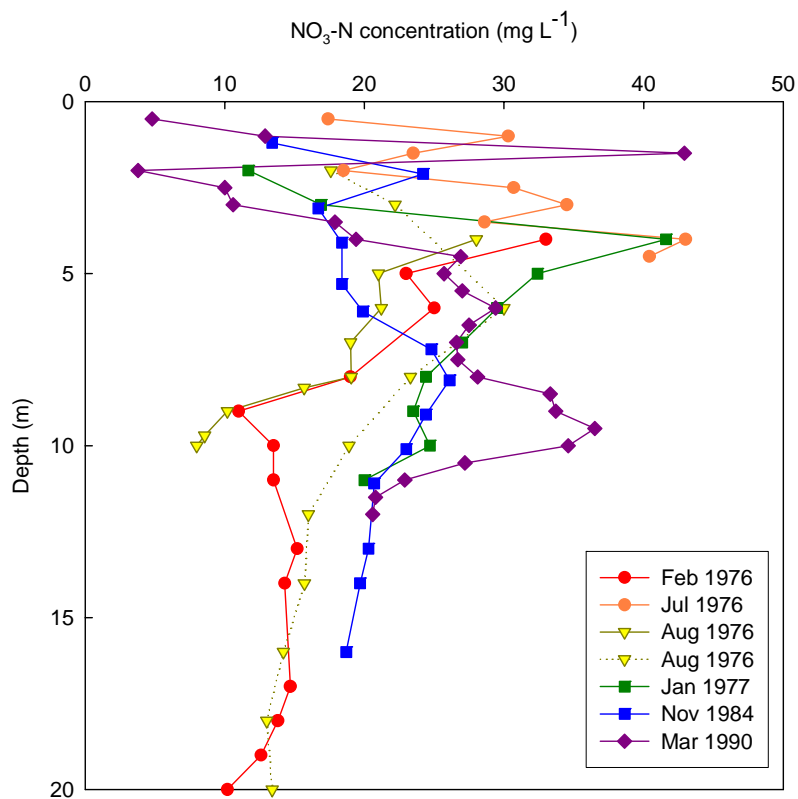




Development of nitrate profiles database

Groundwater Resources and Water Quality Programme
Internal Report IR/05/058



BRITISH GEOLOGICAL SURVEY

GROUNDWATER RESOURCES AND WATER QUALITY PROGRAMME

INTERNAL REPORT IR/05/058

Development of nitrate profiles database

M E Stuart

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Sequential nitrate profiling at Bircham, Norfolk.

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Foreword

This report is the second published product of a study by the British Geological Survey (BGS) aimed at gaining an improved understanding of the 3-dimensional distribution of nitrate in groundwater. It describes the continued development of a database of nitrate porewater profiles from BGS, WRc and other investigations which have been carried out over the past 30 years.

The author is grateful to a number of BGS colleagues who have assisted with locating and interpreting archived material.

Acknowledgements

A particular contribution was made to this work by Chris Young of the WRc who identified nitrate profiles produced by the WRc and the Southern Water Authority which were missing from the first version of the database.

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Summary

This report describes the continued development of the database of nitrate porewater profiles produced by both BGS and other organisations since the mid 1970s. A large number of sites for which profiles were either partially or completely missing from the first version of the database were identified, including investigations by the Southern Water Authority and the University of Birmingham. It was also considered that it would be desirable to capture other relevant data, primarily other nitrogen species and tritium.

All identified profiles were added to the database, using original data where possible and otherwise as scanned and digitised data. A few profiles are outstanding where available plots are of poor quality. Dataholdings have increased from 32,000 to 51,000 individual records of quality data.

1 Introduction

1.1 BACKGROUND

This report describes the continued development of the database of porewater nitrate profiles described in Moreau et al. (2004). Circulation of this report to BGS and WRc staff identified a large number of sites for which profiles were either partially or completely missing. It was also considered that it would be desirable to capture other relevant data, primarily other nitrogen species and tritium. Tasks identified were to:

- Identify any other sources of porewater profile information apart from BGS and WRc;
- Identify all sites completely missing from the database and locate relevant information;
- Locate information for missing profiles, including concentrations of nitrate and other nitrogen species and tritium, porosity, permeability and moisture content where available;
- Replace digitised data by the original where this was available;
- Create a reference table and relate this to individual sources.

