

GROUNDWATER RESOURCE DIRECTED MEASURES

Database Concepts



Tables as Database Objects

- One database can hold many tables
- The tables hold different kinds of data
- Data can be linked between tables
- The link between tables is a RELATION



What is Related?

- We say the two TABLES are “related”
- We really mean certain RECORDS in the two tables are related
- Ability to relate records in multiple tables gives relational databases their power



One-to-One Relationship

Table A

Record 1

Record 2

Record 3

Record 4

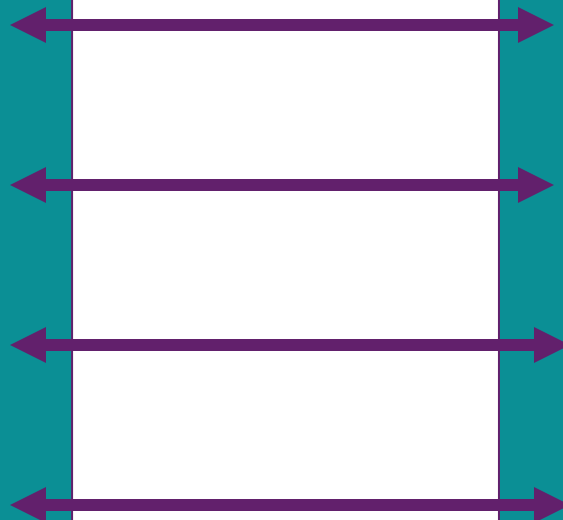
Table B

Record 1

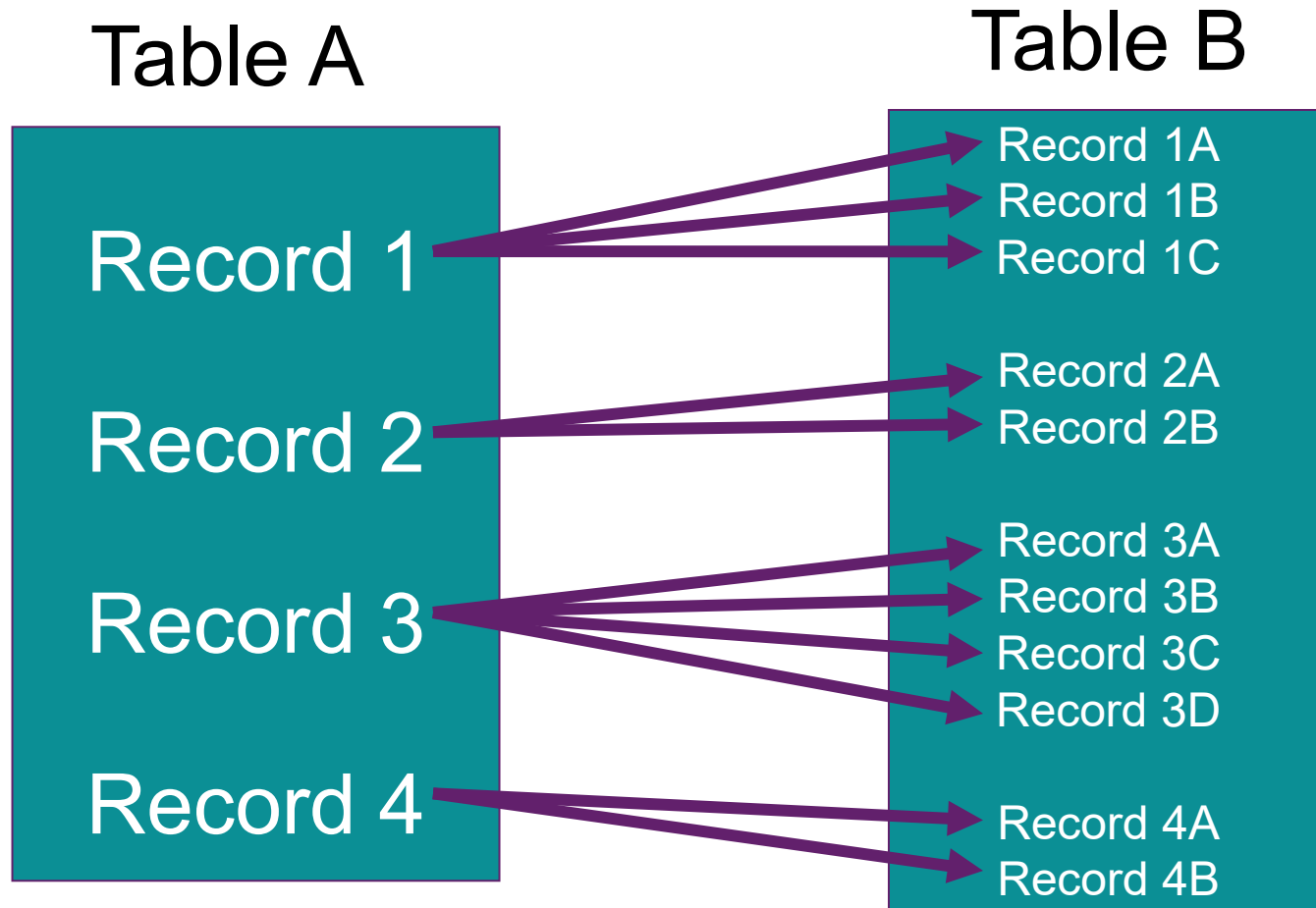
Record 2

Record 3

Record 4



One-to-Many Relationship



Excel Database Structure

SiteName	AltName	Xcoord	Ycoord	Zcoord	SiteType	Standard	Comment
BH1	BH1	27.75675887	-26.48574200	1524.80	B	MyStd	
BH10	BH10	27.77850702	-26.48196086	1516.10	B		
BH11	BH11	27.77270182	-26.47919460	1526.40	B		
BH12	BH12	27.77445315	-26.47564725	1526.30	B		
BH2	BH2	27.77653486	-26.48846067	1511.80	B		
BH3	BH3	27.76573891	-26.49237273	1515.80	B		
BH4	BH4	27.76795587	-26.48034835	1522.60	B		
