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SOURCES OF NITRATE LEACHED TO GROUNDWATER IN GRASSLANDS OF FERMOY, CO. CORK

Volume 2 of 2

Plates and Appendices.

Presented in fulfilment

of the requirements for the degree of

Doctor of Philosophy

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List of Contents Volume 2

List of Plates

List of Plates cont.

List of Appendices

List of Appendices cont.

Plate 2.1 Field application of Dirty water using a Roto Rainer.

Plate 3.1 Inorganic fertiliser application in plot 3 (taken from plot 3a looking towards the Blackwater river to the south).

Plate 3.2 Slurry dumped in plot 6 during early 1995, looking from the farm roadway to the south east towards borehole 4.

Plate 3.3 Dirty water sampling from Roto Rainer in plot 5, which contains borehole 2.

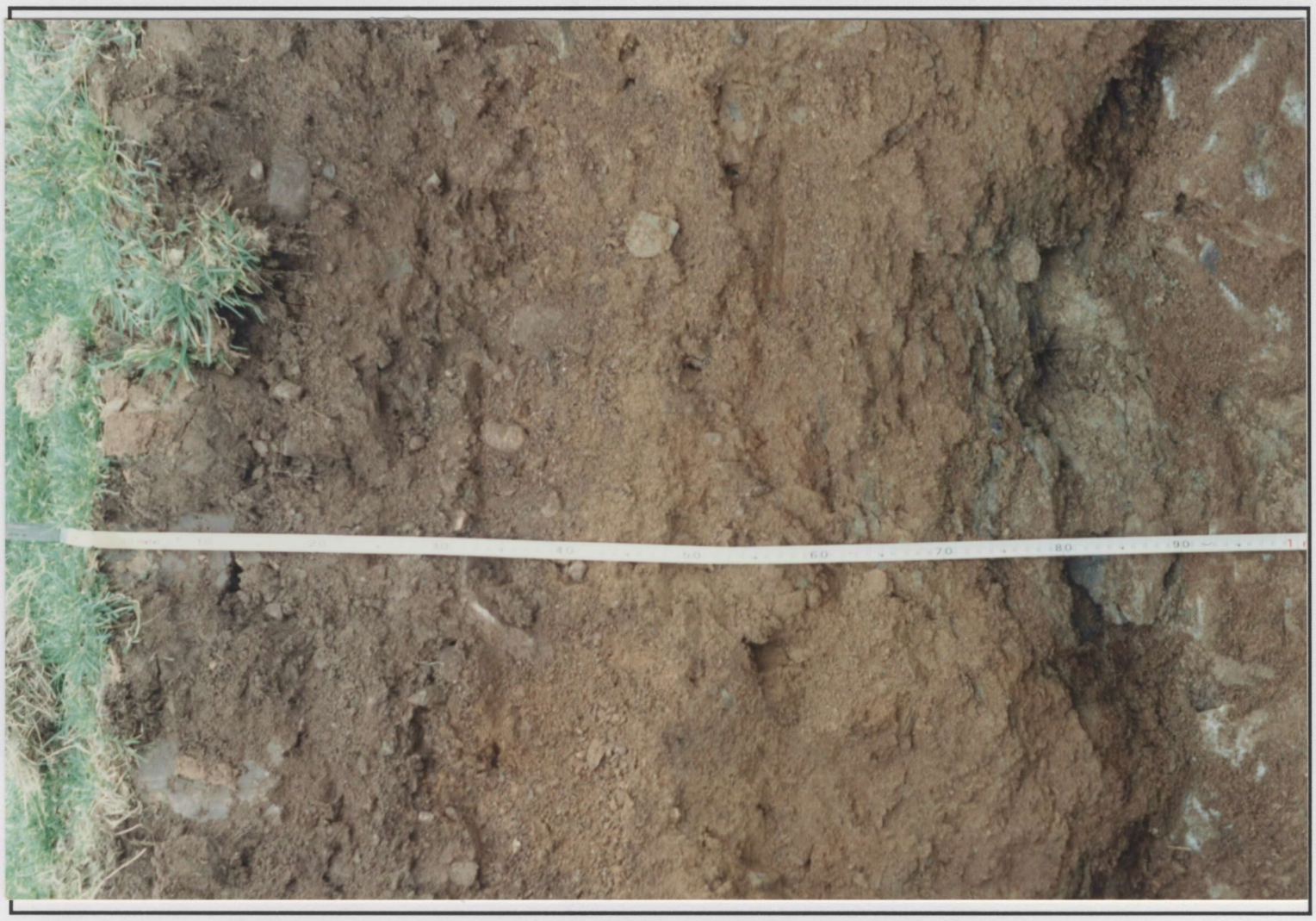


Plate 4.1 Trial pit dug in plot 12, which contains borehole 1.

Plate 4.2 Trial pit dug in plot 5, which contains borehole 2.

Plate 4.3 Trial pit dug in plot 16, which contains borehole 3.

Plate 4.4 Trial pit dug in plot 3a, which contains borehole 4.

Plate 4.5 Trial pit dug in plot 7, which contains borehole 5.

Plate 4.6 Six soil cores in trial pit taken for bulk density determination.

Plate 4.7 Double ring infiltrometer used to measure soil infiltration capacity.

Plate 4.8 Inversed auger-hole method for Quaternary deposit permeability measurement.

Plate 4.9 Bromide tracing experiment plot design in plot 12.

Plate 5.1 Ballysteen limestone bedrock core in borehole 4, cores decrease in depth from the base of the photo to the top and from right to left.

Plate 5.2 Fault area of bedrock core (fragmented area at bottom of photo) from borehole 4, with grey Ballyderown sandstone above the fault (after 25.8 m tag). Cores decrease in depth from the base of the photo to the top and from right to left.

Plate 5.3 Ballysteen limestone in the upper 10 m of borehole 5, which is fragmented due to solutionally enlarged bedding partings. Cores decrease in depth from the base of the photo to the top and from right to left.

Plate 5.4 Ballysteen limestone between 20 and 30 m of the bedrock core in borehole 5. Solutionally enlarged bedding partings observed. Cores decrease in depth from the base of the photo to the top and from right to left.

Plate 5.5 Solution of limestone bedrock at a depth of 26 m b.g.l. in borehole 5.

Plate 6.1 Field insertion of a ceramic cup being pushed into an augured hole. The stratigraphic sequence of soil removed from the hole can be seen to the left of the photo.

Plate 6.2 Layout of the sampling and monitoring equipment in plot 7 at borehole 5.

Plate 6.3 The effect of high rates of dirty water applications in plot 6, during a hot and dry period in June 1995.

Appendix A.1 Inorganic dirty water composition for all sampling dates (mg l^{-1}).

Date	NO_3-N	NH_4-N	Cl	Date	NO_3-N	NH_4-N	Cl	Date	NO_3-N	NH_4-N	Cl
08/01/95	0	24	75	20/04/95	0	19	127	30/09/95	0	88	126
10/01/95	0	30	81	25/04/95	0	60	97	02/10/95	0	76	183
23/01/95	0	17	53	26/04/95	0	67	105	16/10/95	0	82	79
24/01/95	5	4	43	03/05/95	0	66	108	17/10/95	0	58	85
01/02/95	0	6	52	04/05/95	0	98	138	23/10/95	0	100	77
02/02/95	0	1	36	11/05/95	2	60	64	24/10/95	4	33	38
07/02/95	0	22	69	17/05/95	2	118	131	06/11/95	0	88	73
08/02/95	0	12	45	18/05/95	2	117	133	07/11/95	0	117	93
13/02/95	0	27	39	22/05/95	2	98	133	20/11/95	0	87	180
14/02/95	0	28	62	23/05/95	2	111	133	21/11/95	5	49	103
19/02/95	0	14	50	07/06/95	1	106	93	27/11/95	0	29	63
20/02/95	1	27	66	04/07/95	1	117	338	28/11/95	1	48	74
26/02/95	2	45	82	05/07/95	0	71	410	04/12/95	0	32	68
27/02/95	0	35	87	10/07/95	0	135	172	05/12/95	0	39	88
05/03/95	0	29	63	11/07/95	0	103	168	11/12/95	0	41	80
06/03/95	0	17	56	12/07/95	0	97	151	12/12/95	0	72	101
13/03/95	0	29	71	25/07/95	0	204	3	17/12/95	0	33	109
14/03/95	0	38	89	26/07/95	0	147	14	18/12/95	1	28	75
21/03/95	1	31	87	27/07/95	0	126	14	01/01/96	0	23	59
22/03/95	1	23	72	02/08/95	0	243	77	02/01/96	0	9	42
27/03/95	0	46	104	03/08/95	0	136	164	09/01/96	0	9	24
28/03/95	8	63	137	08/08/95	0	220	104	29/01/96	11	21	67
03/04/95	0	79	114	09/08/95	0	188	213	30/01/96	11	24	80
04/04/95	0	64	103	15/08/95	0	258	217	04/02/96	4	30	107
09/04/95	0	69	40	16/08/95	1	284	240	05/02/96	7	32	75
10/04/95	0	51	90	20/08/95	1	238	235	11/02/96	0	38	51
17/04/95	0	46	94	21/08/95	1	216	217	12/02/96	0	44	94
18/04/95	0	33	88	24/09/95	1	72	119				
19/04/95	0	19	84	25/09/95	1	82	125				

Appendix A.2 Dirty water Kjeldahl N concentrations (mg l^{-1}) for all sampling dates from 17/6/94 to 22/2/96.

Sampling Date	Total N mg l^{-1}	Sampling Date	Total N mg l^{-1}	Sampling Date	Total N mg l^{-1}	Sampling Date	Total N mg l^{-1}
17-Jun-94	485	2-Dec-94	134.5	29-Apr-95	140.5	27-Sep-95	224
18-Jun-94	569.5	3-Dec-94	25.5	30-Apr-95	158	28-Sep-95	141
20-Jun-94	542.5	4-Dec-94	62.5	1-May-95	166.5	29-Sep-95	170
21-Jun-94	573.5	5-Dec-94	42.5	2-May-95	133.5	30-Sep-95	243
22-Jun-94	531	6-Dec-94	45.5	3-May-95	142	2-Oct-95	210
23-Jun-94	577.5	7-Dec-94	49.5	4-May-95	189	3-Oct-95	110
24-Jun-94	376	8-Dec-94	31	5-May-95	117	4-Oct-95	110
25-Jun-94	582.5	9-Dec-94	40.5	6-May-95	153	5-Oct-95	135
26-Jun-94	585	10-Dec-94	48.5	7-May-95	181	6-Oct-95	197
28-Jun-94	534.6	11-Dec-94	57.5	8-May-95	174	7-Oct-95	145
30-Jun-94	288.25	12-Dec-94	83	9-May-95	215.5	8-Oct-95	213
30-Jun-94	430	13-Dec-94	56	11-May-95	197.5	9-Oct-95	156
1-Jul-94	286.5	14-Dec-94	68.5	12-May-95	143.5	11-Oct-95	150
2-Jul-94	435	15-Dec-94	111	15-May-95	156	12-Oct-95	132
3-Jul-94	591.5	16-Dec-94	118	16-May-95	244.5	13-Oct-95	98
5-Jul-94	314	17-Dec-94	80	17-May-95	253.5	14-Oct-95	137
6-Jul-94	354.5	18-Dec-94	78.5	18-May-95	194	16-Oct-95	112
7-Jul-94	412	19-Dec-94	100.5	19-May-95	142	17-Oct-95	100
9-Jul-94	175.25	20-Dec-94	106.5	20-May-95	179	18-Oct-95	191
9-Jul-94	214.75	21-Dec-94	85.5	21-May-95	157.5	19-Oct-95	178
10-Jul-94	305.75	22-Dec-94	91	22-May-95	211	20-Oct-95	262
11-Jul-94	149.75	23-Dec-94	127	23-May-95	212	21-Oct-95	166
12-Jul-94	178.25	24-Dec-94	172	24-May-95	149	22-Oct-95	142
13-Jul-94	285	25-Dec-94	43.5	25-May-95	340	23-Oct-95	126
14-Jul-94	284.25	26-Dec-94	43.5	26-May-95	503	24-Oct-95	38
15-Jul-94	214.75	27-Dec-94	54.5	27-May-95	737	25-Oct-95	157
16-Jul-94	268	28-Dec-94	56	28-May-95	505	26-Oct-95	103
17-Jul-94	268.75	29-Dec-94	54	29-May-95	480	27-Oct-95	183
18-Jul-94	225.75	1-Jan-95	63	30-May-95	579	28-Oct-95	184
19-Jul-94	331	2-Jan-95	69.5	31-May-95	586	29-Oct-95	145
20-Jul-94	330.25	3-Jan-95	63	1-Jun-95	576	30-Oct-95	145
21-Jul-94	257.5	4-Jan-95	90.5	2-Jun-95	795	31-Oct-95	141.5
22-Jul-94	329	5-Jan-95	86	3-Jun-95	247	1-Nov-95	136
23-Jul-94	328.75	7-Jan-95	48	4-Jun-95	573	3-Nov-95	181
24-Jul-94	328	8-Jan-95	51.5	5-Jun-95	652	4-Nov-95	201
28-Jul-94	644.5	10-Jan-95	64.5	6-Jun-95	400	5-Nov-95	97
29-Jul-94	404.5	11-Jan-95	118	7-Jun-95	324	6-Nov-95	130
30-Jul-94	185	12-Jan-95	190	8-Jun-95	352	7-Nov-95	54
31-Jul-94	342	13-Jan-95	180.5	8-Jun-95	407	8-Nov-95	204
3-Aug-94	504.5	14-Jan-95	100.5	9-Jun-95	269	9-Nov-95	170
4-Aug-94	251.5	15-Jan-95	95	10-Jun-95	469	10-Nov-95	112
5-Aug-94	387	16-Jan-95	46.5	11-Jun-95	810	11-Nov-95	62
6-Aug-94	230	17-Jan-95	34.5	12-Jun-95	260	12-Nov-95	86

Appendix A.2(Contd.) Dirty water Kjeldahl N concentrations (mg l^{-1}) for all sampling dates from 17/6/94 to 22/2/96.