2 Situation at end year 2003-4

2.1 DATABASE CONTENT

The first stages of database development are described in Moreau et al. (2004). The data were collated from a number of BGS projects building on the catalogue of porewater profiles produced as part of the MAFF-funded project 'Denitrification in the unsaturated zones of the British Chalk and Sherwood Sandstone aquifers' and forming an appendix to the main report. A large number of porewater profile data were also supplied by the WRc as original records.

More recent BGS projects producing nitrate profiles included:

- Jersey groundwater
- Pesticides in the Chalk and Sandstone
- Locar

The data holding at this time is summarised in Table 2.1. Sites in the original catalogue have profiles for nitrate-N, chloride and sulphate. The total number of individual chemistry data records was more than 32000.

Table 2.1 Database content March 2004

Source	Sites	Nitrate profiles	Records
BGS profile catalogue	18	138	
Locar sites	10	19	
Other BGS projects	6	14	
Jersey	4	14	
WRc	19	89	
Total	57	274	32920

3 Development

It was recognised that there were a number of shortcomings in data coverage and these were addressed during 2004-5. Database population has concentrated on the following areas

3.1 MISSING DATA

3.1.1 BGS

Many of the profiles collected during early BGS nitrate work were identified in the site table but the actual data were missing. These sites included Ashby, Colney, Gussage and West Ilsley. Sites in South Lincolnshire were missing altogether.

Data from Hatton which appeared in the original catalogue was also absent. Some other sites were found to have additional profiles which were not included in the original compilation. More recent work also completely missing was at Carlton, Pollington and Boston Park Farm in Yorkshire.

3.1.2 WRc

Chris Young of the WRc was able to identify missing sites from their early work. Up to 1977 nitrate profiles collected by the WRc are summarised in Young and Gray (1978). This report contains profiles and agricultural records for all sites studied and most were found to be missing from the database.

Other WRc work was carried out in conjunction with the Southern Water Authority in the Isle of Thanet. The earlier Southern Water Authority Thanet report (1979) contained profile quality data in tabular form. This was scanned and digitised directly from the report. Profiles from redrilling at these sites are available graphically, although these are of very poor quality (SWA, 1985) but have not been entered pending the possibility of getting the original data.

3.1.3 University of Birmingham

Profiles from deep boreholes drilled at Swaffham for Anglian Water are reported in Hiscock et al. (1989). These are valuable since they cover some 80 m of the saturated zone. The original data has been requested from Kevin Hiscock. In the meantime the profiles have been digitised from the published graphs although these are shown on a small diagram.

3.2 UPGRADING OF DATA

Effort has been made to capture other determinands as well as nitrate where these were available. For interpreting profiles, the important determinands were considered to be:

- Other nitrate species, chloride and sulphate
- Tritium
- Porosity and moisture content.

Where possible the Wellmaster number for each profile has been added to the database. For convenience the Jersey profiles have been added to the main database although they do not employ the same grid reference system.

3.2.1 BGS

All of this missing data apart from that for Ashby and Hatton has been recovered from the paper records held in the Wallingford archive as digital data and entered. The profiles from Ashby and Hatton were digitised from graphs, as the data could not be located.

The majority of the data from Gussage were for tritium as this was the main focus of work at this site, and these profiles have been included even where there are no nitrate data.

Profiles collected during the on-going BGS project in the Eden valley will be added to the database at the end of the project. These will provide valuable coverage in the northwest.

3.2.2 Locar

A few of the poorly-populated Locar profiles were found to be from depth samples rather than porewaters and these have been excised from the database.

3.2.3 WRc

For expediency the majority of the data received from the WRc was originally digitised from plotted profiles for nitrate only. For the Wigden's Bottom and Deepdean sites the original data were also available although on hand-written sheets. This data has been typed in and substituted for the digitised data. For the remainder the original data has been requested from the WRc if this can be located and the plots have been scanned and digitised in the interim.

