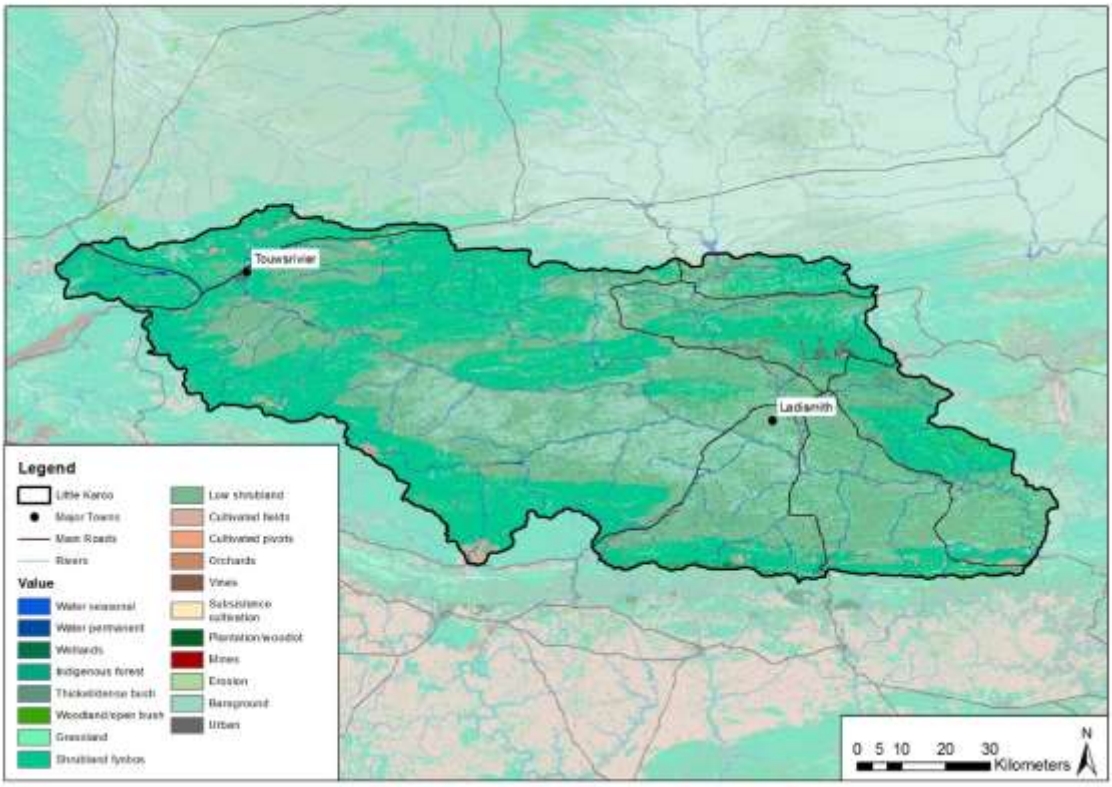


Figure E 6. Land use in the Little Karoo West socio-economic zone (Source: DEA, National Land Cover 2013/14)

Table E 26. GVA per sector in 2015 (R million, nominal 2015 prices) for the Little Karoo West socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	194	20.3%
Mining and Quarrying	-	0.0%
Manufacturing	166	17.4%
Electricity, Gas and Water	33	3.4%
Wholesale and Retail Trade, Catering and Accommodation	133	13.9%
Transport, Storage and Communication	53	5.6%
Finance, Insurance, Real Estate and Business Services	144	15.0%
Community, Social and Government Services	234	24.4%
Total	**957**	

Table E 27. The total area of irrigated and dryland crops within the IUA E8 of the Little Karoo West socio-economic zone (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA E8: Touws
Pome Fruit (apples and pears)	357
Citrus fruit	4
Other fruit crops	140
Grains	272
Stone Fruit	1 288
Grapes - Wine	699
Grapes - Table	94
Planted Pasture	621
Vegetables	21
Total	**3 496**
Dryland Crop Type	
Flowers	9
Grains	2 087
Planted Pasture	5 603
Vegetables	311
Other crops	3
Total	**8 013**

Table E 28. Gross economic output (R million) per IUA in the Little Karoo West socio-economic zone in 2015 for each water affected economic activity