BH5	BH5	27.77153244	-26.48430013	1516.30	B		
BH6	BH6	27.76219347	-26.48402539	1515.10	B		
BH7	BH7	27.77978449	-26.48847003	1509.90	B		
BH8	BH8	27.78350438	-26.48683416	1515.20	B		
BH9	BH9	27.78613561	-26.49030339	1515.10	B		
DAM1	DAM1	27.77467258	-26.48894115	1511.10	S		
DAM2	DAM2	27.77592060	-26.48609398	1511.60	S		
DAM3	DAM3	27.77539296	-26.48656440	1513.10	S		
DAM4	DAM4	27.76382759	-26.48089395	1519.40	S		
DAM5	DAM5	27.76547836	-26.48028945	1520.50	S		
MBH1	MBH1	27.76636392	-26.40347119	1615.20	B		
MBH2	MBH2	27.77125607	-26.43531297	1590.40	B		
Mine-DS	Mine-DS	27.78870000	-26.51830000	1515.90	S		
Mine-US	Mine-US	27.77200000	-26.40100000	1603.00	S		
MBH3	MBH3	27.75899873	-26.48197113	1519.00	B		
MBH4	MBH4	27.77382224	-26.47323012	1530.80	B		
MBH5	MBH5	27.78590487	-26.46254967	1553.10	B		
MBH6	MBH6	27.75347156	-26.41553424	1721.10	B		
BH	BH	27.75600000	-26.48500000	1520.00	B		
RG	RG	27.75000000	-26.48000000	1500.00	R		
FG	FG	27.74500000	-26.47500000	1500.00	G		

Primary Key

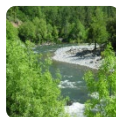
- Site Info (Site Information)



