British Geological Survey

NATURAL ENVIRONMENT RESEARCH COUNCIL

The State of Jersey Groundwater 2001

Groundwater Systems and Water Quality Programme

Commissioned Report CR/02/058

BRITISH GEOLOGICAL SURVEY

COMMISSIONED REPORT CR/02/058

The State of Jersey Groundwater 2001

N S Robins and M J Bird

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Keyworth, Nottingham NG12 5GG

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Parent Body

Natural Environment Research Council, Polaris House, North Star Avenue, Swindon, Wiltshire SN2 1EU

☎ 01793-411500 Fax 01793-411501
www.nerc.ac.uk

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Executive Summary

BGS continued to provide advice to PSD on the Jersey groundwater monitoring and management programme as required. The very wet conditions at the beginning of 2001 were reflected in rising groundwater levels throughout the Island. Summer recession was halted in October when autumn recharge influenced a general rise in groundwater levels. Groundwater quality continues much as before with near stable inorganic chemistry and the persistence of the organic metabolite chlorthal in many groundwater samples. Nitrate concentrations may now have peaked in many areas, although severely contaminated groundwaters near pollution sources have yet to start to improve significantly. The EU Water Framework Directive will need to be attended to with regard to groundwater status definition. Water quality objectives are shortly to be set as part of the Water Pollution (Jersey) Law 2000, and resource requirements will be provided in the proposed Water Resources (Jersey) Law. Proposals to develop a GIS data handling system and to investigate the age of shallow groundwaters are appended

1 Introduction

Groundwater level and groundwater quality monitoring continued throughout 2001. The Public Services Department (PSD) carries out this work, including analytical and archiving activities. The British Geological Survey (BGS) undertake to provide *ad hoc* advice to ensure that data gathered are representative and that the data are useful to the management of the Jersey bedrock aquifer and the peripheral sand aquifers. To this end periodic visits are made to review the monitoring programme and to assist in interpreting the data. Advice is given on sampling stations that may be abandoned and new sample stations that could usefully be adopted. The objective of the monitoring programme is:

- To provide baseline reference data from which to monitor change,
- To help determine the state of the groundwater resource in terms of its physical and chemical status,
- To provide data which will ultimately assist in refining the groundwater balance estimate.

In addition BGS provides advice on the management of the groundwater resources of Jersey in general and, from time to time, on other specific issues relating to groundwater, including groundwater protection and likely impacts of planning proposals.

During the course of the year three specific issues were addressed and reported. These were:

- Confidential advice on burial of animal carcasses, should the UK Foot and Mouth epidemic have spread to Jersey,
- A scoping paper for the development of a GIS type database for groundwater to enable trend analysis and statistics to be prepared on complex data such as inorganic chemistry (see Appendix 1),
- An outline proposal to investigate the age of Jersey groundwaters using CFC and SF_6 compounds as indicators (see Appendix 2).

Neither the GIS nor the age determination proposal has as yet advanced beyond this outline stage.

The St Helier data rescue report (Cheney, 2000) was issued during the year. This contains collated hydrogeological data gathered during site investigation work in and around St Helier during recent civil engineering projects. The report now serves as a repository for these data and a source of hydrogeological data for St Helier.

This annual state of the groundwater report describes the status of the groundwater throughout the calendar year 2001 and considers longer-term trends. It is not intended as a stand-alone report and reference should also be made to the project report produced in 1998 (Robins and Smedley, 1998) which describes the Jersey aquifer system in detail.

2 Current Groundwater Status

2.1 GROUNDWATER LEVELS

A selection of long-term hydrographs is shown in Appendix 3. The early months of 2001 were particularly wet and groundwater recharge was apparent at all sites between December 2000 and the end of February 2001. Some shallow sources had begun to recover earlier, e.g. Mont Sohier

Cottages, whereas others were still receiving recharge well into the following spring, e.g. La Hougue Bie Well. Sources drawing on the weathered bedrock aquifer had generally peaked by early March 2001 and normal seasonal recession then set in (e.g. St George's Estate).

