Bore-hole Information

Artesian bore-holes with various amounts of continuous discharge from 1000 to a few **hundred** G.P.H.

1.

2. Grouville approximately 300 G.P.H.

3. Val de la Mare 1000 G.P.H.

3. for 8 or 9 months of the year 300 to 400 G.P.H.

4. St Ouen 200 G.P.H.

5. St Martin approximately 200 G.P.H.

6. Trinity 2 to 300 G.P.H.

Bore-holes producing large amounts of water on a daily basis.

1. St Mary large head of cattle plus wash down and crop spraying fill up point. 1 x 8" 150 ft possible flow 4000 G.P.H.

2. Grouville cattle, plastic tunnels and crop spraying 1 x 6" 80 ft

3. enormous reservoir plastic tunnels auto irrigation.

4. 1 x 6" x 200 ft flow 2000 G.P.H.

5. Farm over 200 head plus crop spraying use 1 x 6 x 200 ft abundance of water

6. St Brelade's Bay. One over 60 sprinklers and 3000 G.P.H. One with large pond and sprinklers over 2000 G.P.H.

7. St Brelade 2 x 6" bores providing irrigation in both properties.

8. 1 x 6" x 300 ft 3000 G.P.H.

9. 2 x 6 " both supplying at least 3000 G.P.H.

10. 1 x 6 x 200 ft 2000 G.P.H. 1 x 6 x 400 ft 255 to 3000 G.P.H.

11. field 1 x 6 x 200 ft suppliers and drives a travelling raingun

12. St Peter 2 x 6" x 200 ft for Agri irrigation 1 x 4000 G.P.H. 1 x 3000 G.P.H.

13. Agri irrigation 1 x 8" x 150 ft : producing 240.000 Gallon a day at 10.000 G.P.H. with ease. Power to drive 26 Agri sprinklers direct from B/H

14. 1 x 8" & 1 x 6" delivering over 7000 G.P.H.

15. 4000 G.P.H. continuously daily

16. 2 x 6" 5000 G.P.H. together

17. 460 ft 1 x 6" 1500 G.P.H. 200 ft from beach - fresh

18. St Martin 375 ft 1 x 6" 3000 G.P.H. into reservoir

19. 1 x 6" 2000 G.P.H. still supplying in spite of enlargement in the last few years.

20. St Martin 3000 G.P.H. into reservoir

21. 4 bore-holes drilled in inappropriate area, all saline ten to twelve years ago. Ours was drilled and is still providing the hotel today in spite of w/works passing the gate.

22. herd large farm house and crop spraying 1 x 6" x 100 ft 2000 to 2500 G.P.H.

23. St Martin over 200 head to water plus crop spraying farm house and staff 3000 plus G.P.H.

24. 250 head plus staff and large reservoir 3000 G.P.H.

25. Glass houses with 5 x 6" all supplying farm 2 to 4000 G.P.H.

26. Agri Bore-H in field Generator driven over 3500 G.P.H.

27. St Martin 1 x 6" x 60 only 3000

28. St Saviour 1 x 6" x 200 ft agri irrigation 2500 G.P.H.

27. 21 flats 1 x 6" x 60 ft on a fully pressurised system no holding tanks.

28. 37 flats full pressurised system 1 x 6" x 200 ft with 1-HP Pump. High head

29. Hotel 1 x 6" x 150 ft for toilets and swimming pool plus garden irrigation

30. for irrigation flower field for Battle of Flowers 3500 G.P.M. 1 x 6"

31. 1 x 6" x 400 ft Big area of glass, cattle herd, staff in 13 porto cabins and wash rooms plus farm veg and potato washing, and reservoir filling 4000 plus

32. St Peter 1 x 6 x 200 ft 2000 G.P.H. farm and c/spraying

33. 1 x 4" x " 200 ft for house hold users car washing etc with the sea on three sides and still fresh for last ten years.

34. Old Fort Road has 5 bore-holes and none have saline intrusion.

35. . 1 x 6" x 300 ft in depth approximately 400 ft from the beach and fresh water has supplied the hotel and the cafe

36. 1 x 6" approximately 30 ft from the sea wall and fresh water 1500 G.P.H. on H.P. Pump. 4 houses along 1 x 4" used for garden watering fresh water.

37. 1 x 6" x 500 ft has supplied fresh for years approximately 250 ft from the shingle beach.

38. 1 x 6" x 200 ft now used for irrigating abundance of water top of the hill 2500 to 3000 G.P.H.

39. Millbrook 1 x 6" x 180 ft 11 vergees of gardens with Automatic sprinklers at least 3000 G.P.H.

40. , St Lawrence 1 x 6" x 300 ft over 3000 G.P.H.