Excel Database Structure

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	
1	Flag	SiteName	DateTimeMeas	pH	EC mS/m	TDS mg/l	Ca mg/l	Mg mg/l	Na mg/l	K mg/l	PALK mg/l	MALK mg/l	Cl mg/l	SO4 mg/l	Cations	Anions	Balance	NO3-N mg/l	F
2		DBD3	2005-12-01 00:00	8.66	36.70	290.00	31.70	3.05	73.30	6.29	-1.00	154.00	1.47	38.80	-1.00	-1.00	3.75	0.20	
3		DB1	2005-12-01 00:00	9.09	32.30	247.00	38.20	3.95	53.80	6.30	-1.00	119.00	1.71	46.50	-1.00	-1.00	2.89	0.20	
4		SD1	2005-12-01 00:00	8.18	52.80	336.00	30.10	2.31	85.80	9.97	-1.00	34.70	47.90	93.50	-1.00	-1.00	0.15	48.69	
5		RTZD1	2005-12-01 00:00	9.29	34.10	265.00	49.60	4.18	56.50	4.12	-1.00	115.00	6.23	41.20	-1.00	-1.00	3.74	17.26	
6		QQS1	2005-12-01 00:00	7.48	21.00	160.00	65.90	9.36	6.80	0.81	-1.00	64.80	2.29	18.85	-1.00	-1.00	3.92	30.90	
7		PSP1	2005-12-01 00:00	8.61	39.80	299.00	83.20	18.60	29.40	4.10	-1.00	148.00	9.90	55.70	-1.00	-1.00	2.41	-0.20	
8		DBD3	2006-11-09 00:00	8.40	25.80	202.36	26.37	2.36	45.90	3.19	-1.00	106.00	3.09	30.30	-1.00	-1.00	-0.91	0.84	
9		DB1	2006-11-09 00:00	8.27	32.10	247.76	36.41	2.97	51.25	4.76	-1.00	109.00	4.93	58.90	-1.00	-1.00	-3.49	1.20	
10		SD1	2006-11-09 00:00	8.04	49.80	350.52	51.19	4.03	73.11	6.66	-1.00	94.00	31.17	95.60	-1.00	-1.00	-4.57	25.23	
11		RTZD1	2006-11-09 00:00	7.57	8.37	63.89	20.41	3.50	4.97	0.50	-1.00	32.20	3.26	9.53	-1.00	-1.00	-1.82	1.77	
12		QQS1	2006-11-09 00:00	7.24	18.40	140.97	47.53	6.28	9.81	0.56	-1.00	49.30	6.49	23.51	-1.00	-1.00	-4.14	25.98	
13		PSP1	2006-11-09 00:00	8.06	31.70	235.23	56.56	11.26	30.11	2.72	-1.00	113.00	9.39	37.92	-1.00	-1.00	0.04	7.84	
14		DBD3	2007-05-02 00:00	8.43	38.20	301.34	9.30	4.70	71.54	6.30	-1.00	155.00	3.10	50.60	-1.00	-1.00	-1.36	0.18	
15		DB1	2007-05-02 00:00	8.68	32.00	239.30	12.30	3.50	49.56	5.20	-1.00	102.00	4.72	62.00	-1.00	-1.00	-4.02	0.18	
16		SD1	2007-05-02 00:00	8.09	40.00	275.57	15.00	2.30	59.88	3.96	-1.00	73.00	24.60	70.00	-1.00	-1.00	-4.78	25.81	
17		RTZD1	2007-05-02 00:00	7.41	25.40	73.10	9.90	4.70	2.94	0.49	-1.00	47.00	1.52	6.40	-1.00	-1.00	-4.21	0.18	
18		QQS1	2007-05-02 00:00	8.34	39.10	172.18	24.50	8.20	12.16	1.09	-1.00	58.00	5.06	28.00	-1.00	-1.00	0.48	34.97	
19		PSP1	2007-05-02 00:00	7.65	37.20	247.07	18.60	11.00	38.69	4.00	-1.00	73.30	19.50	75.60	-1.00	-1.00	-0.70	6.24	
20		DBD3	2007-03-09 00:00	8.31	41.30	315.31	10.50	2.43	82.91	6.88	-1.00	169.00	2.56	40.66	-1.00	-1.00	2.40	0.20	
21		DB1	2007-03-09 00:00	8.82	32.70	242.34	12.00	3.41	57.69	5.33	-1.00	107.00	3.35	53.33	-1.00	-1.00	2.69	0.20	
22		SD1	2007-03-09 00:00	9.12	56.80	378.82	5.33	0.75	111.81	4.73	-1.00	77.00	44.35	99.00	-1.00	-1.00	-0.97	34.35	
23		RTZD1	2007-03-09 00:00	8.81	10.40	68.71	9.50	3.70	3.68	0.52	-1.00	46.00	1.43	3.74	-1.00	-1.00	-4.19	0.20	
24		QQS1	2007-03-09 00:00	7.43	24.50	170.57	21.40	8.18	12.21	1.18	-1.00	61.60	4.10	31.78	-1.00	-1.00	-3.78	29.97	
25		PSP1	2007-03-09 00:00	8.40	45.70	337.94	21.30	13.23	63.47	5.99	-1.00	148.00	18.29	60.00	-1.00	-1.00	2.30	7.48	
26		DBD3	2007-04-25 00:00	8.30	40.90	312.07	9.30	1.98	81.20	5.48	-1.00	168.00	3.19	42.60	-1.00	-1.00	-0.38	0.20	
27		DB1	2007-04-25 00:00	8.68	33.30	246.99	12.20	2.88	55.90	5.02	-1.00	114.00	3.58	53.00	-1.00	-1.00	-1.12	0.20	
28		SD1	2007-04-25 00:00	8.97	52.00	353.47	19.80	7.78	73.20	2.88	-1.00	59.20	50.10	87.00	-1.00	-1.00	-3.34	52.23	
29		RTZD1	2007-04-25 00:00	8.51	10.80	71.46	10.30	3.90	3.70	0.41	-1.00	49.00	1.01	2.94	-1.00	-1.00	-2.78	0.20	
30		QQS1	2007-04-25 00:00	7.94	28.50	206.86	30.10	9.90	10.90	0.79	-1.00	65.90	3.98	39.60	-1.00	-1.00	-2.78	45.55	
31		PSP1	2007-04-25 00:00	9.50	45.10	313.44	18.60	19.00	46.50	3.75	-1.00	109.00	30.00	76.00	-1.00	-1.00	-1.42	10.31	

- Time Chemistry



Excel Database Structure

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	SiteName	DateTimeMeas	WaterLevel mbgl	Comment	Flag									
2	BH3	2006-11-20 12:00	1.50											
3	BH7	2006-11-20 12:00	5.60											
4	BH8	2006-11-20 12:00	2.00											
5	BH10	2006-11-20 12:00	2.60											
6	BH7	2006-12-28 12:00	0.60											
7	BH8	2006-12-28 12:00	1.85											
8	BH10	2006-12-28 12:00	1.45											
9														
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- Time Water Level