3.2.4 SWA

Data from the 1984 redrilling of four sites in Thanet was only provided as very poor quality plots in SWA (1985). This remains an outstanding issue.

3.2.5 Outstanding missing data

A summary of the data remaining to be collected or upgraded is shown in Table 3.1. Profile plots are available for some of the missing data but are either too poor quality or small to be digitised sufficiently accurately, but this remains the final option for capturing these profiles.

Table 3.1 Summary of missing data

Source	Sites	Nitrate profiles
University of Birmingham (digitised NO ₃ only)	1	6
WRc (missing)	0	11
WRc (digitised NO ₃ only)	22	62
SWA		4
Total	23	83

3.3 SUMMARY OF CONTENTS AS AT FEBRUARY 2005

A summary of the current database holdings is shown in Table 3.2. There has been a 60% increase in the number of sites and records but only a 37% increase in number of profiles. This is because the original database contained several sites with very large numbers of profiles e.g. Blackwood, Deepdean and Wigden's Bottom whereas additional sites added during the year average at 3 profiles per site and the additional records include additional determinands at existing sites.

Table 3.2 Database content, February 2005

Source	Sites	Nitrate profiles	Tritium profiles	Records
BGS profile catalogue	18	142	0	
Locar sites	17	18	0	
Other BGS projects	16	68	48	
Jersey	4	14	0	
WRc	38	126	10	
SWA	8	15	2	
University of Birmingham	1	6	0	
TOTAL	102	389	60	52260

Figure 3.1 shows the distribution of profile sites related to the major UK aquifers.

3.4 EXAMPLES

Figure 3.2 shows profiles held in the database from Fleam Dyke in Cambridgeshire. Figure 3.3 shows profiles from the SWA work at Spratling Street Farm which formed part of investigations in the Isle of Thanet. Figure 3.4 shows sequential profiles collected at site 1 at Bircham from 1976 to 1990.

3.5 REFERENCE TABLE

An additional data table cross-referenced to the 'Data source' table has been added containing the reports and publications listed at the back of this report.

Table 3.3 Summary of porewater profiles in database

Site	No of profiles	Aquifer	Origin
Alland Grange	1	Upper Chalk	WRc
Anmer	6	Middle/Upper Chalk	BGS MAFF catalogue
Ashby	5	Lincs Limestone	BGS
Ashwood	1	Sherwood Sandstone	WRc
Aslackby	4	Lincolnshire Limestone	BGS
Bearstone Mill	1	Sherwood Sandstone	Locar
Bicton	1	Sherwood Sandstone	WRc
Bircham	26	Middle/Upper Chalk	BGS MAFF catalogue
Black Wood	21	Upper Chalk	BGS MAFF catalogue
Boston Park Farm	3	Sherwood Sandstone	BGS
Boughton	6	Sherwood Sandstone	BGS MAFF catalogue
Boxford	1	Chalk	Locar
Boynton End	1	Drift/Chalk	BGS
Bricketts Wood	3	Chalk	WRc
Bridgets Farm	2	Chalk	BGS MAFF catalogue
Bridgets Farm	5	Chalk	WRc
Broadfield Cottages	1	Chalk	Locar
Cambridge	7	Chalk	WRc
Camp Farm	2	Triassic SST	WRc
Carlton	14	Sherwood Sandstone	BGS
Cattistock	1	Chalk	Locar
Chateauneuf Grouville	5	Jersey Shale Formation	BGS
Checkhill Farm	3	Sherwood Sandstone	WRc
Cheesemans Farm	1	Upper Chalk	WRc
Childs Ercall	1	Sherwood Sandstone	Locar
Churn Farm	1	Chalk	WRc
Colney	9	Chalk	BGS
Compton	4	Lower Chalk	BGS
Cornish Farm	4	Upper Chalk	WRc
Crudgington	1	Sherwood Sandstone	Locar
Dane Valley Road	1	Chalk	SWA
Deep Dean	37	Middle Chalk	WRc
Down Farm	1	Chalk	Locar
Epsom Downs	1	Chalk	WRc
Etton	4	Middle Chalk	BGS MAFF catalogue
Fleam Dyke	14	Middle Chalk	BGS MAFF catalogue
Fonthill	11	Chalk	BGS MAFF catalogue
Fordington Down	1	Chalk	Locar
Frilsham Meadow	1	Chalk	Locar
Frogmore Farm	1	Chalk	Locar
Frome Whitfield	2	Chalk	Locar
Gleadthorpe	2	Sherwood Sandstone	BGS MAFF catalogue
Gleadthorpe	6	Sherwood Sandstone	WRc
Gothersley Farm	1	Sherwood Sandstone	WRc
Gussage	2	Sherwood Sandstone	BGS
Hatton	6	Sherwood Sandstone	BGS
Heath House	1	Sherwood Sandstone	WRc