41. 1 x 6" x 200 ft 2000 G.P.H.

42. 1 x 8" fresh water now far from the sea but was approximately 250 ft from the sea wall.

43. St Ouen 1 x 6" over 3000 G.P.H. into reservoir.

44. Agri bore/h 4000 G.P.H. alongside 2000 G.P.H. 1 x 6" smaller pump.

St Catherine's breakwater had a well dug in 1847 to provide fresh water for the large work force. It still has its water supply today and is no more than 100 ft from the sea wall.

SWL CONSULTANTS
Control and use of Groundwater

SWL

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London W4 5SD
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'94 tel no. 0763-351435 Vat Reg. 495 4684 90
fax 243845

FAX TRANSMISSION

To: Gerard Baudins	Fax number: 0534-856150
From: Stuart Sutton	Date: 18.9.93
Total number of pages	If you do not receive all pages please telephone

Message

Dear Gerard.

I hope the fishing went well on Friday and that you have forgotten about BGS for at least a couple of days.

I have been thinking a bit about your problems and feel that there are two approaches to be adopted. BGS conclusions do not stand up because of there lack of understanding of the geology and the 40m rubbish and because they have made a totally inadequate allowance for man induced recharge (reservoirs, leaky pipes, irrigation etc.).

For the geology they are best attacked through someone with a good understanding of the geology of Jersey, John Sharp would be ideal as anybody else would have a lot to learn. If he is not available your best bet would be to try to persuade the Department of Agriculture to commission a brief review of the published descriptions of the geology which is probably about 2 weeks work including a visit to Jersey. This could be combined with a careful assessment of the impact of man made effects again probably 2-3 weeks work. The total cost of an exercise such as this is probably in the £15000 range and the work could be carried out by quite a few consulting firms. The one I would reccomend (partly because I will be working for them from the New Year) is called Hydrotechnica based in Shrewsbury. If Peter Bastion is interested in talking further I would be free to come to Jersey in early November as by that time I will no longer be working for my present employer and therefore no pressure can be brought to bear by BGS.

I hope this is of some use to you. It seems an expensive way to go about things but in view of the apparent seriousness of the present disputes to do things by half measures would probably do more harm than good.

Stuart Sutton

S Sutton

The Waterworks Company can now offer quantity and quality

JEP
13/9/93

Water: The main attractions

After yesterday's boost to Jersey's water supplies, and in a year when the 25-year-old desalination plant has not been needed, RICHARD PEDLEY spoke to John Hobbs, for whom the supply and quality of mains water are always top of the agenda

JERSEY is now using roughly the same amount of water as it was during the drought of 1989 — over five million gallons per day — but because the Island now has the Queen's Valley reservoir, the managing director of the Jersey New Waterworks Company loses no sleep over it.

Instead, he now has 591 million gallons up his sleeve, and John Hobbs is free to fret over the quality of the water, as every drop has to be purified before arriving in your home.

'It is just not possible to produce pure water these days,' he said. 'This is not because the water has changed, but because the scientists have become so infernally clever at finding things in it.

'Twenty years ago we worked in milligrams (of pollutants) per litre. If you had one milligram, you had one part per million. Now, they work in nanograms, which is one part per million millionths.'

Mr Hobbs said that even if one could produce pure water, it would have absorbed other things by the time it had been piped through to chrome taps in the home. 'Water can dissolve almost anything, and the problem is that water is seen as being either dirty or clean; people are very "absolute" about it,' he said. Mr Hobbs has now been in con-

'If I were a farmer, I would be up in arms as well,' he said. 'I appreciate that the farmers need irrigation, but it is something that the States will have to decide on.'

It has also been recently suggested by local water diviners that Jersey has large supplies of pure water lying beneath the bedrock of the Island. Although Mr Hobbs is sceptical about this theory, he does not dismiss the ability of the water diviners themselves.

'This water divining stunt does work because I can do it a bit,' he said. 'But I am sceptical because we have heard this all before and nothing was found. However, there are more things in heaven and earth, as they say, and if they did find three million gallons a day, then it would be very welcome.'

The company draws three to four per cent of its water from boreholes, six of which are at the south of St Ouen's Bay, which means that over 23 million gallons of Jersey's water stock is already pumped up from underground.

EC rulings

24

25 YEARS

J E P July 28th 1970

WORK on the Minden Place multi-storey car park is five months behind schedule. Originally intended to be completed this month the project has run into snags which have snowballed and it will not now be finished before Christmas.

The £200,000 car park has been designed to hold about 300 cars and it is likely that the Defence Committee will order that it is to be used by shoppers only.

The main problem has been in the ground for the contractors encountered, among other things, underground streams and this affected the foundation work.

ADDRESS: TRINITY.