Economic activity	Touws
Irrigated fruit	483
Irrigated crops	33
Tourism & recreation	271
Total	**787**

Table E 29. Direct value added, total valued added and total employment in 2015 for the Little Karoo West socio-economic zone for water affected economic activities

Economic activity	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	234	385	3 234
Irrigated crops	14	23	191
Tourism & recreation	93	210	992
Total	**341**	**618**	**4 417**

Table E 30. Summary of population, income, living conditions and reliance on aquatic resources (Source: StatsSA Census 2011)

Total population	22 341
Average household income	R95 437
% poor households	13%
% unemployed	15%
% households with piped water	92%
% households dependant on river water	4.3%

SEZ 7: Great Karoo

The Great Karoo socio-economic zone is the largest of the nine zones, is sparsely populated, and is located in the northern most section of the WMA. The main towns include Laingsburg, Bitterwater and Beaufort West (Figure E 7). A valuable tourism drawcard in this region is the Karoo National Park which is located just outside of the town of Beaufort West. It was estimated that GVA in the Great Karoo was R2.2 billion in 2015, contributing 3.5% to total GVA in the WMA (Table E 31).

Stone fruit, planted pasture land and vegetables represent the most extensive irrigated crops in this zone (Table E 32). Livestock farming and game farming is also an important economic activity here. Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in Table E 33 and Table E 34. Population and income statistics are summarised in Table E 35.

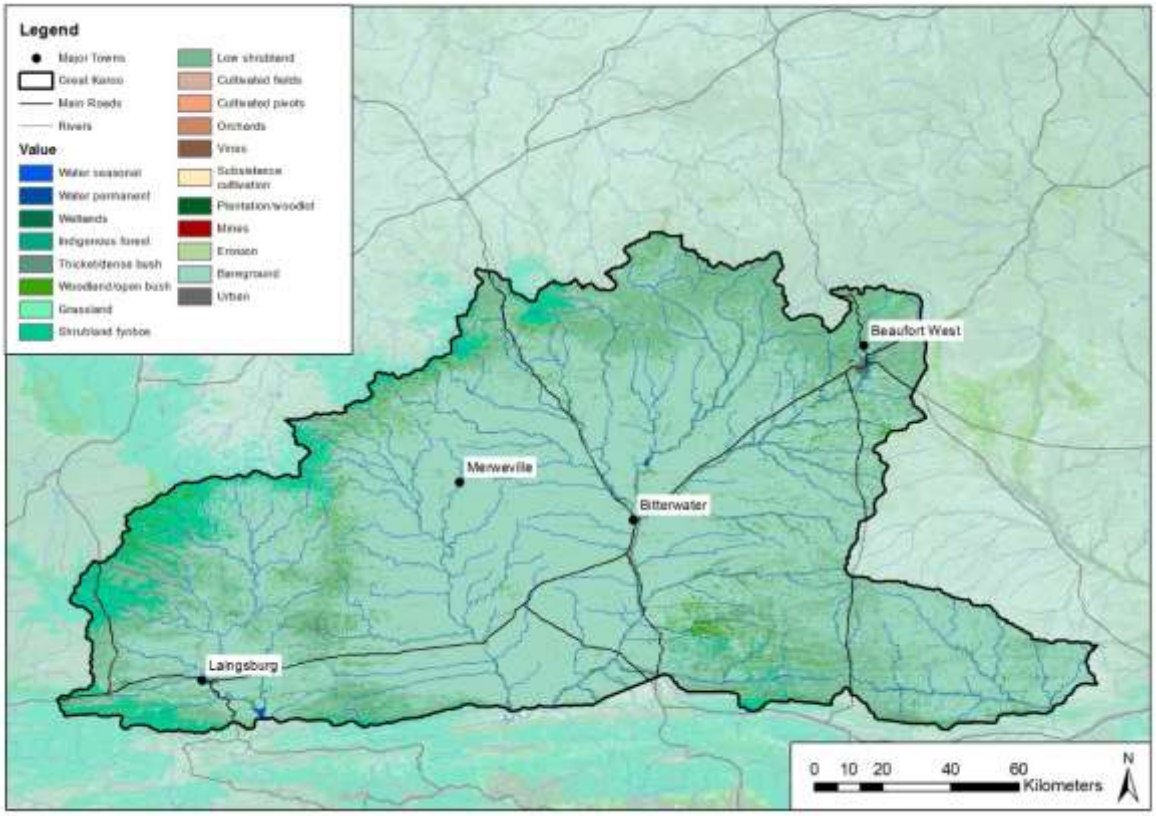


Figure E 7. Land use in the Great Karoo socio-economic zone (Source: DEA, National Land Cover 2013/14)