Sampling Date	Total N mg l_{-1}	Sampling Date	Total N mg l_{-1}	Sampling Date	Total N mg l_{-1}	Sampling Date	Total N mg l^{-1}
7-Aug-94	264	18-Jan-95	45.5	13-Jun-95	324	13-Nov-95	98
9-Aug-94	265.5	19-Jan-95	30.5	14-Jun-95	256	14-Nov-95	90
11-Aug-94	244.5	21-Jan-95	25	15-Jun-95	253	15-Nov-95	98
12-Aug-94	186.5	22-Jan-95	27	16-Jun-95	262	16-Nov-95	126
13-Aug-94	264.5	23-Jan-95	29.5	17-Jun-95	290	17-Nov-95	156
14-Aug-94	345.5	24-Jan-95	23	18-Jun-95	654	18-Nov-95	192
15-Aug-94	238.5	25-Jan-95	33	19-Jun-95	274	20-Nov-95	166
16-Aug-94	123	26-Jan-95	30	20-Jun-95	169	21-Nov-95	76
17-Aug-94	199	27-Jan-95	24	22-Jun-95	321	22-Nov-95	112
18-Aug-94	233.3	28-Jan-95	20.5	23-Jun-95	263	23-Nov-95	116
19-Aug-94	282.3	29-Jan-95	21.5	24-Jun-95	616	24-Nov-95	64
20-Aug-94	285.3	30-Jan-95	26.5	25-Jun-95	1360	25-Nov-95	40
21-Aug-94	254.3	31-Jan-95	26.5	26-Jun-95	686	26-Nov-95	56
22-Aug-94	150.7	1-Feb-95	48	27-Jun-95	221	27-Nov-95	40
23-Aug-94	85.3	2-Feb-95	25.5	28-Jun-95	287	28-Nov-95	68
24-Aug-94	260.7	3-Feb-95	52	1-Jul-95	560	29-Nov-95	56
25-Aug-94	302.5	4-Feb-95	78	2-Jul-95	805	30-Nov-95	44
26-Aug-94	274.5	5-Feb-95	114.5	4-Jul-95	590	1-Dec-95	66
27-Aug-94	260.5	6-Feb-95	117.5	5-Jul-95	635	2-Dec-95	56
28-Aug-94	275	7-Feb-95	102.5	6-Jul-95	410	3-Dec-95	82
29-Aug-94	286	8-Feb-95	44	7-Jul-95	340	4-Dec-95	70
30-Aug-94	261	9-Feb-95	58.5	8-Jul-95	350	5-Dec-95	84
31-Aug-94	302	10-Feb-95	42	9-Jul-95	730	6-Dec-95	80
1-Sep-94	290.5	11-Feb-95	57	10-Jul-95	200	7-Dec-95	116
2-Sep-94	265	12-Feb-95	57	11-Jul-95	160	8-Dec-95	116
3-Sep-94	349.5	13-Feb-95	69	12-Jul-95	260	10-Dec-95	88
4-Sep-94	242	14-Feb-95	69	13-Jul-95	180	11-Dec-95	86
5-Sep-94	244	15-Feb-95	70.5	14-Jul-95	120	12-Dec-95	150
6-Sep-94	243.5	16-Feb-95	41	15-Jul-95	180	13-Dec-95	128
7-Sep-94	422.5	17-Feb-95	41	16-Jul-95	200	14-Dec-95	106
8-Sep-94	315	18-Feb-95	74.5	17-Jul-95	75	15-Dec-95	61
9-Sep-94	108.5	19-Feb-95	33	18-Jul-95	514	16-Dec-95	66
10-Sep-94	176.5	20-Feb-95	96	19-Jul-95	176	17-Dec-95	79
11-Sep-94	217.5	21-Feb-95	86.5	21-Jul-95	206	18-Dec-95	47
12-Sep-94	175	22-Feb-95	40.5	22-Jul-95	843	19-Dec-95	8
15-Sep-94	183	23-Feb-95	65.5	23-Jul-95	478	20-Dec-95	22
16-Sep-94	343.5	24-Feb-95	104	24-Jul-95	456	21-Dec-95	44
17-Sep-94	181	25-Feb-95	123.5	25-Jul-95	317	22-Dec-95	96
18-Sep-94	210	26-Feb-95	151.5	26-Jul-95	253	23-Dec-95	146
19-Sep-94	310.5	27-Feb-95	149	27-Jul-95	253	24-Dec-95	62
20-Sep-94	353	28-Feb-95	89	28-Jul-95	254	25-Dec-95	56
21-Sep-94	189.5	1-Mar-95	62.5	29-Jul-95	400	26-Dec-95	22
22-Sep-94	194	2-Mar-95	104	30-Jul-95	881	28-Dec-95	18

Appendix A.2(Contd.) Dirty water Kjeldahl N concentrations (mg l^{-1}) for all sampling dates from 17/6/94 to 22/2/96.

23-Sep-94	193.5	3-Mar-95	98	31-Jul-95	327	29-Dec-95	26
24-Sep-94	144	4-Mar-95	60	1-Aug-95	292	30-Dec-95	32
25-Sep-94	252	5-Mar-95	44	2-Aug-95	368	31-Dec-95	26
26-Sep-94	178.5	6-Mar-95	45	3-Aug-95	215	1-Jan-96	32
27-Sep-94	167	7-Mar-95	34	4-Aug-95	241	2-Jan-96	16
28-Sep-94	141.5	8-Mar-95	132	5-Aug-95	330	3-Jan-96	44.5
29-Sep-94	128.5	9-Mar-95	54	6-Aug-95	622	4-Jan-96	42
12-Oct-94	174.5	10-Mar-95	26.5	7-Aug-95	293	5-Jan-96	51
13-Oct-94	205.5	11-Mar-95	86	8-Aug-95	333	6-Jan-96	22
14-Oct-94	490.5	12-Mar-95	107	9-Aug-95	288	7-Jan-96	45
15-Oct-94	423.5	13-Mar-95	80	10-Aug-95	299	8-Jan-96	27
16-Oct-94	231.5	14-Mar-95	111	11-Aug-95	235	9-Jan-96	8
17-Oct-94	330	15-Mar-95	90.5	12-Aug-95	226	11-Jan-96	102
18-Oct-94	427	16-Mar-95	97	13-Aug-95	224	12-Jan-96	66
19-Oct-94	67.5	17-Mar-95	81	14-Aug-95	255	13-Jan-96	38
20-Oct-94	87.5	18-Mar-95	85	15-Aug-95	273	14-Jan-96	28
21-Oct-94	154.5	19-Mar-95	83	16-Aug-95	316	15-Jan-96	14
22-Oct-94	135	20-Mar-95	103	17-Aug-95	281	16-Jan-96	122
23-Oct-94	145.5	21-Mar-95	95.5	18-Aug-95	232	17-Jan-96	114
24-Oct-94	140.5	22-Mar-95	63.5	19-Aug-95	248	18-Jan-96	188
25-Oct-94	254	23-Mar-95	90.5	20-Aug-95	309.5	19-Jan-96	44
26-Oct-94	262	24-Mar-95	102.5	21-Aug-95	316	20-Jan-96	26
27-Oct-94	228.5	25-Mar-95	148.5	24-Aug-95	264	21-Jan-96	23
28-Oct-94	260.5	26-Mar-95	114.5	25-Aug-95	290	22-Jan-96	38
29-Oct-94	181	27-Mar-95	114	26-Aug-95	230	23-Jan-96	90
30-Oct-94	64	28-Mar-95	229.5	27-Aug-95	164	24-Jan-96	65
31-Oct-94	146.5	29-Mar-95	140	28-Aug-95	148	25-Jan-96	34
1-Nov-94	173.5	30-Mar-95	162.5	29-Aug-95	228	26-Jan-96	472
2-Nov-94	50	1-Apr-95	294	30-Aug-95	271	27-Jan-96	191
3-Nov-94	53	2-Apr-95	500	31-Aug-95	245	28-Jan-96	51
5-Nov-94	222	3-Apr-95	169	1-Sep-95	264	29-Jan-96	48
6-Nov-94	188.5	4-Apr-95	168	2-Sep-95	172	30-Jan-96	48
7-Nov-94	96.5	5-Apr-95	164	3-Sep-95	283	31-Jan-96	133
8-Nov-94	22	6-Apr-95	195	4-Sep-95	240	2-Feb-96	145
9-Nov-94	136.5	7-Apr-95	146	5-Sep-95	189	3-Feb-96	118
10-Nov-94	137	9-Apr-95	167	6-Sep-95	196	4-Feb-96	80
11-Nov-94	214.5	10-Apr-95	128	7-Sep-95	161	5-Feb-96	113
12-Nov-94	127	11-Apr-95	111	8-Sep-95	173	7-Feb-96	36
14-Nov-94	51	12-Apr-95	132.5	9-Sep-95	138	8-Feb-96	40
15-Nov-94	77	13-Apr-95	123	10-Sep-95	162	9-Feb-96	40
16-Nov-94	99.5	14-Apr-95	145	11-Sep-95	175	10-Feb-96	24
17-Nov-94	100.5	15-Apr-95	143	12-Sep-95	197	11-Feb-96	44
18-Nov-94	79	16-Apr-95	130.5	13-Sep-95	193	12-Feb-96	82
19-Nov-94	77.5	17-Apr-95	132	14-Sep-95	80	13-Feb-96	122
20-Nov-94	31	18-Apr-95	131.5	16-Sep-95	201	15-Feb-96	158

Appendix A.2(Contd.) Dirty water Kjeldahl N concentrations (mg l^{-1}) for all sampling dates from 17/6/94 to 22/2/96.

21-Nov-94	**45.5**	**19-Apr-95**	**109**	**17-Sep-95**	**308**	**16-Feb-96**	**166**
22-Nov-94	**81**	**20-Apr-95**	**138**	**18-Sep-95**	**242**	**17-Feb-96**	**122**
23-Nov-94	**82.5**	**21-Apr-95**	**136.5**	**19-Sep-95**	**149**	**18-Feb-96**	**52**
24-Nov-94	**84**	**22-Apr-95**	**162**	**20-Sep-95**	**144**	**19-Feb-96**	**52**
25-Nov-94	**108.5**	**23-Apr-95**	**159.5**	**21-Sep-95**	**156**	**20-Feb-96**	**98**
26-Nov-94	**114**	**24-Apr-95**	**129.5**	**22-Sep-95**	**218**	**21-Feb-96**	**74**
27-Nov-94	**133.5**	**25-Apr-95**	**136**	**23-Sep-95**	**169**	**22-Feb-96**	**80**
29-Nov-94	**125**	**26-Apr-95**	**149.5**	**24-Sep-95**	**167**		
30-Nov-94	**111.5**	**27-Apr-95**	**161**	**25-Sep-95**	**186**		
1-Dec-94	**173.5**	**28-Apr-95**	**176.5**	**26-Sep-95**	**176**		

Appendix A.3 Annual total and calculated available N loads (kg) applied to each plot on Ballyderown.

	Load of total N to plots			Load of available N	
Plot	1993	1994	1995	1995	1994
1	252	211	195	252	211
2	321	321	467	281	321
2A	345	451	355	293	369
3	344	287	433	300	287
3A	290	316	515	246	303
4	364	345	553	340	319
4A	269	791	366	269	513
5	339	805	455	287	511
5A	315	342	360	271	286
6	198	458	922	198	315
6A	280	281	1204	280	246
7	300	328	490	300	312
7A	365	365	161	357	312
8	312	482	362	312	390
8A	312	403	382	312	353
9	353	419	446	316	343
9A	278	525	287	278	411
10	345	436	355	345	340
10A	345	416	355	345	313
11	278	463	394	278	400
11A	298	386	340	282	345
12	307	358	355	236	294
12A	263	321	270	227	279
13	381	362	347	274	315
13A	327	408	374	272	329
14	286	278	253	286	278
15	397	300	236	302	255
15A	356	400	314	273	314
16	312	185	244	312	185
16A	286	310	304	286	306

Appendix B.1 Particle Size analytical methodology.

Four grams of each sample were weighed into a 400 ml beaker into which 4 ml of H_2O_2 were added; the mixture was then shaken and left for 30 minutes. Another 4 ml H_2O_2 were added to the sample and the mixture was shaken again. This process was repeated until there was no evident reaction of organic matter to the addition of H_2O_2. The solution was then left overnight.

The next day 100 ml of Morgan's reagent (1.480 l of 40% NaOH + 1.444 l of glacial acetic acid diluted to 20 l with H_2O at pH 4.8) was added to the solution which was placed on a hot plate and heated until the solution had reduced to 25 ml. The solution was then washed into a 50 ml polypropylene centrifuge tube with conical base. The solution was centrifuged at 2000 revolutions per minute (rpm) for 30 minutes and the supernatant solution was then poured off. The beaker was washed again into the centrifuge tube and centrifuged again. The process was repeated until the beaker was clean. Dispersal agent solution, containing 10 ml of ($5\%(NaPO_3)_{13}$+ 1 M NaOH l^{-1}), was added to the 45 cm graduation on the centrifuge tube. The tube was then placed on an end-over-end shaker for 15 hours (overnight) at 30 rpm.

The samples were removed and placed on a rack. Pre-weighed dry crucibles were stored in a dessicator, with silica gel as a drying agent. An electronic digital pipette (Rainien Instrument Co., Woburn, MA) was used to remove 2.5 ml aliquot samples from a depth of 2.5 cm below the solution surface. The pipette had the lowest speed setting for sampling. Samples were shaken for 30 seconds (a stop-watch was used)by hand and the silt and clay aliquot was removed immediately, put in the dry pre-weighed crucible and dried at 105 °C for 16 hours. After 1 hour 55 minutes (the sampling time for clay at 20 °C, the ambient laboratory temperature), a clay sample was removed by the method described for the silt and clay and the clay sample was dried at 105 °C for 16 hours.

The centrifuge tube was rinsed with water into a wet 53μm sieve and the sample was washed through. Care was taken to ensure that all the sample was washed from the centrifuge tube and the cap. When washing had removed all of the clay and silt, the sand retained on the sieve was washed into another preweighed dry evaporating dish, using a wash bottle with a jet nozzle and the sample was then dried for 16 hours at 105 °C.

The dry samples were then placed in a dessicator and allowed to cool before being weighed accurately to 3 decimal places on a Mettler Toledo PB303 balance. The results are expressed as the percentage of the dry weight of soil inorganic matter <2mm.

Calculations.

$$Clay(\%)=100*[(RW^2*CF)/TW]-0.009$$

Clay=<2μm fraction

RW^2= residue weight(g) of 2μm fraction

CF= 45 ml / DV

DV = dispensed pipette volume (2.5 ml)

TW = total weight(g) of oven-dry sample

0.009 = residue salt weight

$$Sand = \frac{\text{sand dry weight}}{\text{total soil weight}} * 100$$

Silt = (%(silt and clay) - %clay)

Total corrected weight was adjusted to 100% recovery, according to

$$\frac{(\%clay+\%silt+\%sand)}{(\%clay+\%silt+\%sand)} * \frac{100}{1}$$

The soil textural class was calculated using the particle size classes diagram from Hodgson (1976).

Appendix B.2 Soil particle size analysis and textural classes

Plot No.	Depth (cm)	Percent			Textural Class
		Clay	Silt	Sand	
12	0 - 30	12.4	31.3	56.3	Sandy loam
	30 - 45	12.8	29	58.3	Sandy loam
	45 - 60	12.1	36.7	51.2	Sandy loam
	60 - 90	8.4	46.5	45.1	Sandy silt loam
5	0 - 15	12.6	28.6	58.8	Sandy loam
	15 - 34	11	33.1	55.8	Sandy loam
	34 - 46	6.8	33.7	59.5	Sandy loam
	46 - 60	2.7	33.7	63.6	Sandy loam
	60 - 100	15.1	39.1	45.8	Sandy silt loam
	100 - 130	15.3	35.1	49.6	Sandy silt loam
16	0 - 10	15	34.8	50.2	Sandy loam
	10 - 24	11.4	39.3	49.2	Sandy silt loam
	24 - 50	12.2	44.1	43.7	Sandy silt loam
	50 - 73	9.8	49.3	40.9	Sandy silt loam
	73 - 123	13.6	56.1	30.3	Sandy silt loam
	123 - 160	8	69.4	22.6	Sandy silt loam
3a	0 - 10	16.8	35	48.2	Sandy silt loam
	10 - 30	16.3	31.3	52.3	Sandy loam
	30 - 75	15.1	29	55.9	Sandy loam
	75 - 106	3.8	25.2	71	Loamy sand
	>106	9.9	28.4	61.7	Sandy loam
7	0 - 12	17.7	39.4	43	Sandy silt loam
	12 - 30	18.4	38.2	43.4	Sandy silt loam
	30 - 50	12.1	44.2	43.7	Sandy silt loam
	50 - 70	23.9	39.7	36.5	Clay loam
	70 - 90	0.9	25.3	73.8	Loamy sand
	90 - 140	17.7	34.6	47.6	Sandy silt loam

Appendix C.1 Weekly water budget showing rainfall, actual Evapotranspiration (Ea), effective rainfall and soil moisture deficit (SMD) for the year 1993, week number refers weeks after the 1/1/93, 52 weeks in total.