P.H.D. Ref. No.	881/93
Date	14/6/93
Type of Sample	Bore
Point of Sampling	Kitchen Tap
Temp °C	—
Sampled by	PHD
BACTERIOLOGICAL	
Presumptive Coliforms	Nil
Faecal Coli	Nil
CHEMICAL LAB REF:	31273
Ca hardness as $CaCO_3$	198
Mg hardness as $CaCO_3$	41
Free Ammonia	0·02
Albuminoid Ammonia	
Oxygen Absorbed	0·14
Nitrates as Nitrogen	ND ← (not detected)
Nitrites	0·001
Cl in Chlorides	72
Free Chlorine	
Total Alkalinity	
Total Solids	
Elec. Conductivity	578
pH	7·0
Taste	—
Odour	Slight Vegetation
Appearance	Pale straw Turbid
Detergent	
Hydrocarbons	
Fluoresceine	
Sulphate	88
Pesticides	
Fluoride/Phosphate	ND/ND
METALS	
Lead	ND
Zinc	0·01
Copper	0·01
Iron	1·128
Sodium	31

Description of Sample.

Laboratory reference number	1172/92
Date sampled	3rd August 1992
Date received	6th August 1992
Location or name of source	Ecrehoes Reef St Martin Jersey
Examination	chemical and bacteriological
Type of supply	well
Approximate age of supply	200 years plus – actually 700 - G.B.
Whether in regular use	no
Sampling point	well
Treatment if any	none
Previous examinations if any	
Other details if any	

Characters.

Colour	350 Hazen Units
Turbidity	
Taste	
Odour	odourless
Suspended matter	neglible

Bacteriological Examination

Total coliforms(most probable number) ... ... per 100 ml	more than 1800 **
Faecal coliforms (Escherichia coli) (most probable number) per 100ml	25 **
Total viable count at 22 degrees Celsius ... ... per 1 ml	more than 10,000
Total viable count at 37 degrees Celsius ... ... per 1 ml	1008
Faecal streptococci... ... ... per 100 ml	–
Sulphite reducing Clostridia ... ... per 20 ml	–

Analysis.

(Milligrammes per litre) = (Parts per million)

1172/92

Chloride	610 **
Fluoride	30 **
Nitrite	8.3 **
Nitrate	2400 **
Sulphate	520 **
Total hardness (as calcium carbonate)	2544
Temporary hardness (as calcium carbonate)	70
Permanent hardness (as calcium carbonate)	2474
Calcium	1000 **
Magnesium	10.0
Sodium	380 **
Potassium	188 **
Saline ammonia (ammonium)	16.9 **
Albuminoid ammonia (as nitrogen)	5.0 **
Permanganate value	-
Lead	0.01
Copper	0.16
Zinc	0.72
Dissolved iron	0.01
Iron in sedimentary form	less than 0.01
Manganese	4.5 **
Aluminium	130 **
Total solid constituents (dried at 180 degrees Celsius)	5181 **
Acidity (sodium carbonate decahydrate to neutralise)	40
Residual chlorine (free and combined)	-

--- § ---

Ultraviolet light transmittance at 254 nm per 1 cm layer	0.1%
Hydrogen ion concentration (equivalent to pH)	5.9
Conductivity at 20 degrees Celsius (Micromhos)	6980 **

JERSEY GROUNDWATER

ASSESSMENT OF BRITISH GEOLOGICAL SURVEY REPORTS

by Dr. Sutton.

INTRODUCTION

This note presents a brief assessment of the two reports:

Hydrogeological and hydrogeochemical survey of Jersey: BGS, 1991

Jersey Groundwater - Year 2: BGS, 1992

Copies of these reports were provided by Mr G Baudins and the work was carried out during the period May 7-14, 1993.

The reports present the results of a hydrogeological survey of Jersey carried out during 1990/91 and 92 and of groundwater modelling caried out in 1991. The basic conclusion of the reports is that the level of groundwater abstraction (estimated at 3.7 million cubic metres per year) is sufficiently close to the estimated amount of natural recharge (5.5 MCM per year), that there is a serious risk if long term depletion of groundwater reserves. Additionally it is concluded that nitrate and potassium levels in groundwater sources indicate a potential problem with groundwater quality.

ASSESSMENT

The principal conclusion of the reports and the results of the modelling presented are totally dependent on the accuracy of the groundwater recharge estimates. This estimate is derived from conventional hydrological calculation based on both meteorological records and on soil moisture deficit calculations. Both of which the authors recognise to contain significant approximations. It would perhaps be of interest to enquire as to why estimated annual infiltration for Jersey is so much less than that quoted for the three comparable islands in Table 9 of the 1991 report. In spite of the uncertainty of the recharge estimate it is used as sole basis for the statement that 'the groundwater resources of the island are being overpumped and are not wholly replenished in a normal recharge year' (1991 Report,p77). This conclusion is unsupported by either chemical evidence or by the limited water level data presented.