Excel Database Structure

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	SiteName	DateTimeMeas	Rainfall mm/d	Comment	Flag										
2	RG	1963-01-01 00:00	110.0												
3	RG	1963-02-01 00:00	127.0												
4	RG	1963-03-01 00:00	107.0												
5	RG	1963-04-01 00:00	51.0												
6	RG	1963-05-01 00:00	12.0												
7	RG	1963-06-01 00:00	17.0												
8	RG	1963-07-01 00:00	26.0												
9	RG	1963-08-01 00:00	0.0												
10	RG	1963-09-01 00:00	15.0												
11	RG	1963-10-01 00:00	84.0												
12	RG	1963-11-01 00:00	96.0												
13	RG	1963-12-01 00:00	110.0												
14	RG	1964-01-01 00:00	169.0												
15	RG	1964-02-01 00:00	56.0												
16	RG	1964-03-01 00:00	122.0												
17	RG	1964-04-01 00:00	61.0												
18	RG	1964-05-01 00:00	8.0												
19	RG	1964-06-01 00:00	44.0												
20	RG	1964-07-01 00:00	0.0												
21	RG	1964-08-01 00:00	13.0												
22	RG	1964-09-01 00:00	30.0												
23	RG	1964-10-01 00:00	145.0												
24	RG	1964-11-01 00:00	46.0												
25	RG	1964-12-01 00:00	120.0												
26	RG	1965-01-01 00:00	107.0												
27	RG	1965-02-01 00:00	34.0												
28	RG	1965-03-01 00:00	55.0												

BasicInf Time Chemistry Time WL Time Rainfall Time Discharge Meter Discharge Standard

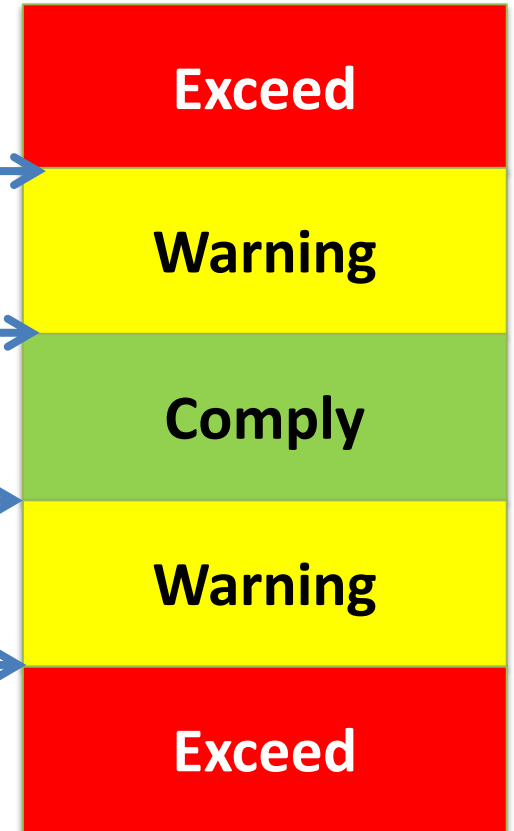
- Time Rainfall



Standard Definition

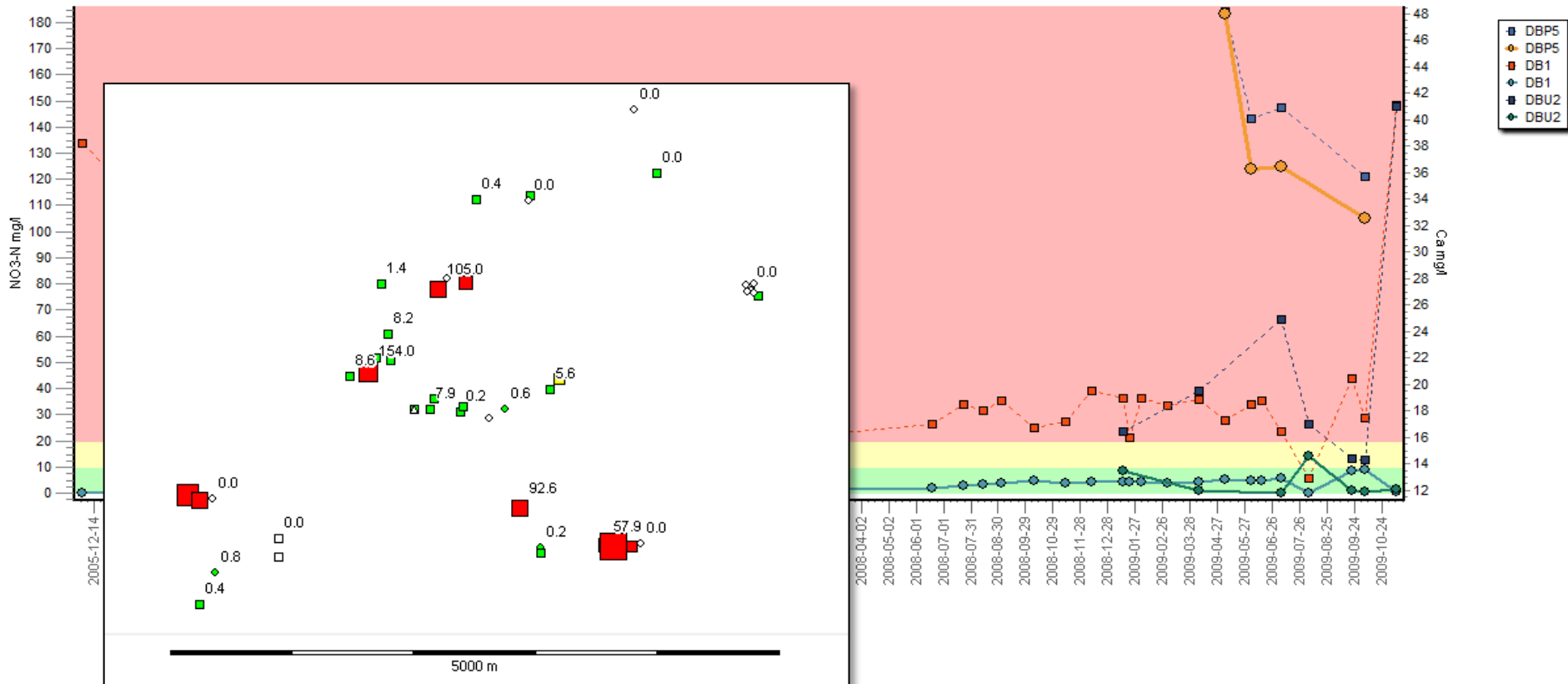
	A	B	C	D	E	F	G	H	I
1	Standard	Parameter	AbsLow	RecLow	RecHigh	AbsHigh			
2	TEST	Discharge m3	0	0	10	40			
3	TEST	NO3-N mg/l	0	0	5	10			
4									
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Time Chemistry Time WL Time Rainfall Time Discharge Meter Discharge Standard