Throughout the summer, water levels were maintained at a level which reflected the previous good winter rains. Autumn recharge set in, for the most part, in October (e.g. Oakvillas and Le Veseau) and levels were again rising towards the end of the year. La Hougue Bie Well had not responded by the year end and it is possible that interference from a nearby pumping source was inhibiting any local water level recovery.

2.2 INORGANIC CHEMISTRY

It was reported in the annual report for 2000 (Robins et al., 2001) that there were some preliminary indications that nitrate concentrations were beginning to show a modest decline in response to changed agricultural practice. This trend appears to be continuing - see Appendix 4 - with the percentage of sources that are sampled which have over 50 mg-NO_3 l^{-1} showing the most change, whereas the smaller sample sets of most polluted water, those exceeding 100 mg l^{-1} and 150 mg l^{-1} show the least change. This suggests that overall groundwater quality may now be showing slightly improved nitrate concentrations, whereas those sources which are most polluted (e.g. close to a silage clamp, dairy or other source of N) remain broadly the same. The mean value of NO_3 for the November sampling campaign was 58.8 mg NO_3 l^{-1} vice 59.7 mg l^{-1} in November 2000 and 73.5 mg l^{-1} in November 1999. Of the 46 samples collected in November 2001, 23 (50%) exceeded the EC maximum admissible concentration of 50 mg NO_3 l^{1}. This percentage is the same as the previous year.

Other major ions continue to remain stable with time.

2.3 ORGANIC CHEMISTRY

Chlorthal arising in Jersey groundwaters still continues to be a cause for concern. It is present in 14 of the 16 sources sampled in the November 2001 sampling campaign. Although the metabolite chlorthal may not pose a health risk in drinking water, traces of associated chemicals such as hexachlorobenzene and dioxin do so. The chlorthal derives from earlier use of the active pesticide Chlorthal Dimethyl, the use of which was banned in Jersey in 1997, and its persistence in Jersey groundwaters reflects its widespread use until that time. There are no other significant organic pollutants evident from the recent sampling exercises.

2.4 GROUNDWATER ABSTRACTION

Groundwater abstraction data are not adequate for judgements to be made. This will remain the case until such time as metered sources are available.

3 Legislation

3.1 THE EU WATER FRAMEWORK DIRECTIVE

The UK and the remainder of the EU is currently evaluating the requirements of the EU Water Framework Directive. This advocates integrated management of groundwater and surface water on a catchment scale (Jersey would constitute a single catchment). The directive requires that so called 'groundwater bodies' be identified in the first instance and that the primary characteristics of these bodies (the physical and chemical status of them) be established along with the degree to which each is at risk. Those deemed to be at risk will need detailed characterisation, monitoring

and remediation. The programme requires completion by 2015 at which time all waters should be of the required status unless declared otherwise.

Jersey, of course, does not need to comply with the directive. However, it should not be difficult for Jersey to comply and to adjust its water management policy in due course to reflect the directive. In the mean time, it is enough to watch other nations in their preliminary discussions regarding definitions of key terms such as groundwater body. It is likely that Jersey would declare two groundwater bodies: the Jersey bedrock aquifer and the sand aquifers at St Ouen's Bay and at Grouville. Characterisation of these aquifers has already been carried out (Robins and Smedley, 1998) but information would need to be reorganised to clearly identify it with the respective groundwater body. Groundwaters that are at risk include all groundwaters in Jersey because of the shallow nature of the water table and because of the permeable soil cover. Remediation is already in hand with improved agricultural practice, and other polluters now being subject to legislative control. An important first step towards good water status is the setting of water quality objectives for Jersey groundwaters. An equally important and essential step for water quantity status will be the need to monitor groundwater abstraction by metering sources. This task will be encompassed within the Water Resources (Jersey) Law.

3.2 THE DRAFT WATER RESOURCES (JERSEY) LAW

The Draft Water Resources (Jersey) Law is intended to complement the Water Pollution Law 2000. The key contribution to hydrogeological investigation will be the machinery by which selected sources will need to be metered under the requirements of an abstraction license. This will provide valuable data with which to improve the water balance of the Island. License exempt sources will need to be carefully defined; setting a yield threshold may be difficult, as few operators know what volumes they are abstracting. Besides, setting the threshold too high will inhibit the number of licenses to such an extent that the data collected will neither be meaningful nor representative. It may be better to require certain categories of use to be exempt, e.g. domestic and garden sources to between one and five dwellings, but to require all industrial users to comply, including low volume users such as hotel swimming pools, and occasional users of groundwater for seasonal irrigation. This is a complex area of the proposed law which needs careful consideration before enactment. A full discussion on yield thresholds applicable to Jersey for licensing purposes was given by Robins et al. (2001, Section 3.2).