Week No.	Rain (mm)	Ea (mm)	Rain - Ea (mm)	SMD (mm)	Week No.	Rain (mm)	Ea (mm)	Rain - Ea (mm)	SMD (mm)
1	31.4	2.7	28.7	0.0	27	0.7	23.9	0.0	30.0
2	48.6	5.7	42.9	0.0	28	5.0	18.0	0.0	46.0
3	21.1	4.1	17.0	0.1	29	53.4	20.4	33.0	27.9
4	2.6	2.6	0.0	0.2	30	3.1	19.7	0.0	18.3
5	2.1	1.5	0.6	1.7	31	6.2	17.2	0.0	28.8
6	10.6	2.7	7.9	1.4	32	1.7	11.8	0.0	36.2
7	0.6	5.4	0.0	2.2	33	16.3	14.7	1.6	41.1
8	6.2	5.9	0.3	2.3	34	0.7	13.0	0.0	47.5
9	1.1	7.4	0.0	6.9	35	2.9	6.9	0.0	58.0
10	10.7	5.7	5.0	5.4	36	0.8	7.4	0.0	67.3
11	2.5	6.7	0.0	3.3	37	57.4	9.7	47.7	30.6
12	33.6	7.7	25.9	5.0	38	43.8	11.9	31.9	17.0
13	69.4	13.7	55.8	0.6	39	14.3	8.7	5.6	0.9
14	18.9	13.4	5.5	0.3	40	69.5	4.1	65.4	0.5
15	12.4	8.6	3.8	1.4	41	41.5	3.5	38.0	0.2
16	28.8	9.7	19.1	0.6	42	0.0	4.6	0.0	4.8
17	0.2	23.7	0.0	12.4	43	0.0	3.2	0.0	11.8
18	0.1	18.0	0.0	32.5	44	1.3	3.4	0.0	15.3
19	28.6	15.0	13.6	40.4	45	9.6	1.6	8.0	14.3
20	32.8	13.4	19.4	18.1	46	23.7	1.6	22.1	3.5
21	58.2	11.8	46.4	2.5	47	1.5	3.2	0.0	0.9
22	15.4	16.4	0.0	3.1	48	38.3	3.2	35.2	0.6
23	62.0	12.5	49.5	3.1	49	24.9	2.5	22.4	0.1
24	16.3	16.3	0.0	1.9	50	41.7	4.9	36.8	0.0
25	0.0	17.1	0.0	14.1	51	52.3	1.7	50.6	0.0
26	0.7	18.1	0.0	27.7	52	36.8	2.2	34.6	0.0

Appendix C.2 Weekly water budget showing rainfall, actual Evapotranspiration (Ea), effective rainfall and soil moisture deficit (SMD) for the year 1994, week number refers weeks after the 1/1/94, 52 weeks in total.

Week No.	Rain (mm)	Ea (mm)	Rain - Ea (mm)	SMD (mm)	Week No.	Rain (mm)	Ea (mm)	Rain - Ea (mm)	SMD (mm)
1	28.8	0.8	28.0	0.1	27	27.7	12.3	15.4	51.9
2	48.3	1.8	46.6	0.0	28	15.4	13.2	2.2	42.0
3	11.8	2.0	9.8	0.3	29	5.3	15.8	0.0	50.0
4	12.5	4.6	8.0	0.0	30	10.4	16.1	0.0	57.5
5	70.4	4.9	65.5	0.2	31	31.4	10.0	21.4	37.9
6	14.4	2.5	11.9	0.6	32	0.8	17.8	0.0	41.0
7	49.4	3.6	45.8	0.6	33	15.8	15.9	0.0	43.0
8	68.4	3.6	64.8	0.0	34	31.8	12.9	18.9	30.1
9	10.0	5.1	4.9	0.2	35	4.1	13.9	0.0	35.0
10	6.1	10.7	0.0	0.8	36	76.3	11.7	64.6	31.6
11	18.9	13.5	5.4	0.8	37	23.6	9.7	13.9	0.5
12	17.6	9.2	8.4	0.6	38	17.1	9.7	7.4	2.4
13	53.0	18.2	34.8	0.5	39	21.9	8.1	13.9	1.1
14	28.3	13.4	14.9	0.0	40	1.0	7.1	0.0	3.0
15	0.0	18.5	0.0	7.2	41	0.3	4.1	0.0	11.2
16	43.0	13.7	29.3	14.2	42	35.5	4.9	30.6	6.8
17	0.9	13.2	0.0	3.3	43	15.7	7.9	7.8	1.3
18	36.6	17.5	19.1	3.9	44	46.1	4.7	41.4	0.2
19	36.7	19.6	17.1	2.0	45	39.1	2.2	36.9	0.1
20	6.4	16.5	0.0	2.3	46	25.6	2.7	22.9	0.2
21	1.6	15.6	0.0	8.8	47	5.8	1.5	4.3	0.2
22	14.0	23.6	0.0	20.5	48	35.3	1.8	33.5	0.4
23	2.0	25.7	0.0	24.7	49	33.5	0.5	33.0	0.1
24	0.6	25.9	0.0	43.6	50	9.3	1.1	8.2	0.2
25	6.7	12.5	0.0	56.2	51	6.9	0.7	6.2	0.2
26	2.8	11.3	0.0	59.6	52	34.0	4.3	30.0	0.2

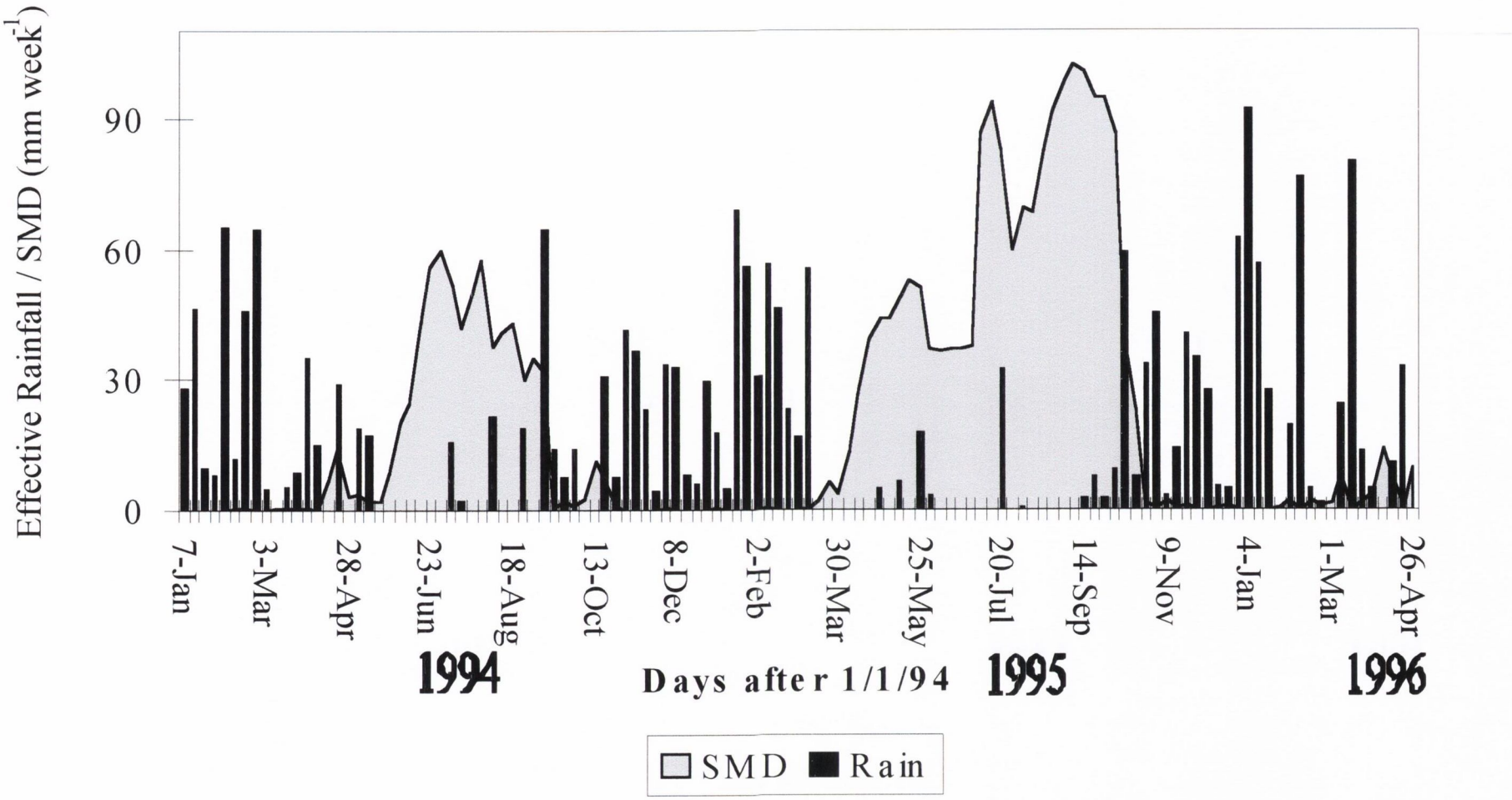
Appendix C.3 Weekly water budget showing rainfall, actual Evapotranspiration (Ea), effective rainfall and soil moisture deficit (SMD) for the year 1995, week number refers weeks after the 1/1/95, 52 weeks in total.

Week No.	Rain (mm)	Ea (mm)	Rain - Ea (mm)	SMD (mm)	Week No.	Rain (mm)	Ea (mm)	Rain - Ea (mm)	SMD (mm)
1	18.6	1.1	17.6	0.3	27	0.0	13.7	0.0	86.7
2	7.0	2.2	4.8	0.0	28	11.1	6.9	0.0	94.0
3	73.2	4.1	69.1	0.0	29	42.0	9.7	32.3	82.9
4	57.5	1.5	56.0	0.0	30	9.3	14.6	0.0	59.9
5	32.7	1.8	30.9	0.2	31	1.9	11.1	0.5	69.6
6	59.9	3.4	56.5	0.4	32	6.1	16.3	0.0	68.7
7	52.2	5.8	46.4	0.1	33	1.2	10.9	0.0	83.1
8	27.5	4.5	23.0	0.2	34	0.0	7.3	0.0	91.8
9	23.7	6.9	16.8	0.1	35	0.9	5.9	0.0	98.2
10	63.7	8.1	55.6	0.3	36	0.0	4.3	0.0	102.3
11	7.3	10.4	0.0	2.3	37	5.8	3.0	2.8	101.1
12	0.7	9.3	0.0	6.7	38	11.2	3.7	7.5	95.0
13	21.0	10.4	0.0	3.8	39	6.2	3.7	2.5	94.8
14	0.0	12.1	0.0	13.7	40	11.9	2.5	9.4	87.0
15	0.0	14.8	0.0	26.7	41	64.4	5.0	59.4	39.3
16	4.7	14.4	0.0	39.5	42	12.2	4.8	7.4	23.4
17	14.2	9.5	4.7	44.2	43	36.3	2.8	33.5	1.6
18	8.8	14.5	0.0	44.3	44	47.5	2.5	45.1	0.5
19	21.6	14.9	6.7	49.2	45	6.1	2.7	3.4	2.0
20	2.4	13.6	0.0	52.9	46	15.4	1.4	14.0	0.4
21	30.2	12.2	18.0	51.0	47	40.9	0.7	40.2	1.0
22	16.5	13.0	3.5	37.1	48	38.3	3.0	35.3	0.0
23	14.3	17.7	0.0	36.8	49	29.1	1.5	27.6	0.1
24	10.7	17.2	0.0	37.1	50	5.9	0.6	5.3	0.7
25	10.7	19.8	0.0	37.2	51	5.1	0.0	5.1	1.2
26	8.9	27.3	0.0	37.9	52	64.3	1.9	62.4	0.0

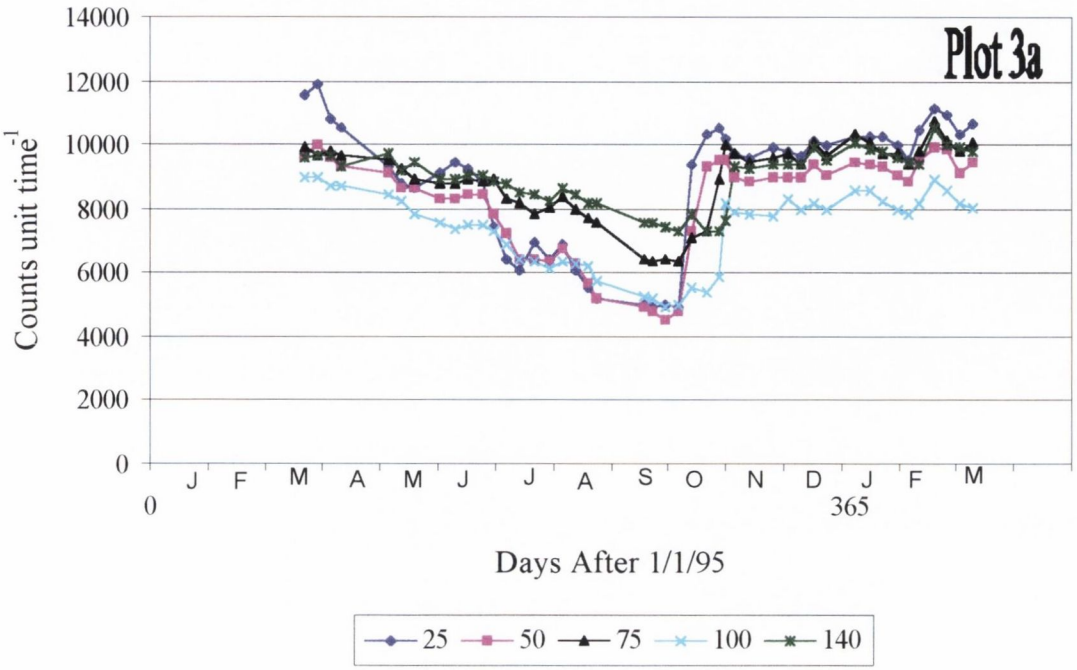
Appendix C.4 Weekly water budget showing rainfall, actual Evapotranspiration (Ea), effective rainfall and soil moisture deficit (SMD) for 1996 from 1/1/96 until 28/4/96, week number refers weeks after the 1/1/96, 17 weeks in total.

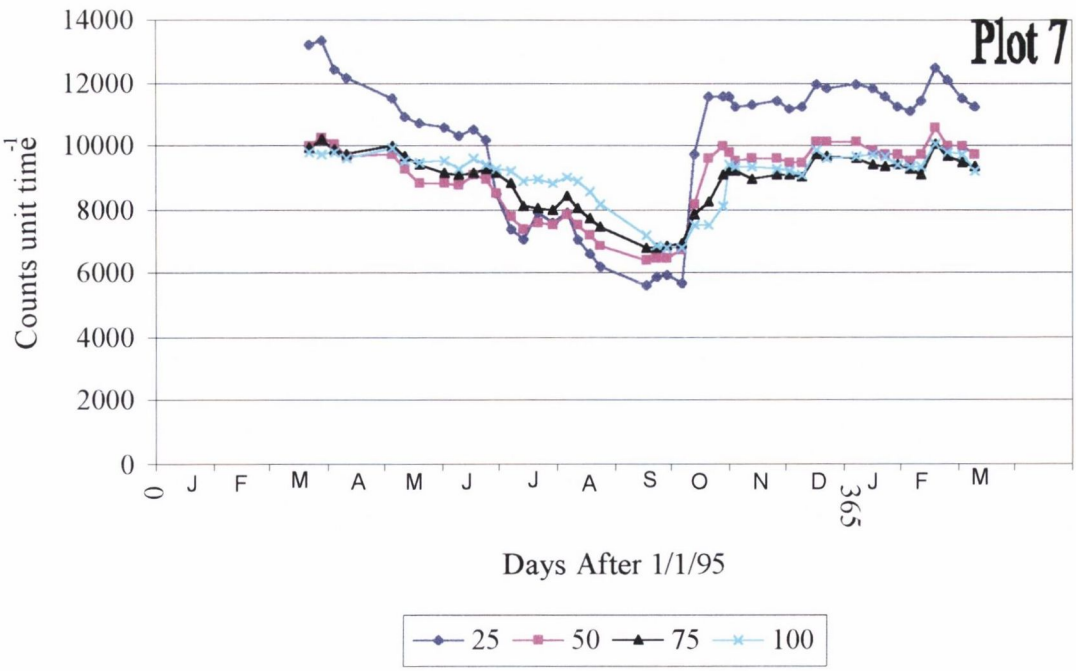
Week No.	Rain (mm)	Ea (mm)	Rain - Ea (mm)	SMD (mm)
1	93.3	1.0	92.3	0.0
2	58.4	1.6	56.8	0.0
3	30.1	2.7	27.4	0.0
4	4.0	3.4	0.6	0.5
5	21.8	2.6	19.2	2.1
6	80.1	3.5	76.6	0.0
7	10.4	5.8	4.6	2.1
8	5.5	4.1	1.4	0.9
9	0.5	7.4	0.0	1.7
10	29.0	5.0	24.0	8.3
11	85.4	5.1	80.3	0.1
12	18.8	5.5	13.3	1.6
13	14.9	10.2	4.7	3.7
14	0.0	10.9	0.0	14.3
15	19.8	8.8	11.1	7.7
16	44.2	11.3	32.9	0.7
17	1.0	15.5	0.0	9.6

Appendix D Temporal variation of effective rainfall and soil moisture deficit from 1/1/94 to 1/3/96.