Table E 31. GVA per sector in 2015 (R million, nominal 2015 prices) for the Great Karoo socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	74	3.4%
Mining and Quarrying	-	0.0%
Manufacturing	201	9.2%
Electricity, Gas and Water	41	1.9%
Wholesale and Retail Trade, Catering and Accommodation	449	20.5%
Transport, Storage and Communication	259	11.8%
Finance, Insurance, Real Estate and Business Services	667	30.4%
Community, Social and Government Services	502	22.9%
Total	**2 194**	

Table E 32. The total area of irrigated and dryland crops within the IUA C6 of the Great Karoo socio-economic zone (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA C6: Gamka-Buffels
Citrus fruit	5
Other fruit crops	1
Stone Fruit	272
Grapes - Wine	0.7
Grapes - Table	2
Planted Pasture	654
Vegetables	50
Total	**984**
Dryland Crop Type	
Grains	12
Planted Pasture	1 009
Vegetables	120
Total	**1 141**

Table E 33. Gross economic output (R million) per IUA in the Great Karoo socio-economic zone in 2015 for each water affected economic activity

Economic activity	Gamka-Buffels
Irrigated fruit	63
Irrigated crops	33
Tourism & recreation	144
Total	**239**

Table E 34. Direct value added, total valued added and total employment in 2015 for the Great Karoo socio-economic zone for water affected economic activities

Economic activity	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	30	50	414
Irrigated crops	15	24	199
Tourism & recreation	49	111	526
Total	**94**	**185**	**1 139**

Table E 35. Summary of population, income, living conditions and reliance on aquatic resources (Source: StatsSA Census 2011)

Total population	50 656
Average household income	R102 100
% poor households	12%
% unemployed	24%
% households with piped water	97%
% households dependant on river water	0.6%

SEZ 8: Little Karoo East

The Little Karoo East socio-economic zone is located on the far eastern side of the WMA, below the Great Karoo and above the Garden Route Coast. The Groot Swartberg Mountain range is located along the length of the zone. The larger towns include Oudtshoorn, Prince Albert, Calitzdorp and Uniondale (Figure E 8). Tourism and agriculture are the economic drivers in this area as well as financial services and government services (Table E 36).

Tourist attractions include the famous Route 62 which passes through Oudtshoorn, the Swartberg Pass and Meiringspoort Pass, and the Cango Caves. There are a number of wilderness areas attracting tourists to this area, including the Groot Swartberg Nature Reserve and Baviaanskloof Nature Reserve. The most dominant agriculture in this zone includes livestock farming (mostly ostrich, sheep and cattle), pome fruit, stone fruit, grapes and some flower cultivation. Along the Olifants River there are considerable Lucerne pastures (Golder Associates 2016). Total GVA in the Little Karoo East socio-economic zone was estimated to be R6.1 billion in 2015, almost 10% of GVA within the WMA (Table E 36 and Table E 37).