References

CHENEY C S 2000. Report on the collection and collation of data from the Fort Regent Cavern and Storm Water Sewer site investigation boreholes, St Helier, Jersey. British Geological Survey Technical Report WD/00/06C.

ROBINS N S and SMEDLEY 1998. The Jersey groundwater study. British Geological Survey Research Report RR/98/5.

ROBINS N S, CHILTON P J AND BIRD M J 2001. The state of Jersey groundwater 2000 and some topical issues. British Geological Survey Technical Report WD/01/26.

Appendix 1

A Geographical Information System (GIS) for the Public Services Department (Jersey). Prepared by R L Hargreaves, BGS Wallingford, November 2001.

1. Introduction

The PSD, along with the British Geological Survey, have been collecting hydrogeological data since the early 1990's and the PSD continue to collect and archive monitoring data on a regular basis. With the proposed introduction of licensing regulations to control the abstraction of groundwater, it is fundamental that these data are readily accessible and can be interrogated to provide an aid to decision making. In order to facilitate this, the data should be stored in a properly designed database, which will allow effective data retrieval, and facilities to view and analyse the spatial properties of the data in relation to other spatial data are required.

2. Present situation

Both current and historic time series data for water levels, water quality and water abstraction rates are stored in digital format by the PSD as Excel spreadsheets. Additional data, including a well inventory, are held by the BGS either digitally or as hard copy. Spatial data which would be invaluable for a PSD GIS (elevation, landuse, topography, habitat) are held by the Planning Department within a GIS using Cadcorp GIS software. This software is the approved software for States of Jersey departments.

3. Proposed work

a) The time series and the well inventory data will be transferred to a simple but comprehensive relational database which will improve the storage and retrieval of the data. This database will be fieldname and structurally compatible with WellMaster which is the groundwater database used by the BGS. WellMaster has a proven track record with data input, querying, management and output facilities which can be modified to meet the needs of the PSD. These can include summary statistics of recharge, hydrographs, reports etc. The data will be stored in either Access or Oracle tables which can be directly read by Cadcorp GIS software.

b) Desirable spatial data (Hydrogeological data from the Hydrogeological Map of Jersey and geological data from the 1:25,000 Geological Sheet, Jersey) will be digitised as either raster or vector data.

c) The data will be incorporated into a Hydrogeological GIS using Cadcorp GIS software. Additional data such as pollution incidents, discharge permits should be made available digitally for inclusion within the database and GIS.

4. Costs and time scale

Design, construction and data conversion to the database 3 weeks (15 days £4,740)

Data preparation for input to GIS 1 week (£1,580)

Data input 2 days

Some of the Hydrogeology/geology map data are available digitally. Confirmation of the amount and quality of these data are awaited. Any additional digitising of the data will incur costs. Should the digitisation of the data prove too expensive the maps could be scanned.

It is proposed that the BGS prepare the data and assist the PSD to import the data to the GIS. As the BGS do not use Cadcorp software, it would be more advantageous for a member of the PSD to be trained in the use of the software in order to develop fully the GIS.

Appendix 2

Concept Note: An Evaluation of Jersey Groundwaters Using Cfc Species to Determine Groundwater Age as a Key to Groundwater Provenance

Jersey has a shallow bedrock aquifer dominated by active recharge each winter and moderate storage that can sustain the aquifer for only one or two consecutive dry winters. Although some tritium dating has already demonstrated that most of the groundwaters are 'young', probably less than 20 years since they fell as rainwater, more accurate methods have not been applied, and indeed are now only recently available. Dating of the groundwater could provide useful information in support (or otherwise) of the current conceptual groundwater flowpath understanding of the bedrock aquifer.