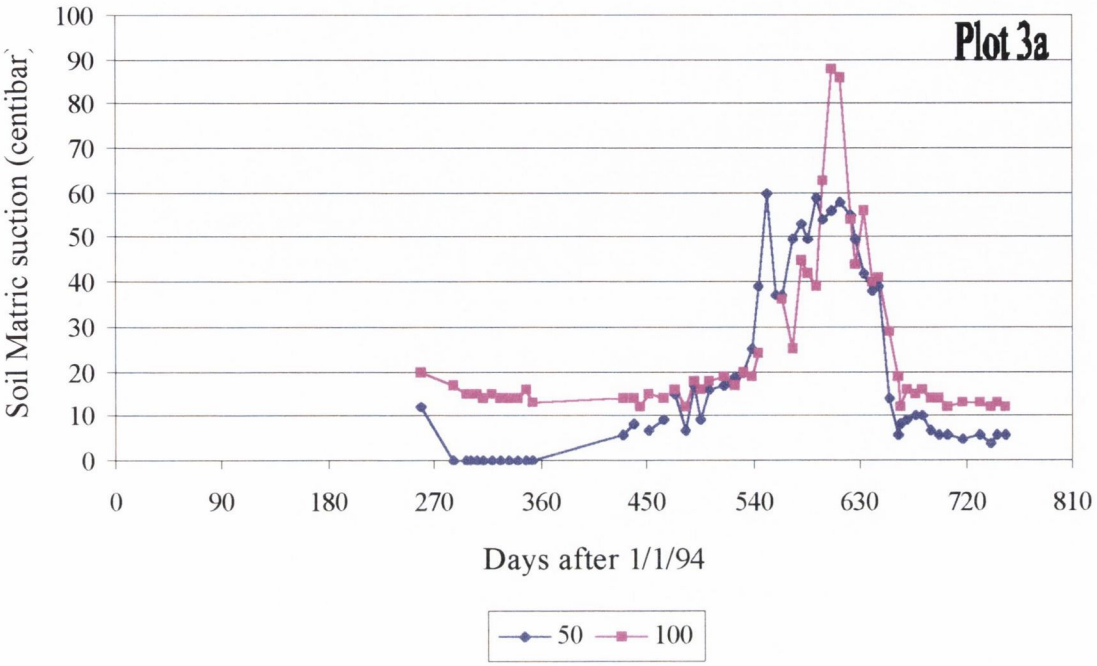


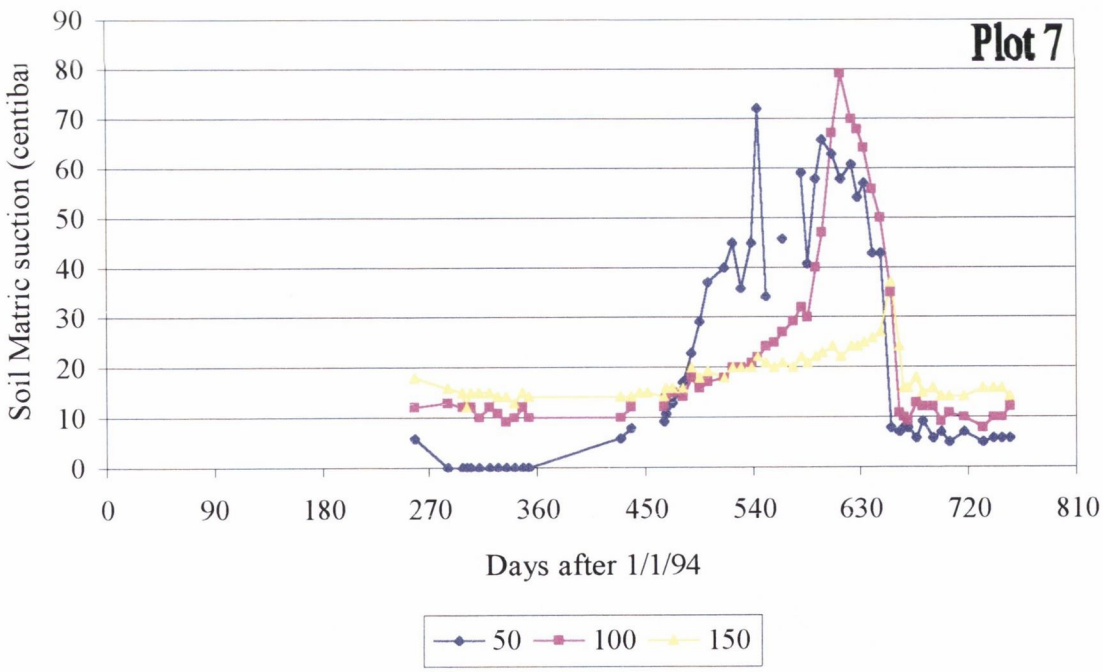
Appendix E Soil moisture temporal variation, in plots 3a and 7, measured using a neutron probe.



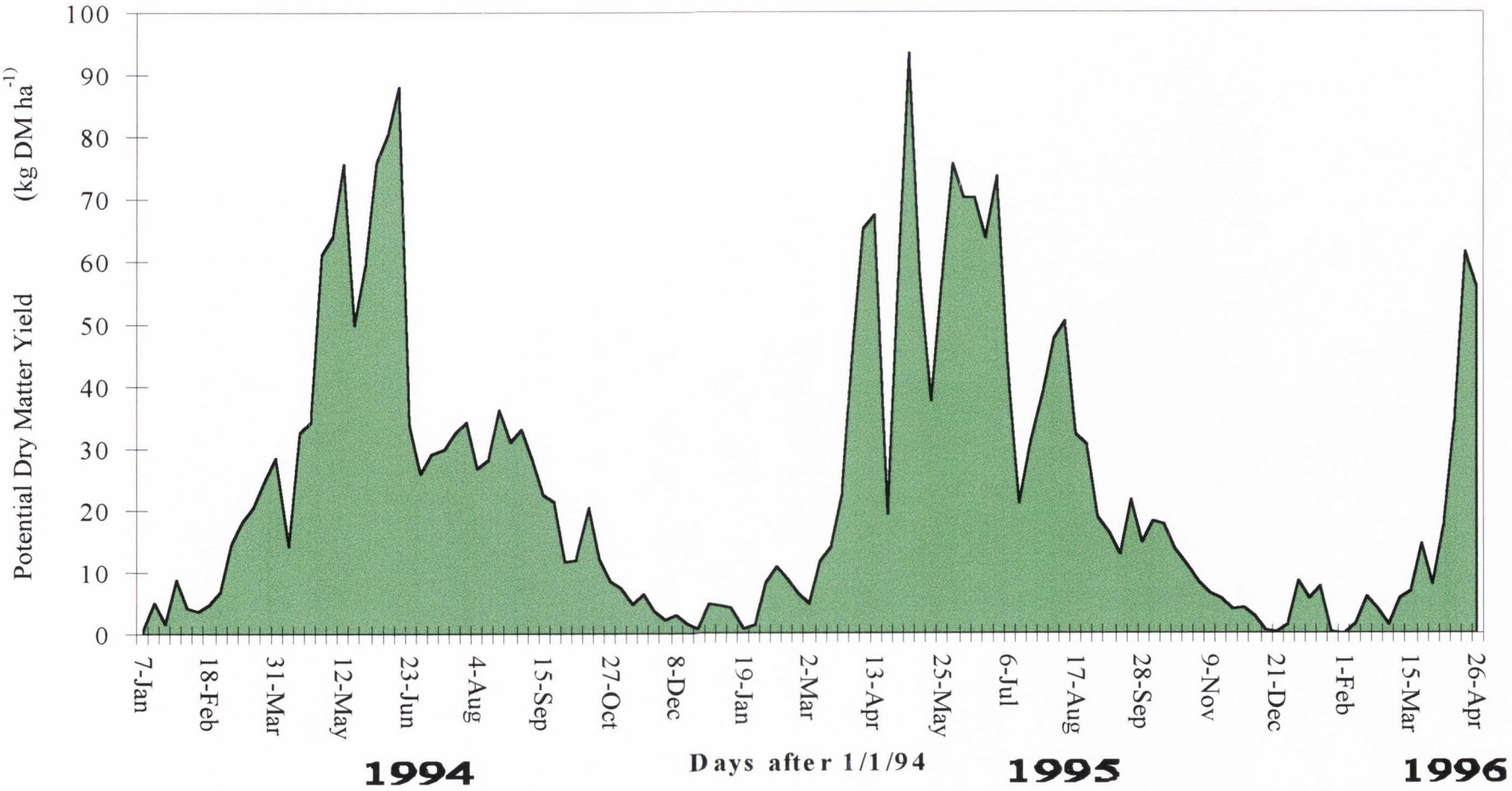


Appendix F Soil matric suction temporal variation measured in plots 3a and 7 at depths of 0.5, 1 and 1.5 m b.g.l..





Appendix G Grass dry matter (DM) production from 1/1/94 to 1/3/96.



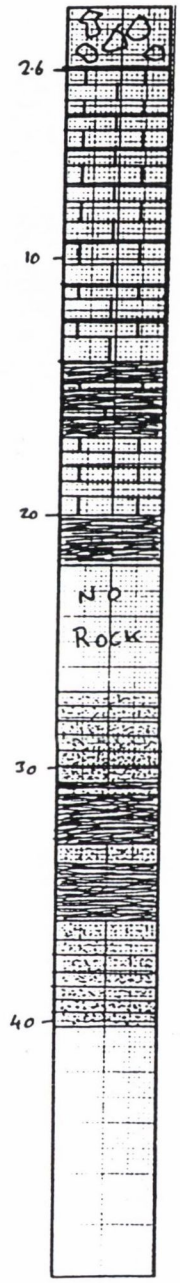
Appendix H.1 Bedrock geology of borehole 4.

Appendix H.1 Bedrock geology of borehole 4.

GEOLOGICAL SURVEY OF IRELAND BOREHOLE LOG

SUMMARY

Company	GEOLOGICAL SURVEY
Company Borehole No.	93.39 (BH4)
G.S.I. Borehole No.	93.39
Townland	BALLYDEROWN
Grid Reference	
Six inch Sheet No.	
1:25,000 Sheet No.	
Date Finished	12/93
Elevation	
Orientation	
Depth	40·3m
Depth to Bedrock	2·6m
Lithology Fm. Top	BALLYSTEEN LMST.
Lithology Fm. Base	BALLYDEROWN SST.
Logged by	



SST OVERBURDEN

LMST WITH INTER-BEDDED SHALES.
BALLYSTEEN LIMESTONE
SHALE ↑ WITH DEPTH

RINGTOYLAN SHALE

MISSING CORE FAULT (THROW ~ 9m)