Site	No of profiles	Aquifer	Origin
Helshaw Grange	1	Sherwood Sandstone	Locar
Hurley	9	Upper Chalk	WRc
Kilham	5	Upper Chalk	BGS MAFF catalogue
La Francheville Grouville	6	Jersey Shale Formation	BGS
La Retraite Five Oaks	2	Jersey Shale Formation	BGS
Lambourn	4	Middle Chalk	BGS MAFF catalogue
Lea Hall	4	Sherwood Sandstone	WRc
Leckford	2	Upper Chalk	BGS
Manston Airport	4	Chalk	SWA
Manston Cleansing Centre	1	Chalk	SWA
Massingham	4	Middle/Upper Chalk	BGS MAFF catalogue
Mid Coal Brook	1	Sherwood Sandstone	Locar
Minster Depot	1	Chalk	SWA
Netherhale Farm	1	Upper Chalk	WRc
Nicola Farm	1	Chalk	WRc
North Dean	6	Middle Chalk with Upper Chalk cap in places	BGS MAFF catalogue
Oakley Folly	1	Sherwood Sandstone	Locar
Oaks Farm	1	Chalk	WRc
Ogbourne	5	Lower Chalk	BGS MAFF catalogue
Old Springs Farm	1	Sherwood Sandstone	Locar
Park Road	1	Chalk	SWA
Perrotts Farm	1	Chalk	WRc
Pollington	4	Sherwood Sandstone	BGS
Prestwood	1	Sherwood Sandstone	WRc
Quex Park	6	Chalk	SWA
Rothamsted	7	Chalk	WRc
Rushall	5	Chalk	BGS
Sherrifhales	2	Sherwood Sandstone	WRc
Shottendane Farm	1	Chalk	SWA
Sparrow Castle	2	Upper Chalk	WRc
Spratling Street Farm	1	Chalk	SWA
Spratling Court Farm	4	Upper Chalk	WRc
St Michaels School Pl Fd	1	Jersey Shale Formation	BGS
Stonor	4	Middle Chalk	BGS MAFF catalogue
Sutton Manor	2	Upper Chalk	BGS
Swaffham	6	Chalk	University of Birmingham
Swaffham	1	Chalk	BGS
Tom Hill	6	Sherwood Sandstone	BGS MAFF catalogue
Trumpletts Farm	1	Chalk	Locar
Warran Farm	1	Sherwood Sandstone	WRc
Wellings	5	Sherwood Sandstone	BGS MAFF catalogue
West Ilsley	8	Chalk	BGS
Westbury	1	Chalk	WRc
Western Court	2	Upper Chalk	BGS
Wigden's Bottom	13	Chalk	WRc
Wildmoor	4	Sherwood Sandstone	BGS MAFF catalogue
Wonston	5	Chalk	BGS
Wood Farm	1	Sherwood Sandstone	Locar