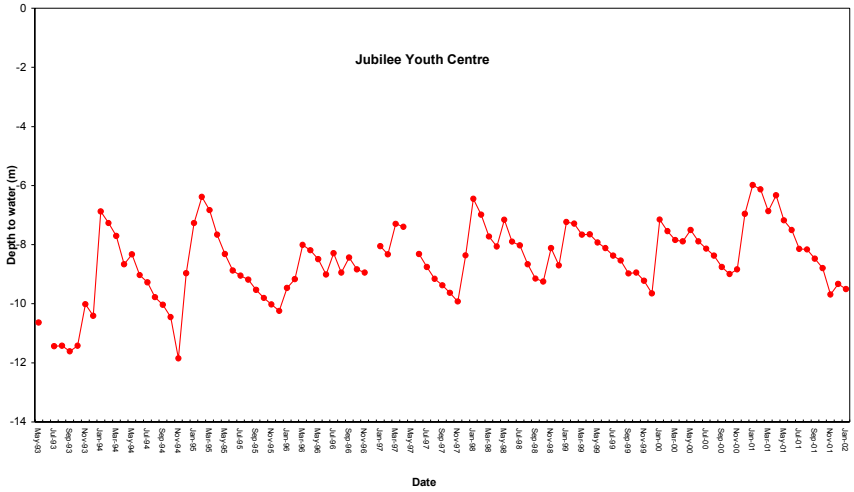
CFCs (chlorofluorocarbons) have built up in the atmosphere at known rates since the 1940s, reaching a peak in the mid-1990s (see Oster et al 1996[1]). The amounts of the three species CFC-11, CFC-12 and CFC-113 present in groundwater can be used to indicate the age of groundwater provided it contains a proportion of 'modern' (post-1940s) recharge. Contamination particularly from point sources may raise groundwater CFC concentrations, in which case they are unusable as dating agents, though they may act as good tracers of pollutant sources. CFCs can also be lowered by degradation under low-oxygen conditions (Oster et al 1996), though generally this is not serious above concentrations of about 0.5 mg l^{-1} O_2, which prevail over much of Jersey except for the St Aubin's Bay discharge area. In both cases (pollution or degradation), dissolved sulphur hexafluoride (SF_6) provides an alternative dating method based on the same principles as the CFCs.

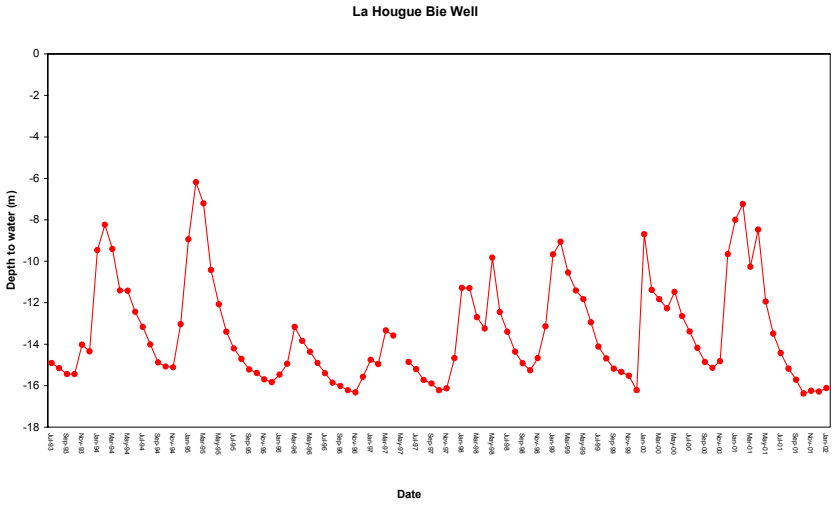
The British Geological Survey is currently commissioning a laboratory to undertake CFC analyses. Sampling of Jersey groundwaters could provide a useful test bed for the laboratory because the groundwater flow system on the island is reasonably well understood. At the same time Jersey would benefit from greater justification for the groundwater flow model. It is suggested that a collaboratively funded project be created whereby some 30 to 40 samples be collected for CFC analysis and analysed and interpreted by BGS. Jersey would in return receive the raw data and a report describing the interpretative procedure and the findings from the data described in terms of groundwater age and provenance. The implications for the groundwater flow model would be described in detail.