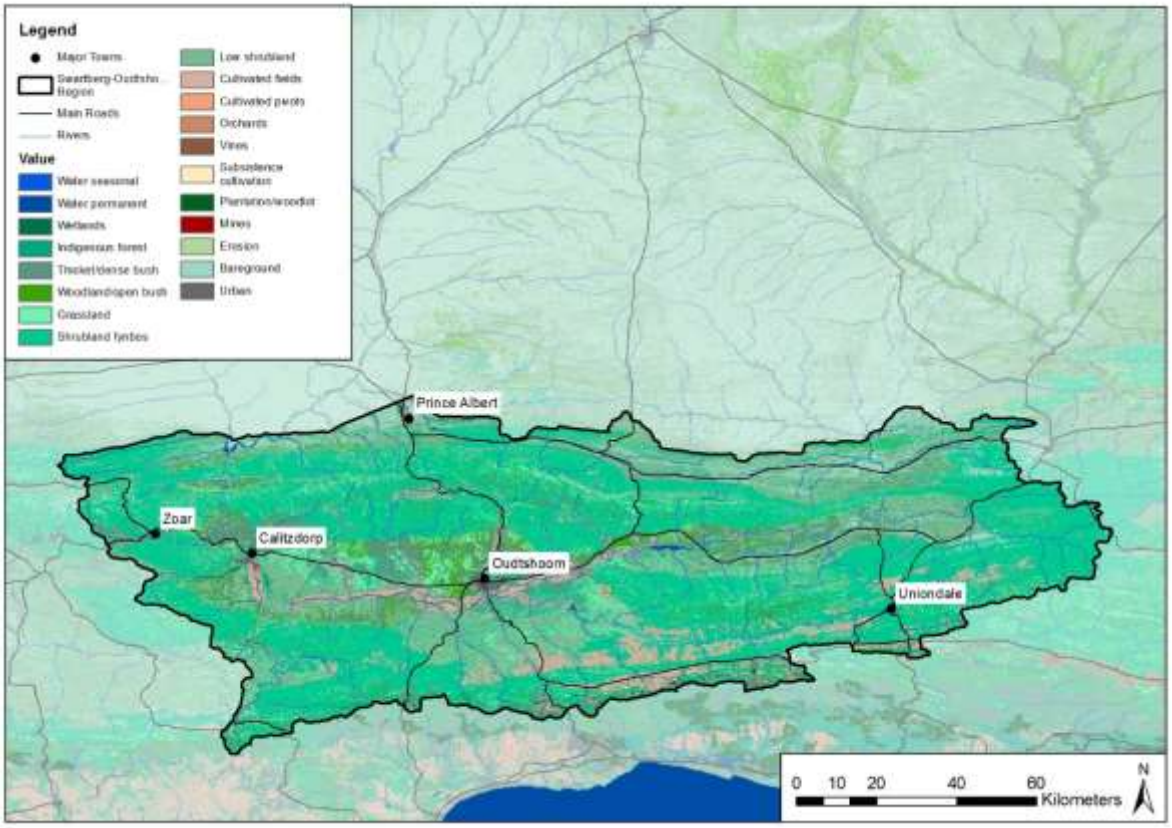


Figure E 8. Land use in the Little Karoo East socio-economic zone (Source: DEA, National Land Cover 2013/14)

Table E 36. GVA per sector in 2015 (R million, nominal 2015 prices) for the Little Karoo East socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	687	11.2%
Mining and Quarrying	8	0.1%
Manufacturing	983	16.0%
Electricity, Gas and Water	78	1.3%
Wholesale and Retail Trade, Catering and Accommodation	1 009	16.4%
Transport, Storage and Communication	380	6.2%
Finance, Insurance, Real Estate and Business Services	1 119	18.2%
Community, Social and Government Services	1 879	30.6%
Total	**6 143**	

Dryland crops represent 78% of the total crop area in the Little Karoo East (Table E 37). The dominant dryland crop is planted pasture which covers almost 44 000 ha and highlights the importance of livestock farming in this zone. Irrigated crops cover approximately 15 000 ha of land, and again, planted pasture makes up most of this area. Other irrigated crops that are cultivated in this zone include pome fruit and stone fruit (mainly peaches), grains, grapes and some vegetables (Table E 37).

Table E 37. The total area of irrigated and dryland crops within the Little Karoo East socio-economic zone (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA D7: Gouritz-Olifants
Citrus fruit	16
Grains	768
Nuts	87
Pome Fruit	1 093
Other fruit crops	118
Stone Fruit	1 454
Grapes - Wine	713
Grapes - Table	135
Planted Pasture	9 903
Vegetables	543
Total	**14 831**
Dryland Crop Type	
Flowers	33.7
Grains	8,137
Planted Pasture	43 666
Vegetables	1 035
Total	**52 871**

Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in

Table E 38 and Table E 39. Population and income statistics are summarised in Table E 40.