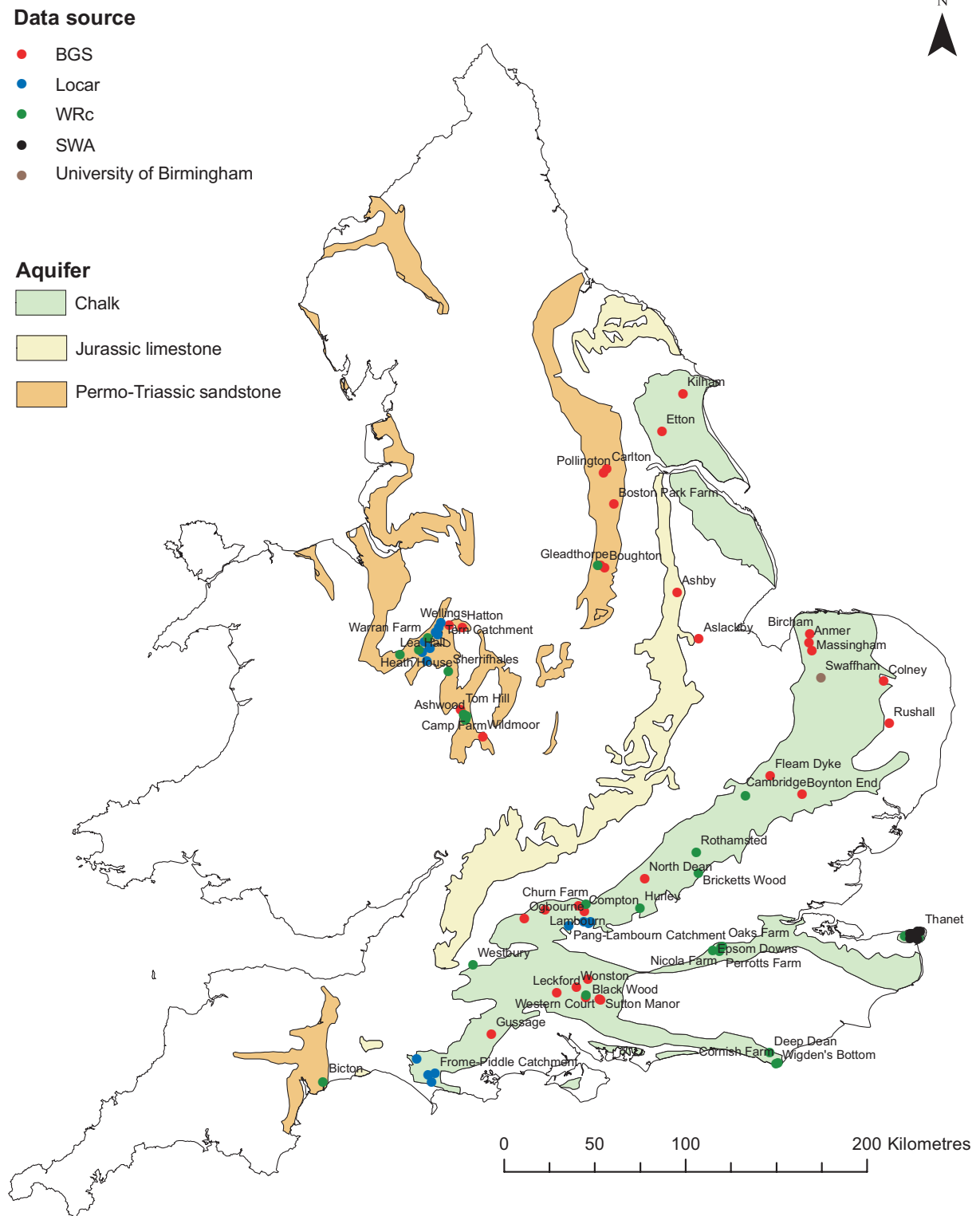


Figure 3.1 Locations of profile sites and major aquifers

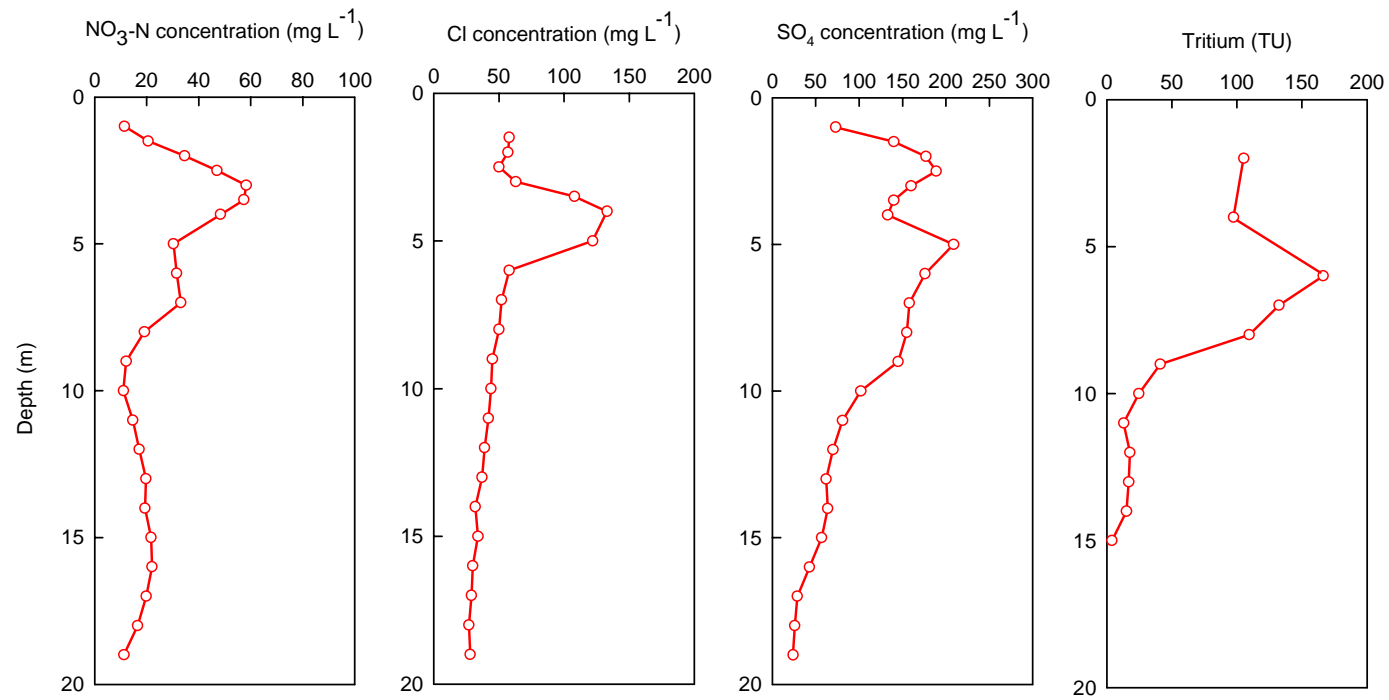