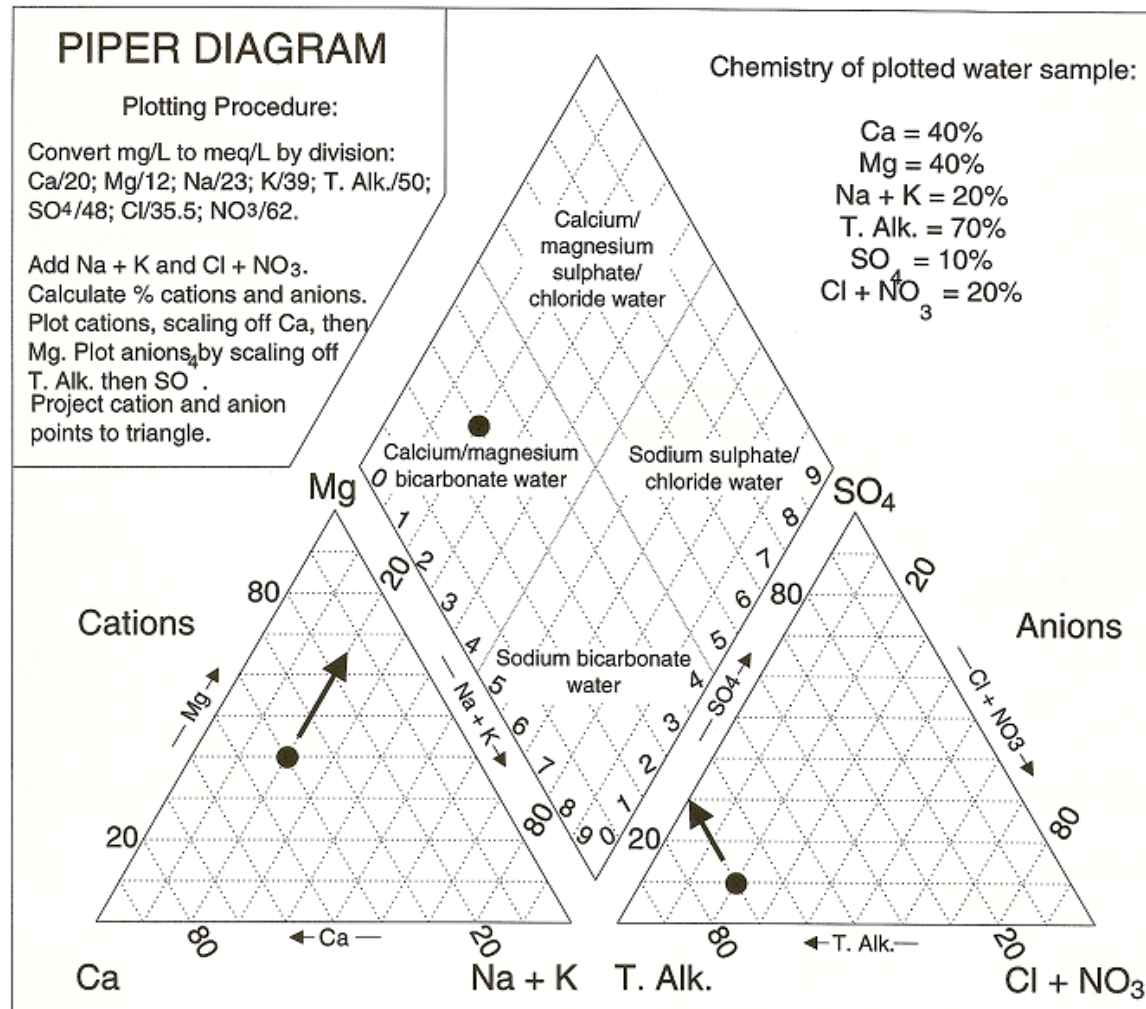


Hydrochemical Interpretation

- Evaluate site time series data against quality

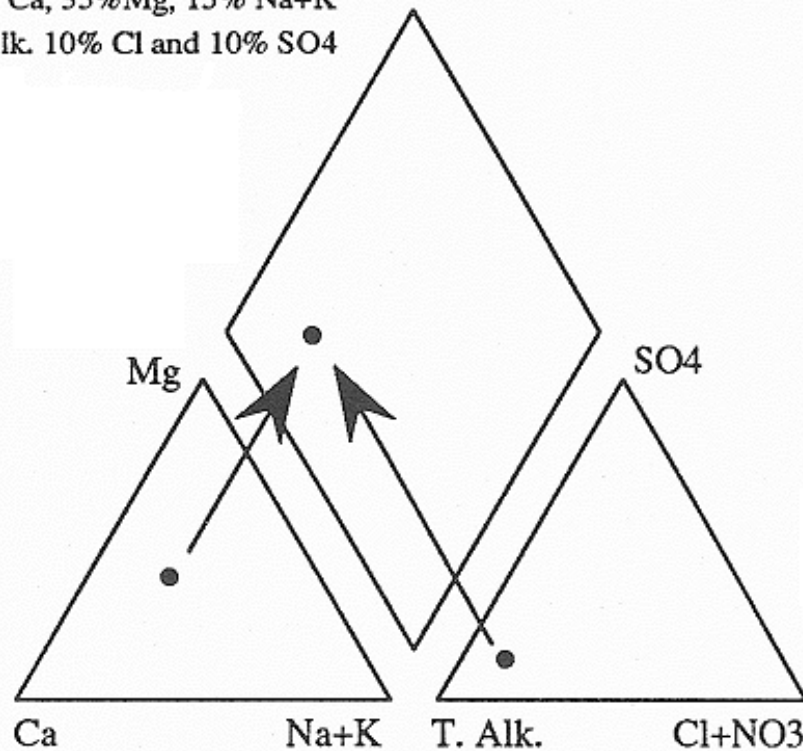