Table E 38. Gross economic output (R million) per IUA in the Little Karoo East socio-economic zone in 2015 for each water affected economic activity

Economic activity	Gouritz-Olifants
Irrigated fruit	704
Irrigated crops	488
Tourism & recreation	598
Total	**1 791**

Table E 39. Direct value added, total valued added and total employment in 2015 for the Little Karoo East socio-economic zone for water affected economic activities

Economic activity	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	342	562	4 693
Irrigated crops	214	350	2 923
Tourism & recreation	205	463	2 192
Total	**761**	**1 375**	**9 807**

Table E 40. Summary of population, income, living conditions and reliance on aquatic resources

Total population	131 491
Average household income	R85 619
% poor households	11%
% unemployed	22%
% households with piped water	91%
% households dependant on river water	2.5%

SEZ 9: Garden Route Coast

The Garden Route Coast socio-economic zone is located in the south-eastern corner of the WMA and runs from the Gouritz Estuary in the west to Natures Valley and the Groot Estuary in the east (Figure E 9). GVA was estimated to be R26.6 billion in 2015, the largest of all the socio-economic zones, contributing 42% to overall GVA in the WMA (Table E 41). This SEZ is one of the most densely populated in the WMA and there are a number of coastal towns that are driven by tourism, financial services and manufacturing (Table E 41). The main towns include Mossel Bay, Groot Brak, George, Wilderness, Knysna, Plettenberg Bay, and Sedgefield. George, which is situated away from the coast, has a large dairy, livestock and poultry industry and a number of abattoirs (Golder Associates 2016). Fishing is an important economic activity along this section of the coastline, with the harbour in Mossel Bay catering mainly for the fishing industry.

Much like the Overberg Coast, the population in the coastal towns in the Garden Route have increased significantly over the last decade. Tourism is the most important economic activity here and during peak holiday seasons the population in these towns increases threefold. There are a number of nature reserves and national parks in this zone, all of which contribute positively to tourism in this zone.