Figure 3.2 Profiles from Fleam Dyke FD01, BGS

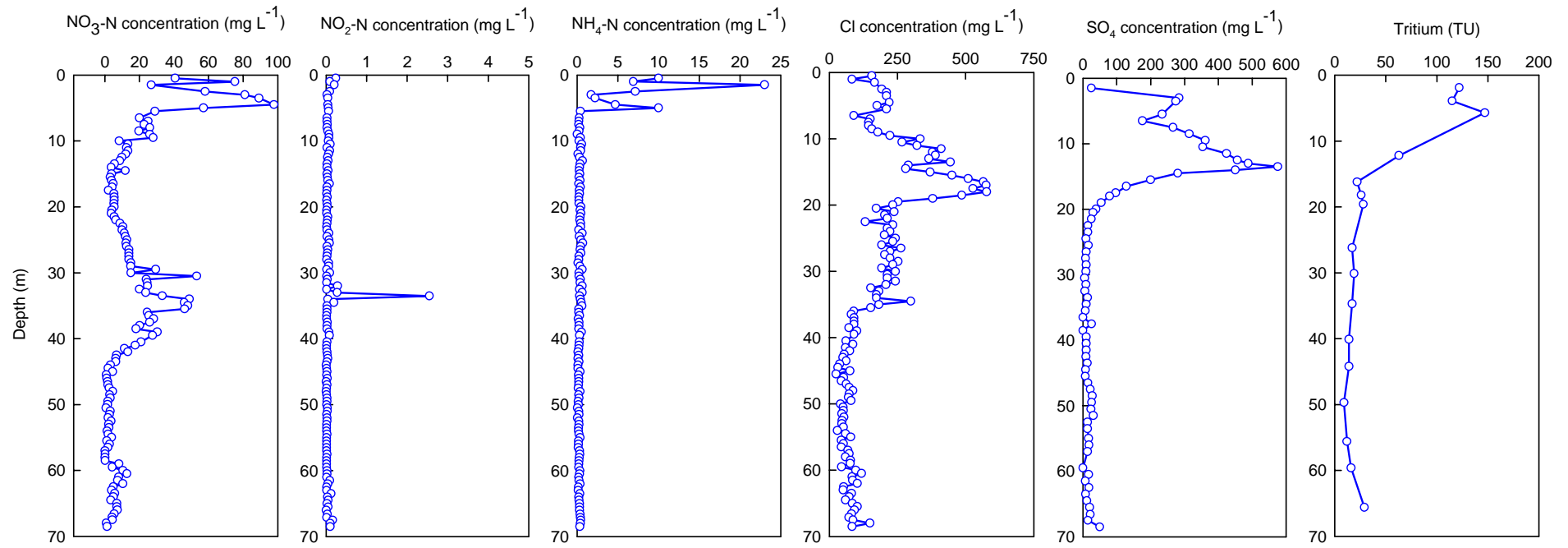


Figure 3.3 Profiles from Spratling Street Farm, SprF5, SWA