Hydrochemical Interpretation cont.



Hydrochemical Interpretation cont.

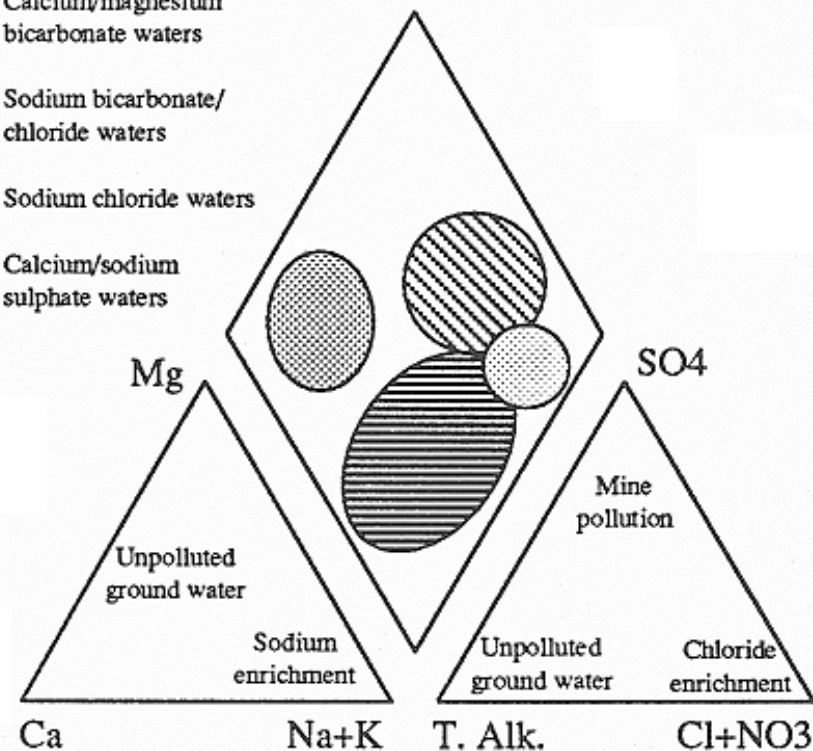
Plot of water containing:
50% Ca, 35% Mg, 15% Na+K
80% T.Alk. 10% Cl and 10% SO₄