BALLYDEROWN SST

Scale of Summary Log	

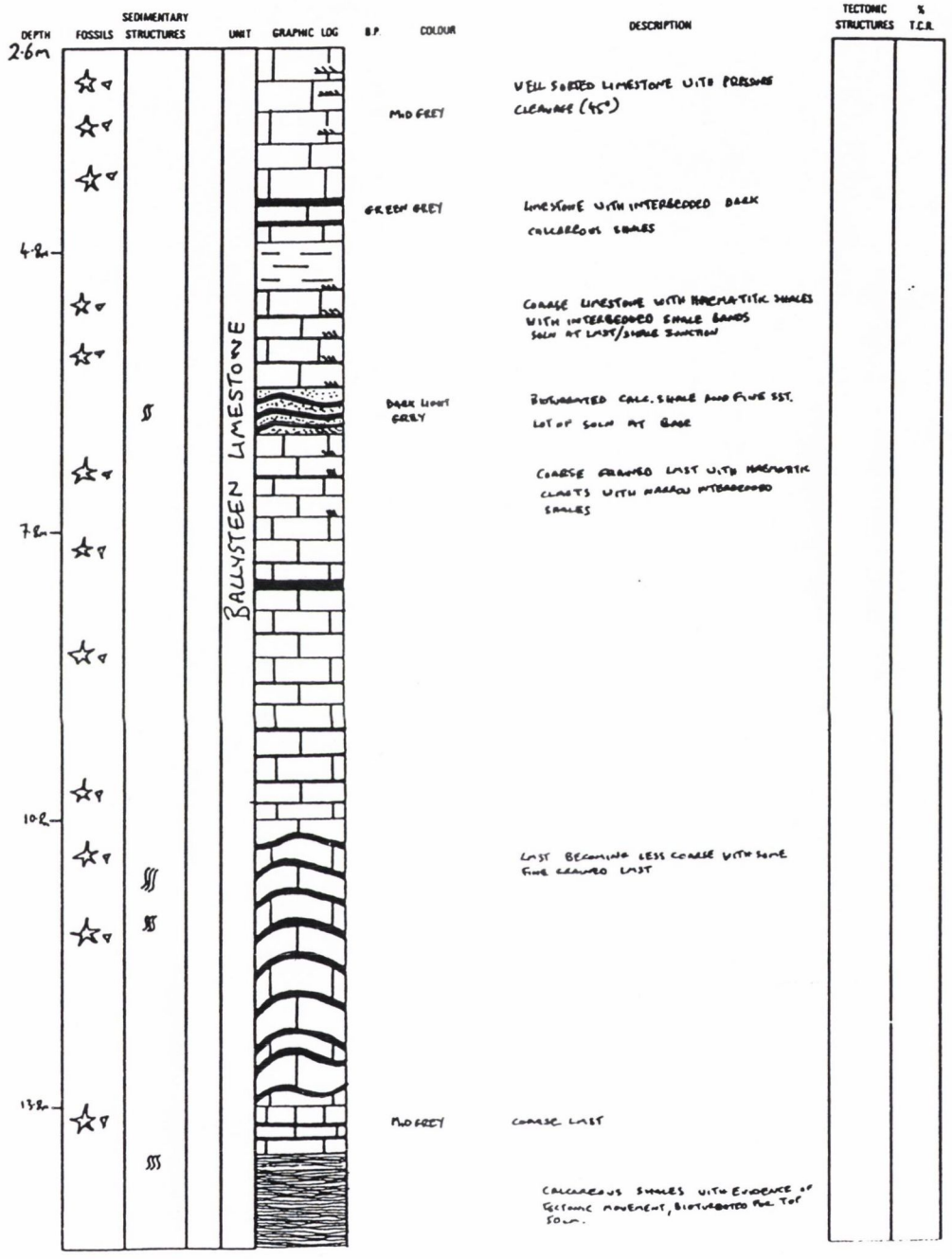
GEOLOGICAL SURVEY OF IRELAND

BOREHOLE LOG

SCALE 1:20

BOREHOLE No. 95.39

Sheet 1 of 3

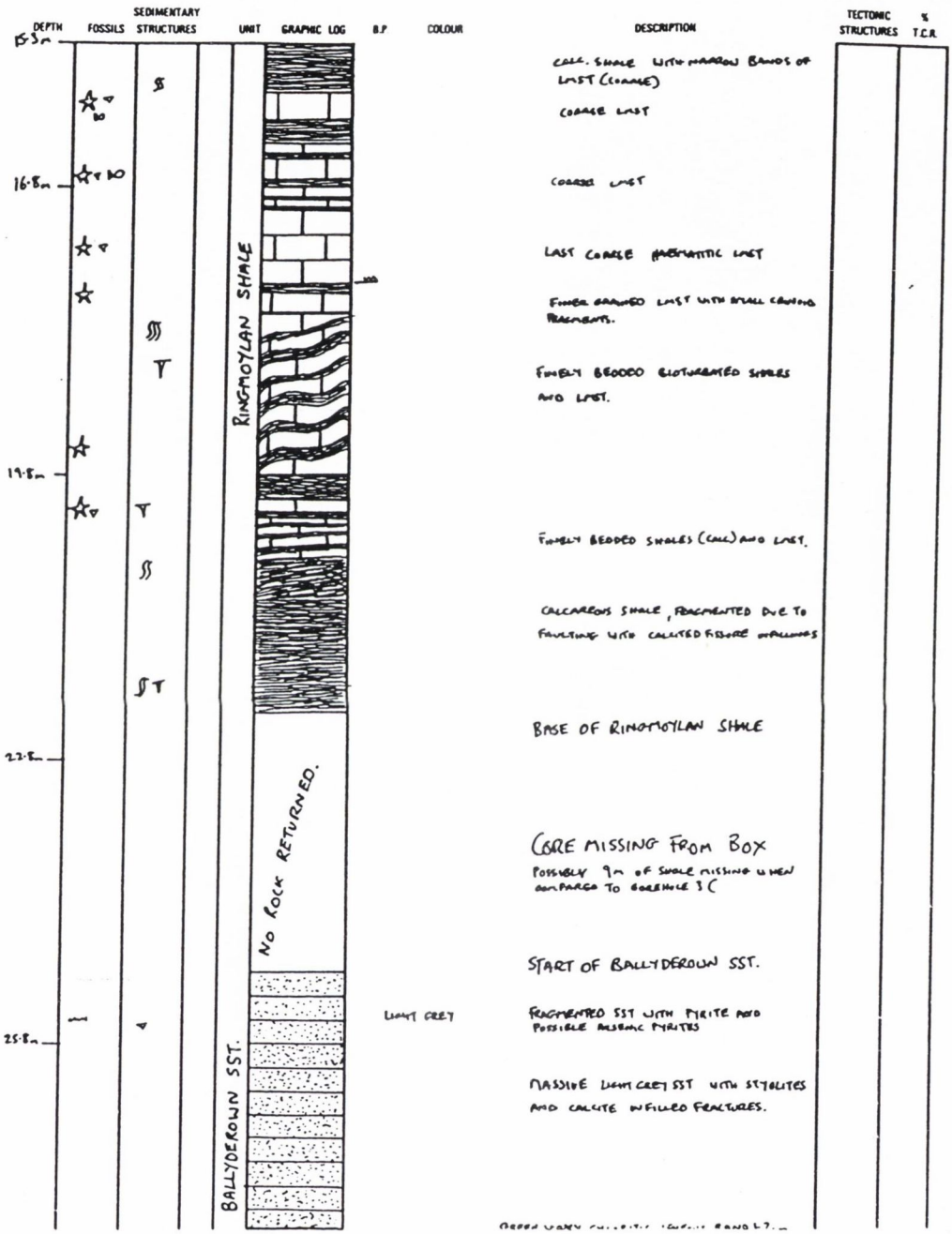


GEOLOGICAL SURVEY OF IRELAND BOREHOLE LOG

SCALE 1:20

BOREHOLE No. 93.39

Sheet 2 of 3

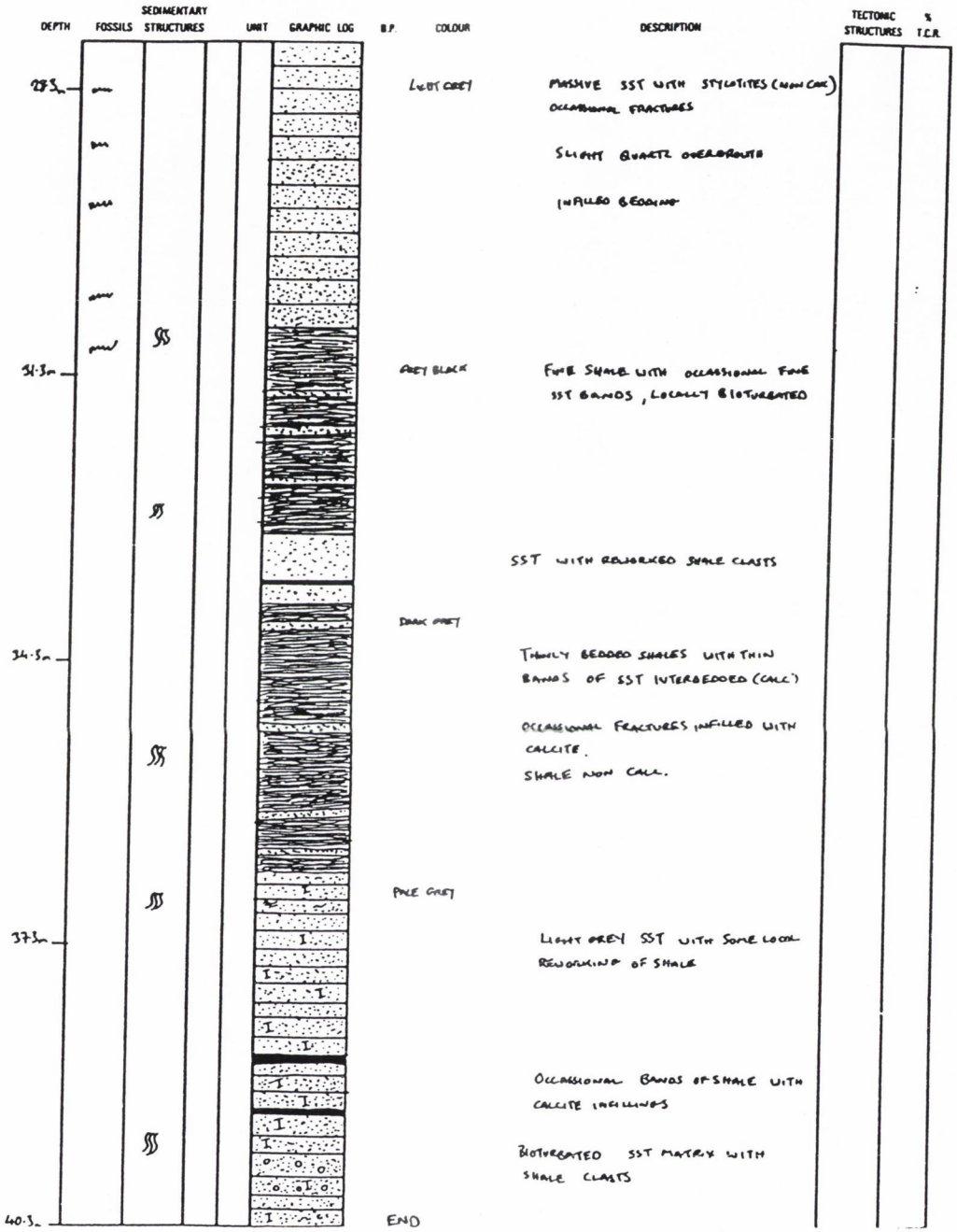


GEOLOGICAL SURVEY OF IRELAND BOREHOLE LOG

SCALE 1:20

BOREHOLE No. 93.39

Sheet 3 of 3

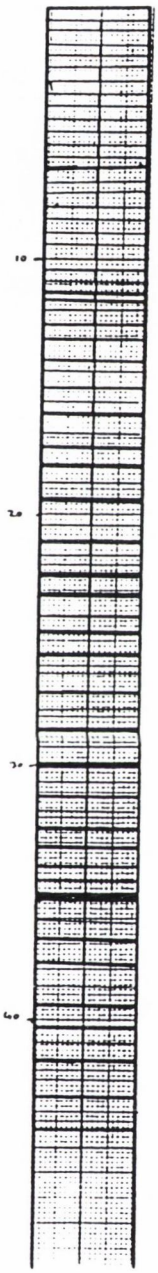


Appendix H.2 Bedrock geology of borehole 5.

GEOLOGICAL SURVEY OF IRELAND BOREHOLE LOG

SUMMARY

Company	Geological Survey.
Company Borehole No.	
G.S.I. Borehole No.	93-40 (BH5)
Townland	Ballyderown
Grid Reference	
Six inch Sheet No.	
1:25,000 Sheet No.	
Date Finished	12/93
Elevation	
Orientation	
Depth	45m.
Depth to Bedrock	3.5m
Lithology Fm. Top	Ballysteen Limest.
Lithology Fm. Base	Ballysteen Limst
Logged by	Karl Richards + David Smith