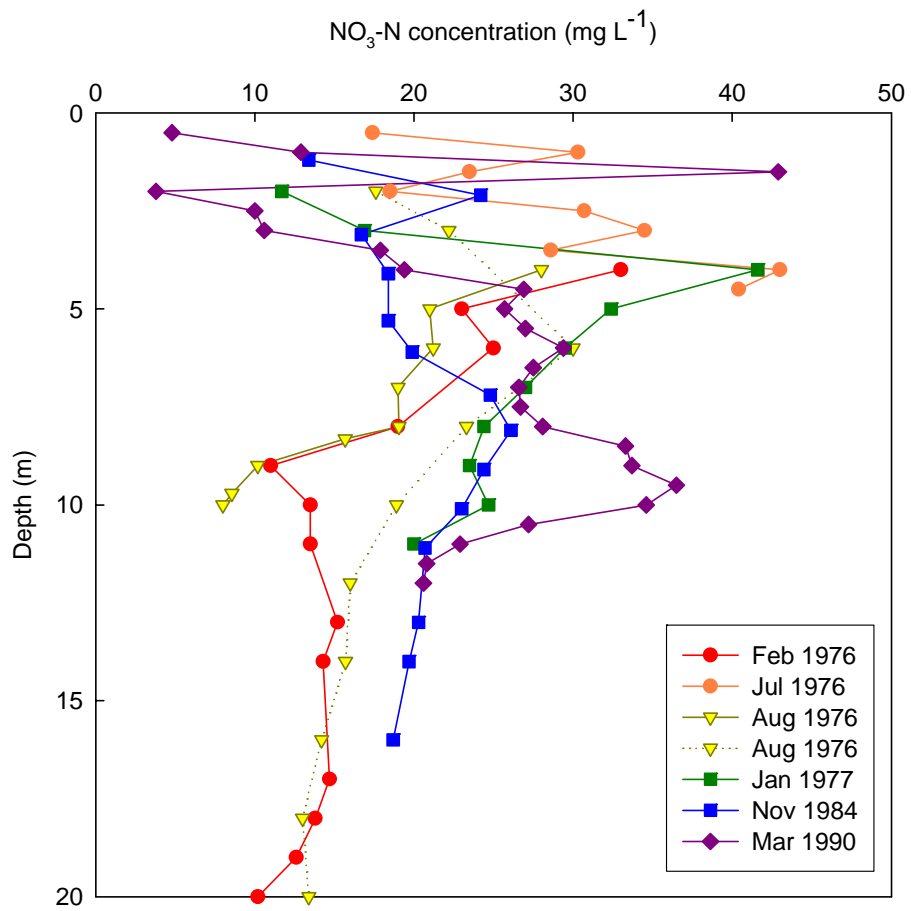


Figure 3.4 Sequential nitrate profiles from Site NN1, Bircham

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