Plotting procedure on the Piper Diagram

Legend

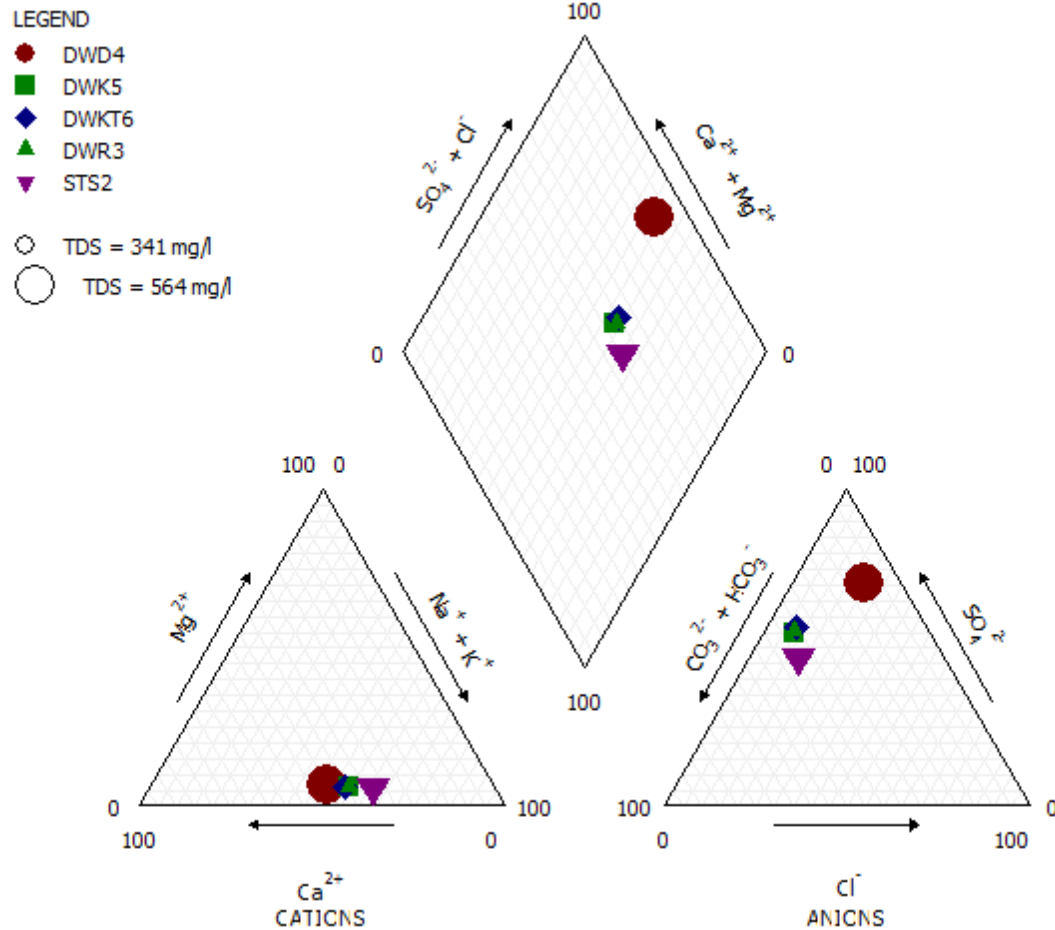
-  Calcium/magnesium bicarbonate waters
-  Sodium bicarbonate/chloride waters
-  Sodium chloride waters
-  Calcium/sodium sulphate waters