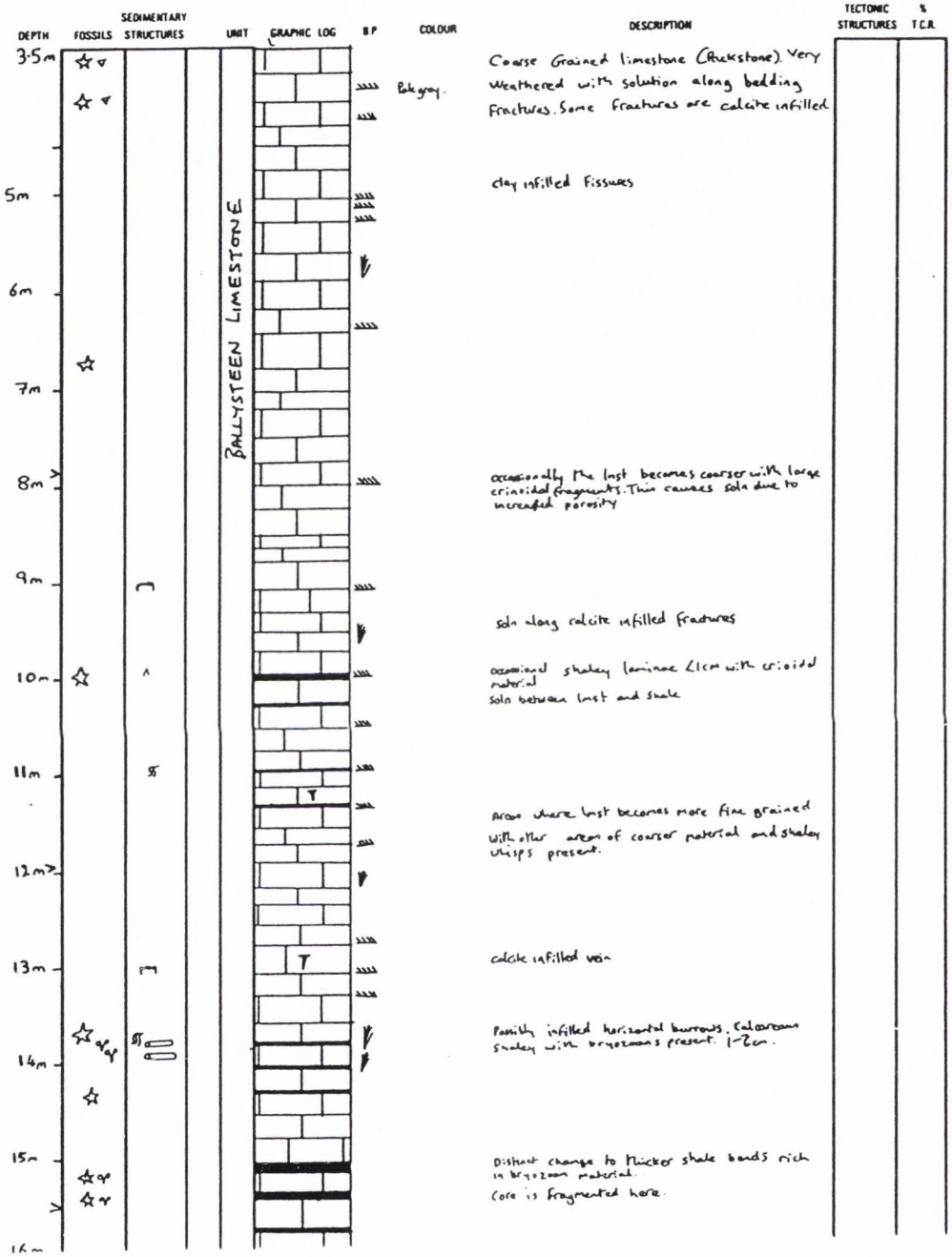
Scale of Summary Log	1 : 200

GEOLOGICAL SURVEY OF IRELAND BOREHOLE LOG

SCALE 1:50

BOREHOLE No. 93-40

Sheet 1 of 4

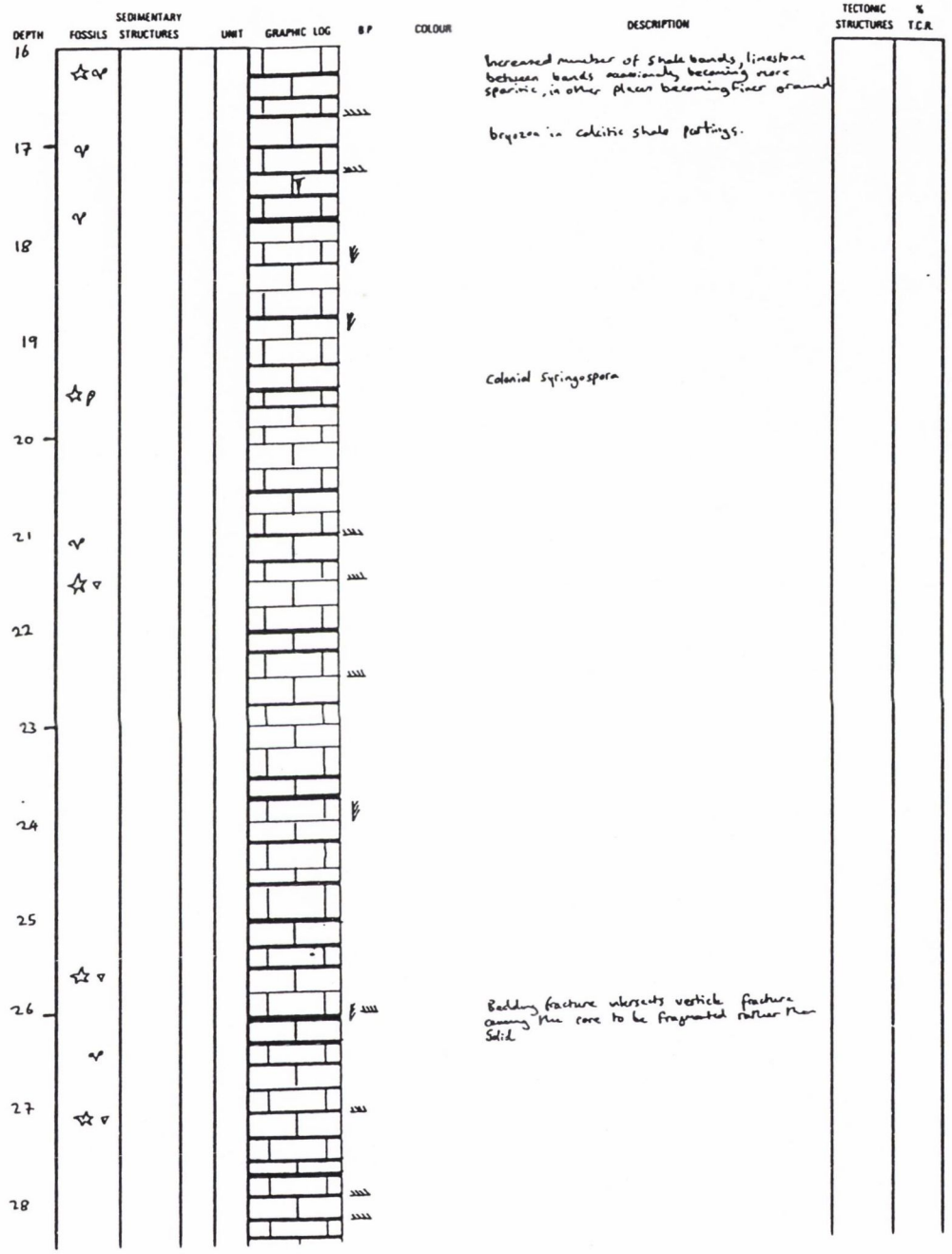


GEOLOGICAL SURVEY OF IRELAND BOREHOLE LOG

SCALE

BOREHOLE No. 93-40

Sheet 2 of 4



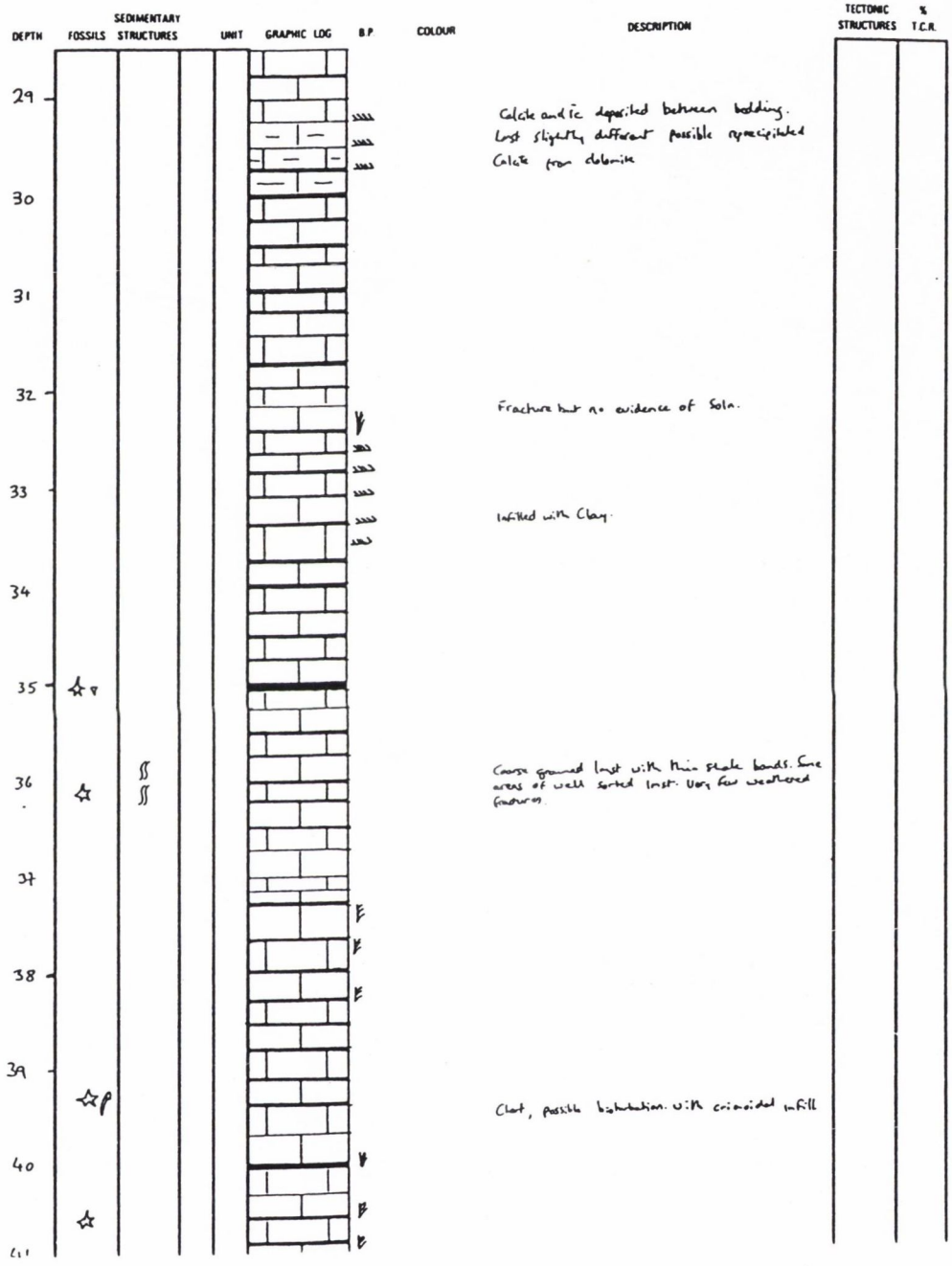
GEOLOGICAL SURVEY OF IRELAND

BOREHOLE LOG

SCALE

BOREHOLE No. 93-40

Sheet 3 of 4

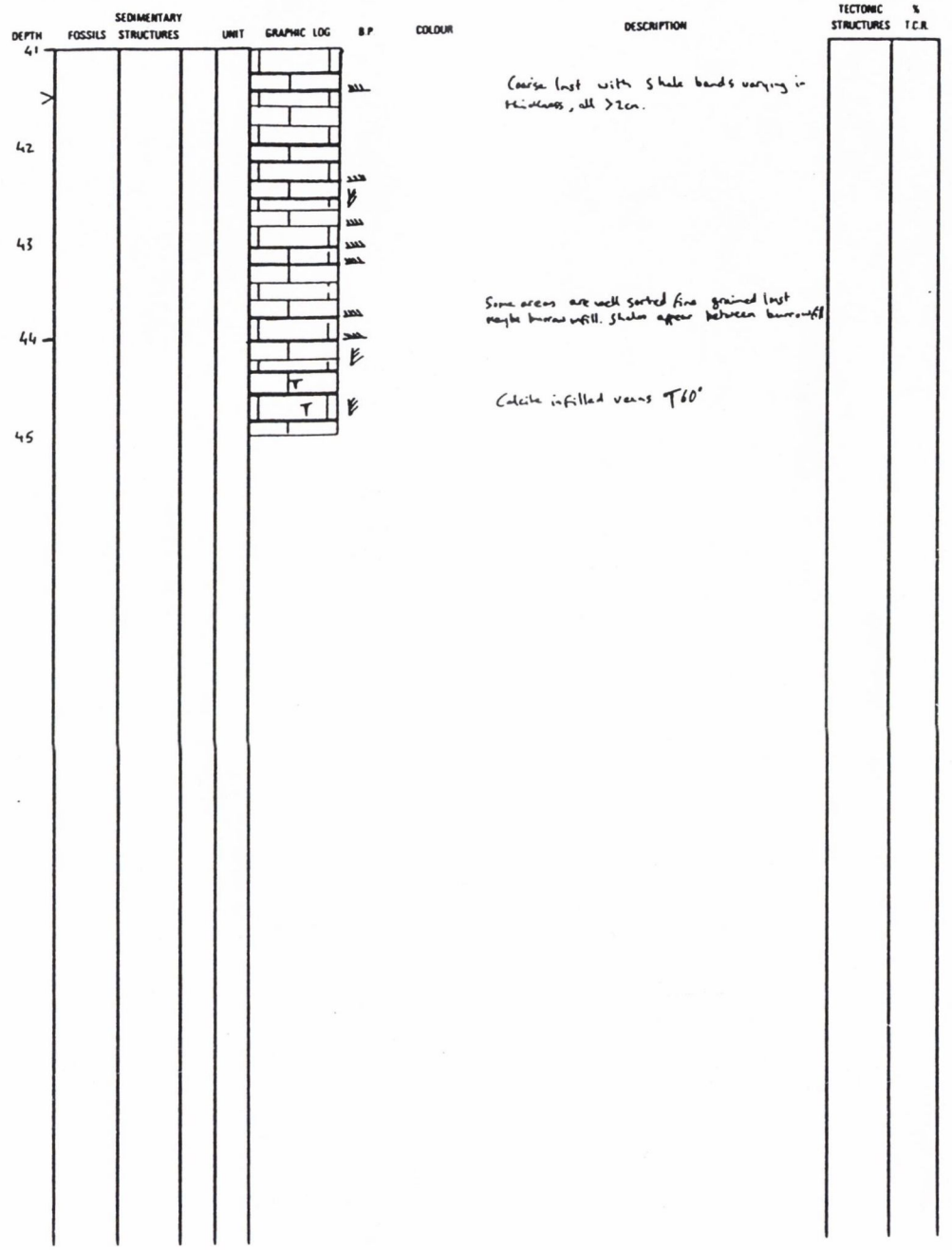


GEOLOGICAL SURVEY OF IRELAND BOREHOLE LOG

SCALE 1 : 50

BOREHOLE No. 93-40

Sheet 4 of 4



Appendix I Water chemistry and biology analysis methodology.

Total oxidised nitrogen (NO_3-N)

Total oxidised nitrogen (TON) was determined by the reduction of NO_3-N to NO_2-N by a copper-hydrazine reagent and the total nitrite content was determined by the formation of an azo dye measured colorimetrically at 520 nm. Thus TON was a measure of NO_3-N + NO_2-N of the sample.

Ammonia -Nitrogen (NH_4-N)

Ammonia was reacted with salicyclate and dichloroisocyanurate (DIC) in an alkaline solution with nitroprusside as a catalyst. This gave a substituted indophenol which was measured colorimetrically at 650 nm.

Molybdate Reactive Phosphate (MRP)

Ammonium molybdate and potassium antimonyl tartrate react with the orthophosphate in the sample in an acid medium to form an antimony-phosphomolybdate complex. This was reduced using ascorbic acid to yield an intense blue colour which was then measured photometrically at 880 nm.

Chloride

Chloride concentration was determined on a Mettler DL21 automatic titrator by potentiometric titration with silver nitrate solution using a glass and silver-silver chloride electrode system. During titration, an electronic voltmeter was used to detect the change in potential between the two electrodes. The end-point of the titration is the instrument reading at which the greatest change in voltage has occurred for a small and constant increment of silver nitrate added. A 10 ml sample was pipetted into a sample holder to which 0.2 ml concentrated HNO_3 and 20 ml deionised water were added. Less sample was used when the Cl concentration was high.

Potassium and Sodium

A Varian AA Atomic absorption spectrophotometer with automatic sample changer was used for the determination of potassium (K) and sodium (Na) in water samples. Each sample had 0.075 ml of conc nitric acid added per 50 ml of sample. The sample was then poured into a sample tube and placed on a carousel. Four standards and a blank were used to calculate a calibration curve for the samples. Standard 1 was used for the re-slope. Sample details were recorded on a computer and the results were printed out and expressed as mg l^{-1}.

Total coliforms

The principle of the MF technique for coliforms is defined as comprising all aerobic and facultative, gram-negative, non-spore forming, rod-shaped bacteria that produce a dark colony with a metallic sheen an incubation at 35 °C for 24 hours on an endo-type medium containing lactose. Sterile forceps were used to place a sterile membrane onto the sterile funnel which was locked into place. One hundred ml of the sample were filtered under vacuum through the membrane. The funnel was then rinsed with three 20 ml portions of sterile dilution water. The membrane was removed using sterile forceps and placed onto M-endo agar. The petri dish was opened for the minimum amount of time. The dish was then inverted, placed in an incubator and incubated at 35 °C±0.5 for 22-24 hours. After incubation the petri dishes were analysed. The number of coliform colonies, which were typically dark red/pink and have a metallic (green-gold) surface sheen, were noted. The results are reported as total coliform colonies per 100 ml^{-1}.

Faecal coliforms

The MF procedure uses an enriched lactose medium and incubation temperature of 44.5±0.2 °C for selectivity and gives a 93% accuracy in differentiating between coliforms from warm-blooded animals and those from other sources. A lactose enriched membrane was locked into a funnel and 100 ml of the sample was filtered using the same methodology outlined above. The petri dish was then incubated in a HPI-70 oven at 44.5±0.2 °C for 24±2 hours.

Appendix J.1 Mean soil solution NO_3-N concentrations for all plots at depths of 50, 100 and 150 cm from 19/1/94 until 23/5/95.

Sample	day	50 cm depth					100 cm depth				150 cm depth			
Date	no.	12	5	16	3a	7	5	16	3a	7	5	16	3a	7
19-1-94	19	22	14	20		29		28		33				72
26-1-94	26	17	12	9		43		30		29				104
3-2-94	33	13	10	7	4	15		13		25				113
16-2-94	46	11	8	5	5	12		12		24				47
23-2-94	54	7	5	4	4	9		9		19				71
2-3-94	60	4	3	3	3	8		9		16				28
8-3-94	66	5	5	2	3	7		4		15				28
15-3-94	73	5	5	3	3	7		7		16				27
23-3-94	81	5	6	3	6	7		4		15				67
30-3-94	88	4	5	4	2	5		3		13				24
6-4-94	95	2	6	0	2	5		5		11				51
12-4-94	101	2	3	2	2	5		5		11				45
21-4-94	110		9	1	1	3		4		9				37
10-5-94	129	8	11	2	1	5		3		7				8
16-5-94	135	1	15	1	1	2		3		5				21
23-5-94	142	1	17	1	1	1		4		5				19

Appendix J.2 Mean soil solution NO_3-N concentrations (mg l^{-1}) for all plots at depths of 50, 100 and 150 cm from 14/10/94 until 15/6/95.

Sample	day	50 cm depth					100 cm depth				150 cm depth			
Date	no.	12	5	16	3a	7	5	16	3a	7	5	16	3a	7
17-10-94	290	8	132		21	3	21	7	69	8	19	6	16	35
24-10-94	297	19		8	14	5	18	8	52	26	22	6	16	23
1-11-94	305	14	168	7	14	5	18	7	45	26	24	12	16	31
8-11-94	312	12		6	14	3	23	7	41	35	31	8	23	33
15-11-94	319	13	136	1	15	3	24	6	38	43	36	40	26	37
22-11-94	326	21	105	2	14	4	24	7	35	47	28	53	27	43
29-11-94	333	25	89	5	14	4	25	6	33	50	41	55	25	44
6-12-94	340	33	69	7	10	4	26	6	30	51	38	62	32	51
13-12-94	347	31	72	7	12	4	24	7	29	60	39	60	21	64
19-12-94	353	31	65	12	13	4	23	7	30	50	40	58	34	52
3-1-95	368	30	60	9	14	5	23	7	27	61	38	56	34	47
10-1-95	375	30	51	8	14	7	22	7	25	55	40	47	35	51
18-1-95	383	32	56	9	15	10	22	9	20	51	38	43	37	48
24-1-95	389	21	53	7	12	11	42	9	19	51	38	36	19	41
1-2-95	397	13	59	5	10	10	46	10	17	37	33	27	11	35
8-2-95	404	11	17	4	9	10	32	10	15	36	32	21	7	34
14-2-95	410	7	12	3	8	11	27	9	14	32	27	17	7	31
20-2-95	416	7	9	3	6	11	22	8	14	26	25	13	12	31
27-2-95	423	6	8	3	6	11	18	9	15	27	26	11	12	31
6-3-95	430	6	7	2	11	10	15	6	15	23	23	7	12	25
14-3-95	438	5	7	1	8	8	8	4	8	28	21	6	11	12
21-3-95	445	5	7	1	9	9	6	5	10	20	18	6	23	24
28-3-95	452	6	7	1	9	10	5	7	11	20	17	6	21	29
4-4-95	459	7	7	0	10	9	2	5	12	20	16	5	25	27
10-4-95	465	8	7	0	8	9	1	5	7	19	15	5	19	22
18-4-95	473	9	6	2	7		1	5	10	20	14	5	23	23
27-4-95	482	11	6	3	8		2	6	12	23	14	7	24	15
4-5-95	489	10	8	5	8		3	6	16	17	13	7	22	22
11-5-95	496	12	8	5	13		3	6	15	16	13	9	18	19
18-5-95	503	9		1	7	15	0	3		10	13	4	21	20
31-5-95	516	11		2		16	0	8	23	21	11	5	30	21
15-6-95	531	12	1	1			1	4	29	21	8	5	26	24

Appendix J.3 Mean soil solution NO_3-N concentrations (mg l^{-1}) for all plots at depths of 50, 100 and 150 cm from 2/10/95 until 26/2/96.

Sample	day	50 cm depth					100 cm depth				150 cm depth			
Date	no.	12	5	16	3a	7	5	16	3a	7	5	16	3a	7
2-10-95	640									25	13	5	34	24
9-10-95	647	58	55			15				20	13	6	32	20
17-10-95	655	48	40	52		32	7		43	20	13	7	31	20
24-10-95	662	121	69	28	27	74	10	8	43	15	15	6	30	19
31-10-95	669		41	3	33	16	13	7	27	20	16	11	29	22
7-11-95	676	174	68	26	21	16		0		21		13	30	38
21-11-95	690	150	54	15	13	68	34	12	38	20	37	81	37	35
5-12-95	704	39	44	25	20	26		18		21	42	49		
18-12-95	717	24	30	24	7	32	22	19	32	19	26	30	44	43
10-1-96	740	18	11	12	5	7	37	31	41	18	47	36	32	20
24-1-96	754	15	14				34				45			
30-1-96	760	11	13	9	3	9	41	32		10	49	35		
5-2-96	766	15	19				29				39			
12-2-96	773	20	27	12	8	13	35	26		11	35	26	21	
26-2-96	786	28				14	25	23		18		16		15

Appendix K Groundwater nitrate concentrations (mg N l^{-1}) from all boreholes between 1993 and 1996.