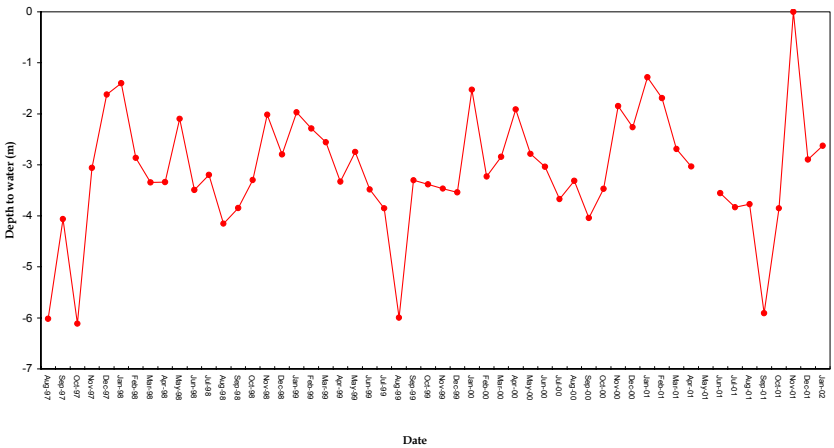
[1] OSTER, H., SONNTAY C. & MUNNICH, K. O. 1996. Groundwater age dating with chlorofluorocarbons. *Water Resources Research*, **32**, 2989-3001.