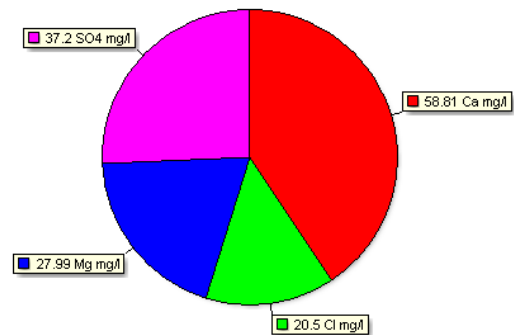
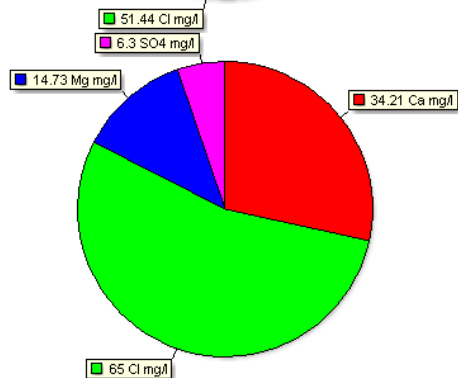
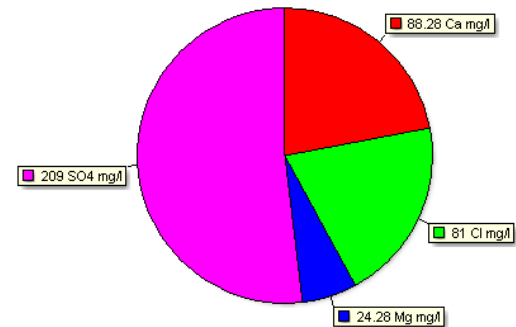
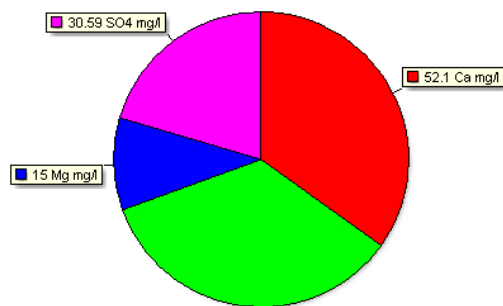
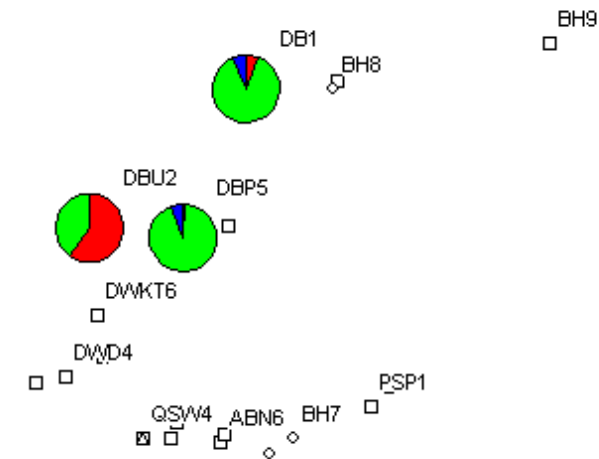
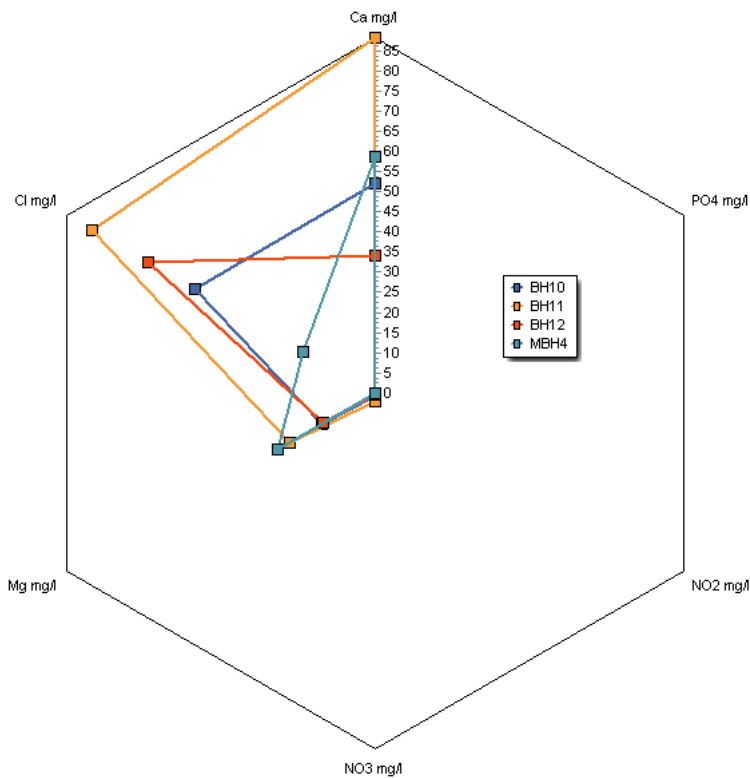
Examples of typical plotting positions on the Piper Diagram, for water from various environments



Fingerprinting through the Piper



Other Graphs



Interpreting Geology Maps

Geology and Boreholes

Legend

- Boreholes
- Boundary
- Structural Lineaments
- Geological Lineaments

Geology

Lithology

- Alluvium
- Dolomite, subordinate chert, minor carbonaceous shale, limestone and quartzite
- Andesitic lava, subordinate pyroclastic rocks, minor quartzite, shale and conglomerate
- Basaltic andesite, acid lava (quartz-feldspar porphyry), subordinate quartzite
- Fine- to medium-grained quartzite, shale (in middle of formation)
- Arkosic quartzite, subgreywacke, siltstone, shale, conglomerate (in places)
- Quartz-feldspar porphyry, subordinate amygdaloidal andesitic lava
- Chert and tuff
- Chert breccia, conglomerate
- Dark-coloured dolomite
- Diabase
- Gravel, diamondiferous in places
- Greywacke, shale, limestone, tuff
- Mudrock, quartzite, minor diamictite
- Quartzite
- Quartzite (ferruginous in places), wacke, siltstone, shale, magnetic ironstone
- Quartzite with minor shale and siltstone
- Quartzite, conglomerate
- Quartzite, shale, minor/subordinate conglomerate
- Quartzite, subordinate conglomerate and shale
- Quartzite, subordinate conglomerate, shale and amygdaloidal lava
- River sand, alluvium
- Shale
- Shale, minor limestone/dolomite, basalt and tuff
- Shale, quartzite, subordinate lava, minor conglomerate
- Shale, subordinate quartzite
- Shale, subordinate siltstone, minor quartzite
- Subequal shale and quartzite, minor conglomerate
- Syenite
- Tholeiitic basalt
- Undifferentiated granite and gneiss
- Shale, with sandstone-rich units present towards the basin margins in the south, west and northeast and coal seams in the northeast
- Diamictite (polymictic clasts, set in a poorly sorted, fine-grained matrix) with varved shale, mudstone with dropstones and fluvio-glacial gravel common in

0 5 10 20 30 40 Kilometers



Depth [m]