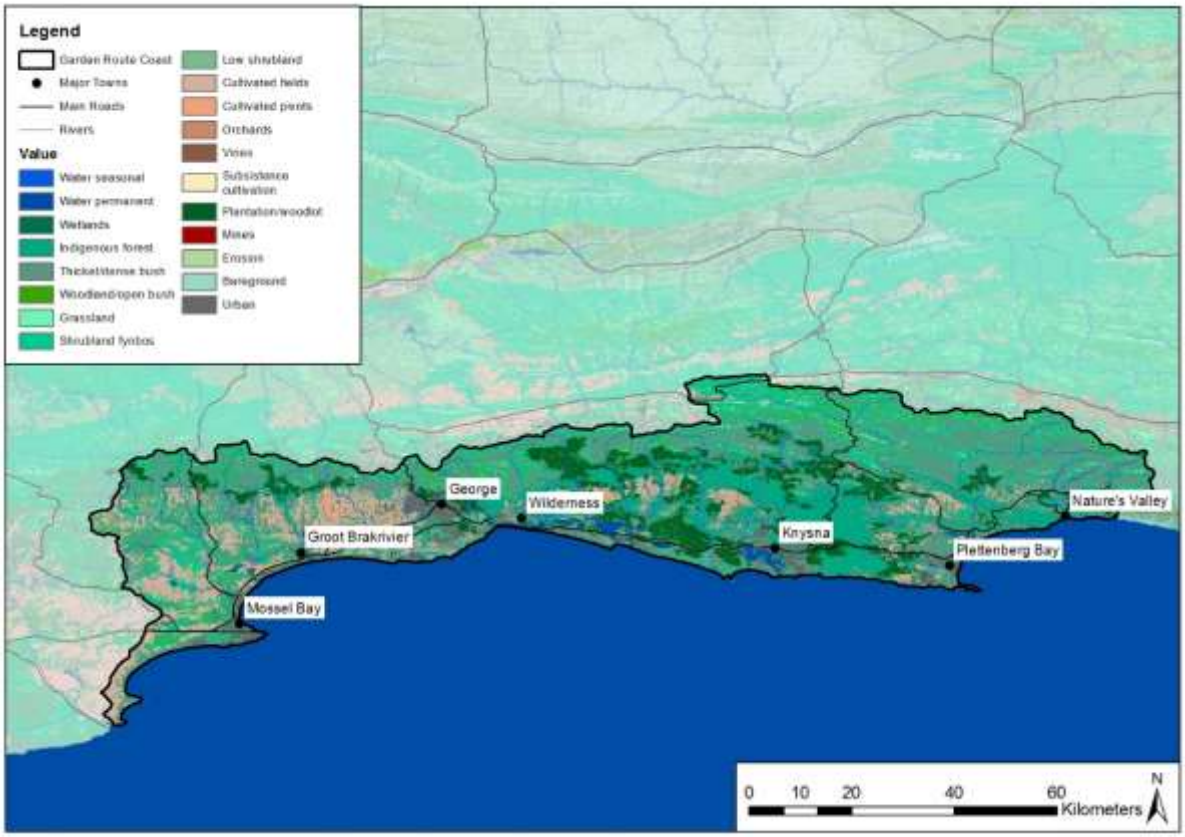


Figure E 9. Land use in the Garden Route Coast socio-economic zone (Source: DEA, National Land Cover 2013/14)

Table E 41. GVA per sector in 2015 (R million, nominal 2015 prices) for the Garden Route Coast socio-economic zone. Note that the construction sector was not included in the analysis. (Source: GAP 2011, WCG 2014, and StatsSA 2016)

Sector	GVA (R million)	% of total
Agriculture, Forestry and Fishing	829	3.1%
Mining and Quarrying	68	0.3%
Manufacturing	4 530	17.0%
Electricity, Gas and Water	709	2.7%
Wholesale and Retail Trade, Catering and Accommodation	6 698	25.1%
Transport, Storage and Communication	2 024	7.6%
Finance, Insurance, Real Estate and Business Services	6 732	25.3%
Community, Social and Government Services	5 064	19.0%
Total	**26 654**	

There are a total of 45 000 ha of cropland in the Garden Route SEZ, of which 86% is dryland crops and 14% is irrigated crops (Table E 42). Planted pasture covers the largest area, highlighting the importance of livestock farming in this zone. Other important crops include grains, vegetables and berries.

Table E 42. The total area of irrigated and dryland crops within the Garden Route Coast socio-economic zone (Source: Western Cape DoA Crop Census 2013)

Irrigated Crop Type	IUA G14: Groot Brak	IUA G15: Coastal	Total
Berries	16	139	155
Pome Fruit (apples and pears)	-	10	10
Citrus / sub-tropical Fruit	79	36	115
Other fruit crops	42	24	66
Grains	159	380	539
Vegetables	71	153	224
Stone Fruit	1	22	23
Grapes - Wine	-	27	27
Grapes - Table	-	15	15
Planted Pasture	1 112	3 821	4 932
Nuts & oil seeds	110	101	210
Flowers	-	25.4	25
Total	**1 588**	**4 752**	**6 341**
Dryland Crop Type			
Flowers	86	56	142
Grains	1 059	1 210	2,269
Planted Pasture	18 409	17 586	35 996
Vegetables	56	176	232
Oil seeds	66	55	121
Other crops	6	35	41
Total	**19 683**	**19 119**	**38 801**

Summaries of economic output, direct value added, total value added and employment for the main water affected economic activities are given in Table E 43 and Table E 44. Population and income statistics are summarised in Table E 45.

Table E 43. Gross economic output (R million) per IUA in the Garden Route Coast socio-economic zone in 2015 for each water affected economic activity

Economic activity	Groot Brak	Coastal	Total
Irrigated fruit	78	36	114
Irrigated crops	183	58	240
Plantation forestry	41	412	452
Tourism & recreation	890	273	1 163
Fisheries	19	67	86
Total	**1 583**	**474**	**2 056**

Table E 44. Direct value added, total valued added and total employment in 2015 for the Garden Route Coast socio-economic zone for water affected economic activities

Economic activity	Direct Value Added (R millions)	Total Value Added (R millions)	Total Employment
Irrigated fruit	55	91	756
Irrigated crops	105	172	1 442
Plantation forestry	200	326	2 837
Tourism & recreation	398	899	4 260
Fisheries	28	53	463
Total	**786**	**1 542**	**9 758**

Table E 45. Summary of population, income, living conditions and reliance on aquatic resources (Source: StatsSA Census 2011)

Total population	**381 171**
Average household income	R230 482
% poor households	19%
% unemployed	23%
% households with piped water	91%
% households dependant on river water	0.6%