Appendix 3

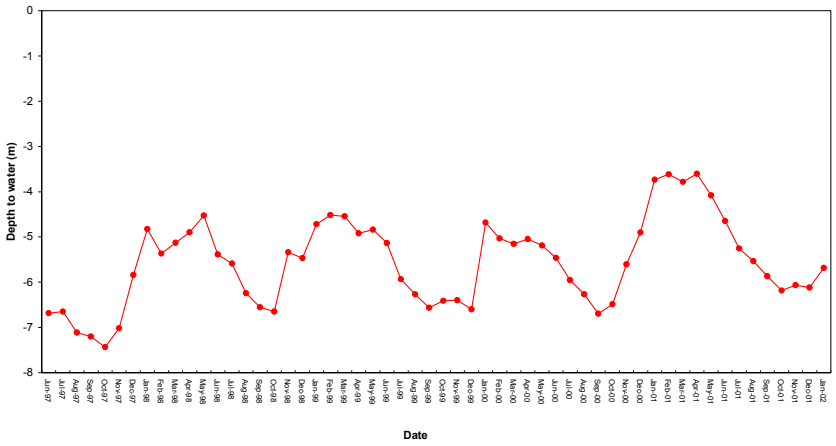
Selected Borehole Hydrographs



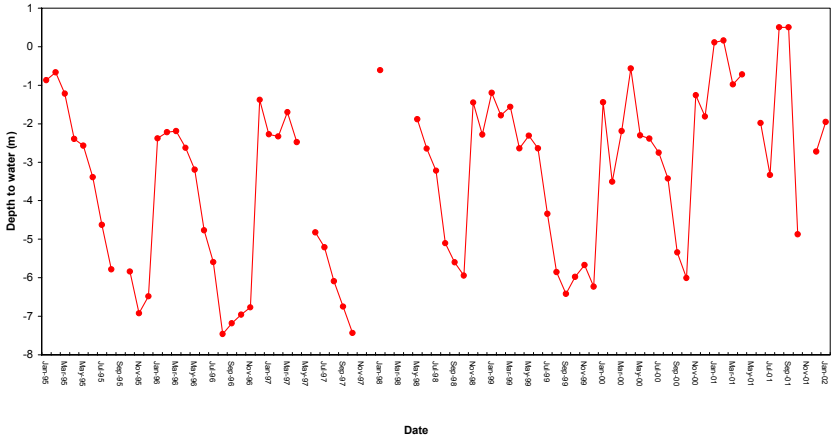




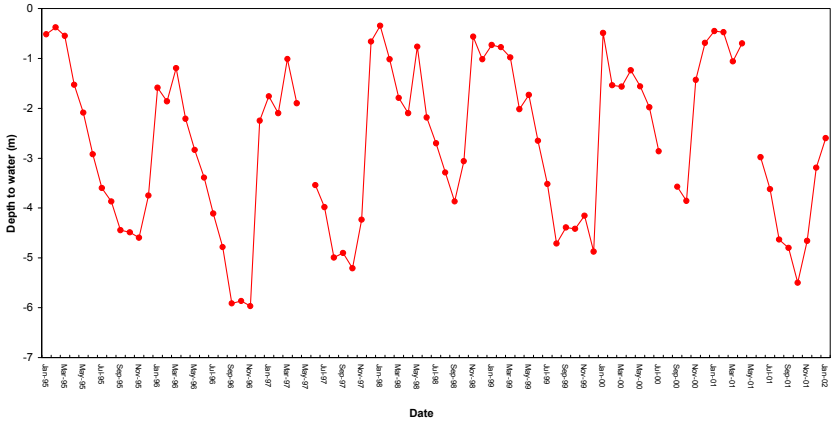
Mont Sohier Cottage



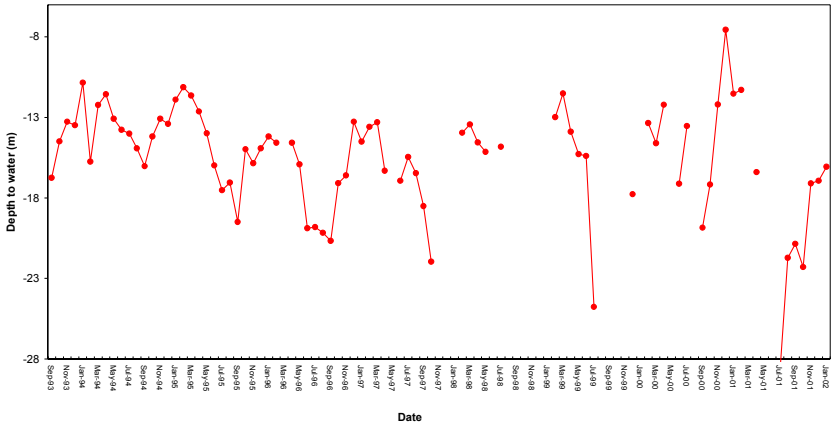
Aviemore



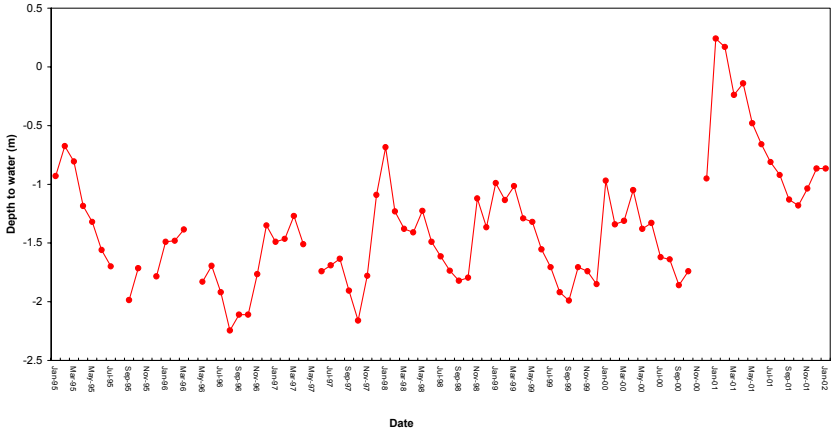
Oakvillas



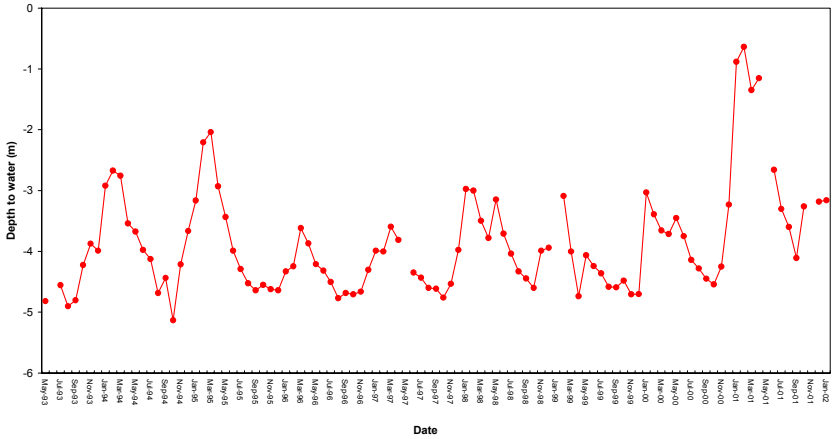
Orchid Foundation



Redwood

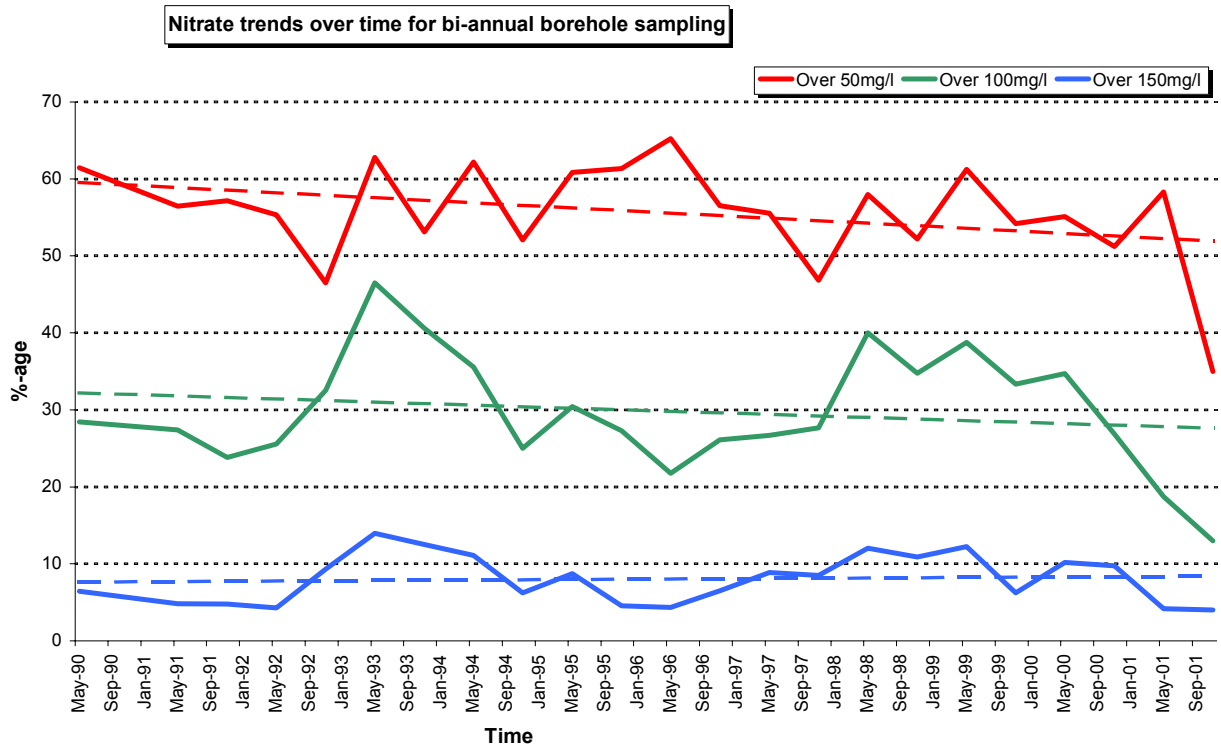


St. George's Estate



Appendix 4

NITRATE TRENDS



Although the sample population has varied with time the data show that the percentage of the sample population with greater than 50 mg NO_3 l^{-1} has apparently declined. A lesser change is apparent for the smaller more polluted sample populations with greater than 100 and 150 mg NO_3 l^{-1}, although they too may be showing some change. The significance of the trends is unclear as yet and it will be interesting to see if the decline in percentage of polluted sources continues over the next few years. If it does become a significant trend, it will be ample reward for the farming community who have modified agricultural practice in recent years.