		Borehole Identity				
Date	Day No.	1	2	3	4	5
10-Jan-93	11	25.3	36.4	35.7		
10-Feb-93	41	33.6	44.4	33.9		
1-Mar-93	70	27.4	35.5	30.8		
5-Apr-93	95	28.0	38.5	34.1		
4-May-93	124	26.6	34.4	29.0		
8-Jun-93	159	25.1	38.7	28.4		
8-Jul-93	189	22.5	36.1	27.8		
24-Aug-93	236	22.6	37.0	27.8		
21-Sep-93	264	20.7	35.7	31.8		
19-Oct-93	292	15.7	35.5	34.3		
16-Nov-93	320	16.4	35.3	27.0		
13-Dec-93	347	25.2	28.5	21.7		
12-Jan-94	377	32.2	22.0	20.2	51.2	16.8
18-Jan-94	383	34.1	22.1	17.7	57.6	15.2
26-Jan-94	391	34.7	21.5	18.8	69.5	16.0
3-Feb-94	399	42.1	20.9	21.1	66.6	16.9
16-Feb-94	412	33.8	20.7	17.0	54.3	17.2
21-Feb-94	417	23.8	21.3	17.8	58.0	17.5
23-Feb-94	419	21.6	20.5	19.2	58.7	16.6
2-Mar-94	426	19.2	19.9	15.3	54.5	17.6
8-Mar-94	432	19.5	19.2	17.5	47.1	16.9
16-Mar-94	440	23.4	19.9	18.6	56.5	17.4
6-Apr-94	461	21.0	18.0	17.5	58.9	16.5
21-Apr-94	476	20.3	21.0	19.2	61.3	19.7
25-Apr-94	480	22.1	19.3	20.7	67.9	17.3
4-May-94	489	19.9	20.4	22.3	58.0	18.1
11-May-94	496	17.6	17.8	19.7	52.4	17.3
16-May-94	501	15.6	16.4	20.0	53.0	16.4
23-May-94	508	15.0	17.7	20.8	57.5	17.4
31-May-94	516	16.0	19.6	22.3	56.6	17.5
14-Jun-94	530	16.0	19.5	21.8	46.0	15.9
21-Jun-94	537	17.4	20.0	23.3	54.6	16.4
30-Jun-94	546	16.1	22.6	26.2	64.0	18.1
7-Jul-94	553	17.9	21.3	27.8	59.0	18.0
19-Jul-94	565	17.0	21.2	22.3	57.7	15.4
9-Aug-94	586	15.2	15.6	20.5	54.0	12.8
23-Aug-94	600	14.8	13.5	21.6	50.0	13.8
15-Sep-94	623	15.4	16.1	22.7	53.6	15.7
13-Oct-94	651	15.1	19.7	22.4	56.9	13.5
24-Oct-94	662	14.4	20.0	24.0	62.0	14.4
1-Nov-94	670	15.1	20.6	26.4	67.0	15.7
15-Nov-94	684	13.1	17.3	24.6	62.1	17.0
22-Nov-94	691	13.0	17.1	20.0	50.0	15.7

Appendix K cont. Groundwater nitrate concentrations (mg N l^{-1}) from all boreholes between 1993 and 1996.

		Borehole Identity				
Date	Day No.	1	2	3	4	5
29-Nov-94	698	13.6	18.7	21.6	56.1	15.7
13-Dec-94	712	12.8	22.1	19.1	52.1	17.0
18-Jan-95	748	17.1	34.3	19.4	49.7	16.0
25-Jan-95	755	22.6	37.5	18.5	49.3	16.2
20-Feb-95	781	19.0	41.6	17.2	38.2	21.5
20-Mar-95	809	17.9	40.4	18.6	35.9	19.9
6-Apr-95	826	17.9	36.3	20.7	37.1	20.4
20-Apr-95	840	18.6	39.1	24.0	38.0	18.6
25-Apr-95	845	18.5	37.2	20.4	36.7	16.6
4-May-95	854	18.0	35.0	23.3	39.0	17.5
15-May-95	865	19.0	33.3	23.5	39.2	17.2
23-May-95	873	18.1	33.1	23.4	36.3	16.8
8-Jun-95	889	16.7	33.7	21.8	37.9	14.6
15-Jun-95	896	16.1	33.6	21.8	38.1	15.3
22-Jun-95	903	15.8	34.0	21.9	37.8	15.0
28-Jun-95	909	15.7	34.6	22.2	38.0	15.0
5-Jul-95	916	16.2	35.2	22.8	38.0	15.2
3-Aug-95	945	14.7	33.1	21.7	38.1	
9-Aug-95	951	14.7	34.2	20.7	38.5	
16-Aug-95	958	14.8	35.1	21.8	38.2	
21-Aug-95	963	14.1	33.6	20.8	38.9	
14-Sep-95	987	11.8	31.2	20.8	37.6	
25-Sep-95	998	12.1	33.8	20.5	36.9	13.6
9-Oct-95	1012	11.1	32.7	20.2	36.2	13.9
17-Oct-95	1020	11.1	32.0	19.6	36.1	13.6
31-Oct-95	1034	12.2	32.1	21.0	35.8	14.0
7-Nov-95	1041	11.5	31.6	17.1	34.0	13.9
21-Nov-95	1055	12.6	36.2	17.5	33.2	14.5
28-Nov-95	1062	14.3	34.6	24.4	35.4	14.6
5-Dec-95	1069	18.0	32.2	18.7	32.6	14.5
12-Dec-95	1076	17.8	33.6	19.4	32.3	14.7
18-Dec-95	1082	17.4	32.9	19.6	31.0	14.7
2-Jan-96	1097	32.1	38.5	23.0	31.1	16.5
10-Jan-96	1105	37.7	44.0	20.0	28.6	18.0
17-Jan-96	1112	36.4	43.0	18.9	27.8	18.8
24-Jan-96	1119	35.5	51.1	21.0	28.7	19.5
30-Jan-96	1125	39.2	48.3	23.4	30.0	20.0
5-Feb-96	1131	36.4	40.5	19.4	32.1	20.9
12-Feb-96	1138	31.4	42.9	20.8	26.3	19.8
19-Feb-96	1145	32.5	43.2	21.4	26.7	19.5
26-Feb-96	1152	35.3	42.4	22.6	26.8	19.5
4-Mar-96	1159	33.4	40.5	23.0	28.8	21.5
2-Apr-96	1188	29.5	25.7	23.5	27.7	20.7

Appendix L.1 Analysis of variance tables for farm soil comparison on 29/3/94.

Analysis of Variance For Soil NO_3-N (29/3/94)

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	6	162.886	27.1477	4.628	0.0022
Error	28	164.246	5.86592		
Total	34	327.132			

Bonferroni mean comparison procedure for NO_3-N.

Farm	Mean Difference	Probability	Farm	Mean Difference	Probability
JK - BD	-2.38	0.9486	PY - JK	-0.09	1.0000
LK - BD	-2.58	0.8973	PY - LK	0.12	1.0000
LK - JK	-0.21	1.0000	PY - MR	3.13	0.6624
MR - BD	-5.60	0.0219	PY - PO	3.90	0.2984
MR - JK	-3.22	0.6169	SH- BD	-5.64	0.0202
MR - LK	-3.01	0.7217	SH- JK	-3.27	0.5930
PO - BD	-6.36	0.0058	SH- LK	-3.06	0.6989
PO - JK	-3.99	0.2664	SH- MR	-0.05	1.0000
PO - LK	-3.78	0.3454	SH- PO	0.72	1.0000
PO - MR	-0.77	1.0000	SH- PY	-3.18	0.6387
PY - BD	-2.47	0.9295			

Analysis of Variance For Soil NH_4-N (29/03/94)

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	6	287.954	47.9923	1.0989	0.3876
Error	28	1222.81	43.6719		
Total	34	1510.77			

Analysis of Variance For Total inorganic soil N (29/03/94)

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	6	315.34	52.5567	0.86069	0.5354
Error	28	1709.79	61.0638		
Total	34	2025.13			

Appendix L.2 Analysis of variance tables for farm soil comparison on 8/11/94.

Analysis of Variance For Soil NO_3-N (8/11/94)

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	7	1618.94	231.278	25.783	< 0.0001
Error	32	287.05	8.97031		
Total	39	1905.99			

Bonferroni mean comparison procedure for soil NO_3-N.

Farm	Mean Difference	Probability	Farm	Mean Difference	Probability
JK - BD	-15.78	<0.0001	PY - PO	4.40	0.5313
LK - BD	-17.33	<0.0001	SH- BD	-15.42	<0.0001
LK - JK	-1.55	1.0000	SH- JK	0.36	1.0000
MR - BD	-21.88	<0.0001	SH- LK	1.91	1.0000
MR - JK	-6.10	0.0788	SH- MR	6.46	0.0485
MR - LK	-4.55	0.4671	SH- PO	5.19	0.2434
PO - BD	-20.62	<0.0001	SH- PY	0.79	1.0000
PO - JK	-4.84	0.3570	TC - BD	-11.49	<0.0001
PO - LK	-3.29	0.9338	TC - JK	4.29	0.5783
PO - MR	1.27	1.0000	TC - LK	5.84	0.1108
PY - BD	-16.22	<0.0001	TC - MR	10.39	<0.0001
PY - JK	-0.44	1.0000	TC - PO	9.13	<0.0001
PY - LK	1.11	1.0000	TC - PY	4.73	0.3970
PY - MR	5.67	0.1386	TC - SH	3.93	0.7319

Analysis of Variance For Soil NH_4-N (18/11/94)

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	7	3252.07	464.582	1.6177	0.1662
Error	32	9189.91	287.185		
Total	39	12442			

Analysis of Variance For Total inorganic soil N (18/11/94)

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	7	5177.21	739.602	2.284	0.0526
Error	32	10362.3	323.822		
Total	39	15539.5			

Appendix L.3 Analysis of variance tables for farm soil comparison on 14/2/95.

Analysis of Variance For Soil NO_3-N (14/2/95)

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	7	317.891	45.413	6.7377	< 0.0001
Error	32	215.685	6.74016		
Total	39	533.576			

Analysis of Variance For Soil NH_4-N (14/2/95)

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	7	131.366	18.7666	5.9489	0.0002
Error	32	100.949	3.15465		
Total	39	232.315			

Analysis of Variance For Total inorganic soil N (14/2/95)

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	7	721.971	103.139	6.0037	0.0002
Error	32	549.737	17.1793		
Total	39	1271.71			

Bonferroni mean comparison procedure.

	Soil NO_3-N		Soil NH_4-N		Soil total inorganic N	
Farm	Difference	Probability	Difference	Probability	Difference	Probability
JK - BD	-7.34	0.0026	-0.66	1.0000	-0.66	0.1196
LK - BD	-4.29	0.3194	0.12	1.0000	0.12	0.9740
LK - JK	3.06	0.8763	0.78	1.0000	0.78	0.9903
MR - BD	-5.81	0.0346	1.02	1.0000	1.02	0.8939
MR - JK	1.53	1.0000	1.68	0.9874	1.68	0.9993
MR - LK	-1.52	1.0000	0.90	1.0000	0.90	1.0000
PO - BD	-7.31	0.0027	-0.49	1.0000	-0.49	0.1430
PO - JK	0.03	1.0000	0.17	1.0000	0.17	1.0000
PO - LK	-3.03	0.8854	-0.61	1.0000	-0.61	0.9953
PO - MR	-1.50	1.0000	-1.51	0.9971	-1.51	0.9998
PY - BD	-4.96	0.1284	0.54	1.0000	0.54	0.9494
PY - JK	2.38	0.9917	1.20	0.9999	1.20	0.9964
PY - LK	-0.68	1.0000	0.42	1.0000	0.42	1.0000
PY - MR	0.85	1.0000	-0.48	1.0000	-0.48	1.0000
PY - PO	2.35	0.9929	1.03	1.0000	1.03	0.9985
SH- BD	-2.87	0.9279	2.45	0.6513	2.45	1.0000
SH- JK	4.47	0.2545	3.11	0.2299	3.11	0.1754
SH- LK	1.41	1.0000	2.33	0.7353	2.33	0.9933
SH- MR	2.94	0.9123	1.43	0.9987	1.43	0.9562
SH- PO	4.44	0.2638	2.94	0.3151	2.94	0.2075
SH- PY	2.09	0.9987	1.91	0.9456	1.91	0.9838
TC - BD	0.46	1.0000	5.15	0.0019	5.15	0.6830
TC - JK	7.80	0.0011	5.81	0.0003	5.81	0.0003
TC - LK	4.74	0.1757	5.03	0.0025	5.03	0.0208
TC - MR	6.27	0.0162	4.13	0.0238	4.13	0.0107
TC - PO	7.77	0.0012	5.64	0.0005	5.64	0.0004
TC - PY	5.42	0.0642	4.61	0.0073	4.61	0.0158
TC - SH	3.33	0.7678	2.70	0.4667	2.70	0.5492

Appendix L.4 Analysis of variance tables for farm soil comparison on November 1995.

Analysis of Variance For Soil NO_3-N (November 1995)

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	9	21726.2	2414.03	10.639	<0.0001
Error	37	8395.42	226.903		
Total	46	30121.7			

Analysis of Variance For Soil NH_4-N (November 1995)

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	9	1678.83	186.537	3.4429	0.0036
Error	37	2004.69	54.1807		
Total	46	3683.52			

Analysis of Variance For Soil total inorganic N (November 1995)

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	9	20271.3	2252.37	7.3299	< 0.0001
Error	37	11369.6	307.286		
Total	46	31640.9			

Appendix L.5 Bonferroni mean comparison procedure tables for farm soil comparison on November 1995.

Bonferroni mean comparison procedure.

	NO_3-N		NH_4-N		Total inorganic N	
Farm	Difference	Probability	Difference	Probability	Difference	Probability
B - A	1.83	1.0000	2.55	1.0000	4.40	1.0000
BD - A	31.20	0.1579	-5.27	1.0000	25.89	0.7895
BD - B	29.38	0.2418	-7.82	0.9971	21.49	0.9711
JK - A	53.40	0.0003	1.79	1.0000	55.17	0.0016
JK - B	51.58	0.0005	-0.76	1.0000	50.77	0.0051
JK - BD	22.20	0.6851	7.06	0.9987	29.28	0.4201
LK - A	1.83	1.0000	2.55	1.0000	4.40	1.0000
LK - B	0.00	1.0000	0.00	1.0000	0.00	1.0000
LK - BD	-29.38	0.2418	7.82	0.9971	-21.49	0.9711
LK - JK	-51.58	0.0005	0.76	1.0000	-50.77	0.0051
MR - A	14.28	0.9997	14.55	0.2209	28.81	0.5812
MR - B	12.46	1.0000	12.00	0.5982	24.41	0.8738
MR - BD	-16.92	0.9807	19.82	0.0061	2.92	1.0000
MR - JK	-39.12	0.0095	12.76	0.3456	-26.36	0.6442
MR - LK	12.46	1.0000	12.00	0.5982	24.41	0.8738
PO - A	7.02	1.0000	0.15	1.0000	7.15	1.0000
PO - B	5.20	1.0000	-2.40	1.0000	2.75	1.0000
PO - BD	-24.18	0.5046	5.42	1.0000	-18.74	0.9910
PO - JK	-46.38	0.0010	-1.64	1.0000	-48.02	0.0049
PO - LK	5.20	1.0000	-2.40	1.0000	2.75	1.0000
PO - MR	-7.26	1.0000	-14.40	0.1558	-21.66	0.9331
PY - A	33.42	0.0904	-3.07	1.0000	30.33	0.4704
PY - B	31.60	0.1434	-5.62	1.0000	25.93	0.7869
PY - BD	2.22	1.0000	2.20	1.0000	4.44	1.0000
PY - JK	-19.98	0.8608	-4.86	1.0000	-24.84	0.7592
PY - LK	31.60	0.1434	-5.62	1.0000	25.93	0.7869
PY - MR	19.14	0.9090	-17.62	0.0243	1.52	1.0000
PY - PO	26.40	0.3248	-3.22	1.0000	23.18	0.8647
SH- A	10.08	1.0000	-7.43	0.9989	2.59	1.0000
SH- B	8.26	1.0000	-9.98	0.9031	-1.82	1.0000
SH- BD	-21.12	0.7776	-2.16	1.0000	-23.30	0.8580
SH- JK	-43.32	0.0025	-9.22	0.9220	-52.58	0.0014
SH- LK	8.26	1.0000	-9.98	0.9031	-1.82	1.0000
SH- MR	-4.20	1.0000	-21.98	0.0015	-26.22	0.6552
SH- PO	3.06	1.0000	-7.58	0.9952	-4.56	1.0000
SH- PY	-23.34	0.5809	-4.36	1.0000	-27.74	0.5355
TC - A	63.08	<0.0001	-4.25	1.0000	58.77	0.0006
TC - B	61.26	<0.0001	-6.80	0.9998	54.37	0.0020
TC - BD	31.88	0.0816	1.02	1.0000	32.88	0.2114
TC - JK	9.68	1.0000	-6.04	1.0000	3.60	1.0000
TC - LK	61.26	<0.0001	-6.80	0.9998	54.37	0.0020
TC - MR	48.80	0.0004	-18.80	0.0117	29.96	0.3734
TC - PO	56.06	0.0000	-4.40	1.0000	51.62	0.0018
TC - PY	29.66	0.1483	-1.18	1.0000	28.44	0.4817
TC - SH	53.00	0.0001	3.18	1.0000	56.18	0.0005

Appendix L.6 Analysis of variance tables for farm soil Kjeldahl N comparison

Analysis of Variance For Soil kjeldahl N at 0-15 cm sampling depth.

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	7	0.0276	0.00394286	4.2283	0.0021
Error	32	0.02984	0.0009325		
Total	39	0.05744			

Analysis of Variance For Soil kjeldahl N at 15-30 cm sampling depth

Source	d.f.	Sums of Squares	Mean Square	F-ratio	Probability
Farm	7	0.0182575	0.00260821	4.5558	0.0013
Error	32	0.01832	0.0005725		
Total	39	0.0365775			

Bonferroni mean comparison procedure for soil Kjeldahl N at 0 to 15 and 15 to 30 cm sampling depths..

	0 to 15 cm sampling depth		15 to 30 cm sampling depth	
Farm	Mean Difference	Probability	Mean Difference	Probability
JK - BD	0.03	0.9239	0.02	0.9743
LK - BD	0.03	0.9799	0.06	0.0155
LK - JK	0.00	1.0000	0.03	0.5940
MR - BD	-0.02	1.0000	0.03	0.8821
MR - JK	-0.05	0.2165	0.00	1.0000
MR - LK	-0.05	0.3332	-0.03	0.8012
PO - BD	-0.03	0.9970	-0.01	1.0000
PO - JK	-0.06	0.1049	-0.04	0.4861
PO - LK	-0.06	0.1716	-0.07	0.0016
PO - MR	-0.01	1.0000	-0.04	0.2990
PY - BD	0.03	0.9584	0.05	0.0892
PY - JK	0.00	1.0000	0.02	0.9743
PY - LK	0.00	1.0000	-0.01	1.0000
PY - MR	0.05	0.2703	0.02	0.9977
PY - PO	0.06	0.1347	0.06	0.0108
SH- BD	0.00	1.0000	0.03	0.8821
SH- JK	-0.04	0.8114	0.00	1.0000
SH- LK	-0.03	0.9239	-0.03	0.8012
SH- MR	0.02	1.0000	0.00	1.0000
SH- PO	0.02	0.9998	0.04	0.2990
SH- PY	-0.04	0.8748	-0.02	0.9977
TC - BD	0.05	0.3332	0.02	0.9977
TC - JK	0.02	1.0000	0.00	1.0000
TC - LK	0.02	1.0000	-0.04	0.3862
TC - MR	0.07	0.0274	-0.01	1.0000
TC - PO	0.08	0.0117	0.03	0.7022
TC - PY	0.02	1.0000	-0.03	0.8821
TC - SH	0.05	0.2165	-0.01	1.0000

Appendix M Regional groundwater sampling results (mg l^{-1}).

Code	NO_3-N	NH_4-N	P	T. Coliforms	F. Coliforms	K	Ca	Mg	Mn	Cu	Fe	Zn	Na	Cl	K\Na ratio
1	12.2	0	0	0	0	1.6	114.4	5.8	0	0	0	0	9.99	26.2	0.16
2	5.3	0	0.015	7	5	2.1	20.1	5	0	0	0	0	11.14	19.1	0.19
3	4.4	0	0.019	0	0	1	83.5	4.5	0	0.033	0	0.101	16.84	30	0.06
4	7.5	0	0.086	3	2	20.6	99.3	4.3	0	0.011	0	0.037	9.66	16.1	2.13
5	1.7	0	0.006	65	1	0.8	11.3	2.8	0	0	0	0.078	10.33	17.3	0.08
6	2.4	0	0	6	0	1.7	22.6	5.6	0	0	0	0.053	9.46	18	0.18
7	2.8	0	0	27	0	1.8	25.2	5.7	0	0	0	0.029	9.17	18.2	0.20
8	1	0	0	2	0	1.6	2.9	2.3	0	0.05	0	0.08	11.73	15.8	0.14
9	8.7	0	0	11	0	3.1	42.7	7.7	0	0	0	0.039	12.93	23.8	0.24
10	12.5	0	0	22	0	1.3	16.8	7.2	0	0	0	0	9.92	18.1	0.13
11	18.1	0	0	34	14	2.6	36.6	10.5	0	0	0	0	12.2	22.3	0.21
12	4.2	0	0	0	0	1.8	7.7	5.2	0	0	0	0.031	11.46	21.7	0.16
13	10.7	0	0	10	0	2.9	63	7.4	0	0	0	0	11.97	22.3	0.24
14	11.4	0	0.012	200	200	8.3	26.7	8	0	0	0	0	15	26.4	0.55
15	9.7	0	0	2	0	4.7	24.4	8.2	0	0	0	0	14.08	23.4	0.33
16	8.8	0	0	1	0	1.6	18	6.7	0	0	0	0.012	10.59	21.4	0.15
17	11.4	0	0	0	0	7.2	13.5	5.8	0.715	0	0	0.035	12.71	35.9	0.57
18	3.6	0	0	0	0	4.5	3.1	4.1	0.121	0.005	0	0.172	12.14	23.3	0.37
19	2.6	0	0	0	0	2.7	21.3	3.9	0	0	0	0.01	7.97	15	0.34
20	5.8	0	0	0	0	2	25.8	5.2	0	0	0.081	0.019	13.62	19.2	0.15
21	3	0	0	0	0	1.2	8.4	3	0	0	0	0.075	7.39	16.6	0.16
22	6	0	0	0	0	2.4	38.3	4.6	0	0	0	0	12.84	19.1	0.19
23	7.9	0	0	0	0	2.6	11.9	7.5	0	0.07	0	0.038	13.28	22.2	0.20
24	0.5	0	0	0	0	2.5	74.6	3.2	0.406	0	0.528	0	9.07	17.1	0.28
25	5.5	0	0.034	1	0	1.7	26.6	5.5	0	0	0	0.021	13.62	20.9	0.12
26	11	0	0	9	4	6.6	20.6	5.1	0.044	0	0	0.014	20.05	37.1	0.33
27	4.4	0	0	0	0	2	24.5	7.1	0	0.069	0	0.42	12.02	19.3	0.17

Appendix M cont. Regional groundwater sampling results (mg l^{-1}) continued.

Code	NO_3-N	NH_4-N	P	T. Coliforms	F. Coliforms	K	Ca	Mg	Mn	Cu	Fe	Zn	Na	Cl	K\Na ratio
28	4.1	0.65	0	0	0	2	34.6	3.9	0.033	0	1.2	0	12.92	23.5	0.15
29	6.3	0	0	0	0	5.5	23.2	6.1	0	0.05	0	0.128	10.46	21.1	0.53
30	7	0	0	0	0	1.5	14	5.1	0	0	0	0	10.6	20.8	0.14
31	20.5	0	0	0	0	3.8	137.9	7.4	0	0	0	0.362	13.83	29.8	0.27
32	15.4	0	0	2	0	4.8	123.5	12.7	0	0	0	0	26.1	60.3	0.18
33	5.4	0	0.018	29	25	19.8	38.8	4.5	0	0	0	0.158	11.23	20.3	1.76
34	14.5	0	0	5	4	3.6	114.4	3.9	0	0	0	0.028	10.95	17.1	0.33
35	2	0	0	3	0	1.8	58.7	14.6	0	0	0	0	9.31	18	0.19
36	4.5	0	0.199	0	0	1.4	14.4	5	0	0	0	0	10.38	18.9	0.13
37	3	0	0	200	106	1.2	27.8	4.4	0	0	0	0	8.48	11.5	0.14
38	2.6	0	0	0	0	1.8	9	4.5	0	0	0	0	10.88	17.2	0.17
39	11.6	0	0	2	2	5.4	27.1	6.9	0	0	0	0	14.5	24.8	0.37
40	3.2	0	0	0	0	2.5	8.6	1.3	0	0.012	0	0.053	11.46	19.7	0.22
41	11.9	0	0.153	0	0	25.7	33.5	5.8	0	0	0	0.62	18.37	27.7	1.40
42	13.6	0	0.005	124	66	2.7	27.6	5.3	0	0	0	0	10.29	20.6	0.26
43	8.9	0.13	0.021	200	76	7	112.7	8	0	0	0	0	11.01	24.8	0.64
44	4.6	0	0	80	4	8.3	90.8	6.4	0	0	0	0.015	13.2	27.6	0.63
45	10	0	0	0	0	6.4	20.2	4.3	0	0	0	0	19.91	24.6	0.32
46	3.8	0.31	0	104	40	1.7	20.6	2.2	0	0	0.0414	1.9	7.39	13.8	0.23
47	11.2	0	0	0	0	0.8	123.3	4.7	0	0	0	0	14.49	38.5	0.06
48	6.8	0	0	0	0	1.6	118.4	5.9	0	0	0	0	11.34	22.8	0.14
49	18.3	0	0.13	0	0	9.7	112.7	9.4	0	0	0	0.052	13.96	31	0.69
50	11.6	0	0	0	0	0.2	10.5	0.7	0	0	0	0.016	55	24.8	0.00
51	5.9	0	0.091	0	0	12.2	111.7	5	0	0	0	0	11.69	21.9	1.04
52	10.3	0	0	0	0	3	130.4	8.6	0	0	0	0	13.4	25.8	0.22
53	12.4	0	0.041	73	0	15.5	114.7	7.3	0	0	0	0	19.3	38.1	0.80
54	11.6	0	0	200	60	1.5	53.4	4.2	0	0	0	0	10.6	23.6	0.14

Appendix N Kilworth NO_3-N concentrations, mg l^{-1}, (1988 to 1992, inclusive).

Date	Day No.	NO_3-N	Date	Day	NO_3-N
2-Jan-88	2	7.3	10-Sep-90	984	8.4
14-Jan-88	14	7.9	9-Oct-90	1013	8.1
2-Mar-88	62	8.3	13-Nov-90	1048	7.9
24-Mar-88	84	8.6	4-Dec-90	1069	7.5
25-Apr-88	116	8.9	21-Jan-91	1117	9.0
27-May-88	148	8.2	12-Feb-91	1139	8.6
27-Jun-88	179	8.2	12-Mar-91	1167	8.5
29-Aug-88	242	8.0	9-Apr-91	1195	9.3
26-Sep-88	270	8.3	6-May-91	1222	9.1
21-Nov-88	326	7.5	10-Jun-91	1257	7.9
4-Jan-89	370	6.6	9-Jul-91	1286	8.2
14-Feb-89	411	9.2	7-Aug-91	1315	8.3
29-Mar-89	454	7.0	9-Sep-91	1348	8.3
27-Apr-89	483	8.0	7-Oct-91	1376	8.5
20-Jun-89	537	7.8	4-Nov-91	1404	10.0
24-Jul-89	571	7.2	3-Dec-91	1433	9.5
11-Sep-89	620	9.3	7-Jan-92	1468	9.2
9-Oct-89	648	7.2	10-Feb-92	1502	10.0
23-Nov-89	693	9.1	10-Mar-92	1531	8.6
12-Jan-90	743	7.5	7-Apr-92	1559	8.4
9-Feb-90	771	8.0	6-May-92	1588	8.4
13-Mar-90	803	7.4	9-Jun-92	1622	9.1
14-Apr-90	835	10.1	7-Jul-92	1650	8.9
7-May-90	858	8.7	10-Aug-92	1684	9.5
17-May-90	868	7.5	7-Sep-92	1712	8.3
13-Jun-90	895	9.2	6-Oct-92	1741	9.0
11-Jul-90	923	9.7	9-Nov-92	1775	8.8
1-Aug-90	944	7.1	14-Dec-92	1810	8.7

Appendix N cont. Kilworth NO_3-N concentrations, mg l^{-1}, (1993 to 1996, inclusive).

Date	Day No.	NO_3-N	Date	Day No.	NO_3-N	Date	Day No.	NO_3-N
10-Jan-93	1837	8.8	23-May-94	2335	9.7	3-Aug-95	2772	9
1-Mar-93	1887	9.5	31-May-94	2343	9.5	9-Aug-95	2778	9.1
5-Apr-93	1922	9.1	21-Jun-94	2364	9.1	16-Aug-95	2785	9.8
4-May-93	1951	8.1	30-Jun-94	2373	9.7	21-Aug-95	2790	9.2
8-Jun-93	1986	8.7	7-Jul-94	2380	9.4	14-Sep-95	2814	9.1
8-Jul-93	2016	8.8	19-Jul-94	2392	8.9	25-Sep-95	2825	8.3
24-Aug-93	2063	9.0	9-Aug-94	2413	8	9-Oct-95	2839	8.1
21-Sep-93	2091	9.3	15-Sep-94	2450	8.9	17-Oct-95	2847	8
19-Oct-93	2119	10.0	24-Oct-94	2489	9.7	31-Oct-95	2861	8.3
16-Nov-93	2147	8.2	1-Nov-94	2497	10.5	7-Nov-95	2868	8.4
13-Dec-93	2174	8.1	24-Nov-94	2520	9.4	21-Nov-95	2882	8.3
12-Jan-94	2204	8.9	29-Nov-94	2525	9.6	28-Nov-95	2889	8.4
18-Jan-94	2210	8.9	13-Dec-94	2539	9	18-Dec-95	2909	8.6
26-Jan-94	2218	8.3	18-Jan-95	2575	8.8	2-Jan-96	2924	9.6
3-Feb-94	2226	9.3	25-Jan-95	2582	9.5	10-Jan-96	2932	8.2
16-Feb-94	2239	9.3	20-Mar-95	2636	9.5	17-Jan-96	2939	9
21-Feb-94	2244	9.8	6-Apr-95	2653	9.3	24-Jan-96	2946	7.5
23-Feb-94	2246	9.4	20-Apr-95	2667	10	30-Jan-96	2952	9.4
2-Mar-94	2253	9.1	25-Apr-95	2672	8.8	5-Feb-96	2958	8.3
8-Mar-94	2259	8.8	4-May-95	2681	10.7	12-Feb-96	2965	8.5
15-Mar-94	2266	9.1	15-May-95	2692	10.8	26-Feb-96	2979	9
6-Apr-94	2288	9.3	23-May-95	2700	10.5	4-Mar-96	2986	8.9
12-Apr-94	2294	9.8	31-May-95	2708	10.4	2-Apr-96	3015	10.5
21-Apr-94	2303	9.7	8-Jun-95	2716	9.1			
25-Apr-94	2307	10	15-Jun-95	2723	8.9			
4-May-94	2316	9.5	22-Jun-95	2730	9.2			
11-May-94	2323	9.8	28-Jun-95	2736	9			
16-May-94	2328	9	5-Jul-95	2743	9.2			