While the recharge estimates provided are recognised as being approximations this aproximation is insignificant when compared with an extremely basic ommission from the calculation. The Island of Jersey is a developed community and the vast majority of the population receive piped water supply. For Jersey the figures presented in the introduction to the 1991 Report suggest that 80% of the population receive piped water from public supply, 96% of which is derived from surface sources. This would suggest that surface water supplies a volume three to four times greater than groundwater (12-15 MCM per year). In any piped water system leakage is likely to be of the order of 20% (cf Twort, Hoather and Law, 1974) the bulk of which will return to the groundwater reservoir. This suggests that for Jersey a recharge estimate based solely on natural recharge underestimates the volume of recharge by 2-3 MCM per year. Other significant contributions to groundwater recharge are likely to be derived from large surface storage reservoirs and from soakaway type sanitation.

It is therefore suggested that the principal conclusion of the BGS Reports is derived from an initially erroneous estimation of recharge volumes and that, in terms of volume, the groundwater resources of the Island of Jersey are not under stress.

The chemical evidence presented in the reports does not provide any indication of overexploitation or of developing saline intrusion. It does however provide cause for concern in view of the consistently high levels of nitrate and potassium reported. This indicates increasing contamination from human activity which in turn serves to underline the gravity of the ommission of anthropogenic sources from the recharge calculations presented.

For a groundwater regime as complex as that of the fissured rock aquifers of Jersey the task of construction of a representative groundwater model is one of immense complexity and can certainly not be achieved by the use of a porous medium model such as MODFLOW. The model results presented are of dubious reliability and are totally dependent on the accuracy of the input parameters none of which are well defined and one of which (recharge) I would contend is seriously in error.

CONCLUSION

The principal conclusion of the BGS Reports that the groundwater resources of Jersey are at serious risk of substantial depletion is based on an erroneous estimation of recharge volumes and is untenable. There is however, a serious risk of declining water quality arising from human activity.

Dr J S Sutton, FGS, CGeol, MICE, CEng.

Fort Regent

1808 - 70 ft water

1993 - 160 ft water = 90 ft higher

P Conway, Lissadele, Gorey

1973 - 42 ft down
1991 - 49 ft down
1993 - 37 ft down (after 2 dry years)

Miscellaneous (history of Jersey)

1356 - St Ouen inundated (by sea)

1812 - (Oct.) Sea flooded large area of East Coast of Jersey

1869 - JWNCo inaugurated supply of water to St Helier

'Thorough disapproval' of officers' actions

Water report: Public Services chiefs under fire

BY JACKIE HONE

SENATOR Vernon Tomes has expressed 'thorough disapproval' of yesterday's actions of Public Services ch in speaking publicly about the views of the UK Institute of Hydrology on Jersey's water situation without bringing a formal report from the institute to the Public Services Committee first.

And water diviner George Langlois has strongly criticised the institute's comments that the Island may have to start shipping in water by the year 2010 if legislation is not introduced, describing it as 'scaremongering'.

Public Services chief executive John Mulready and one of the department's chief engineers, Roger Culverwell, yesterday revealed that the institute had expressed concern about the deteriorating quality of th 'sland's water supply.

Investigation

They further revealed that the institute had set up a team to produce a case study on Jersey as an example of 'how not to do things' as part of a global investigation into the socio-economic impact of the over-exploitation of water resources.

Senator Tomes, the vice-president of Public Services, said that Mr Mulready had informed him of the views of the institute's principal hydro-geologist, Nick Robins, prior to talking to the press.

'However, I felt that it was a matter that Mr Robins should put in his next report,' said Senator Tomes. 'I don't think the committee should act on reported conversation. I thoroughly disapprove of the actions of Mr Mulready and Mr Culverwell.'

The Senator said that Mr Robins had already presented Public Services with three 'very disappointing' reports on water resources.

'The third report was a watered-down version of the first and second, and Mr Robins has said that the fourth will be even more watered down,' he said.

'He has also said that his reports could have a 20 per cent margin of error either way, so if that error went in favour of water diviners, that could completely change things.'

Yesterday, Mr Mulready dismissed the opinions of water diviners that the Island had an unlimited supply of quality water, saying that Jersey should listen to the views of a world expert on water rather than those of the water diviners.

Senator Tomes said: 'I have continually said that Mr Culverwell and Mr Mulready should sit down with the water diviners, explore their theories and destroy them scientifically if they can.

'If they can do that, I will be happy to go along with them. But everyone is entitled to a fair hearing.'

However, Mr Mulready said that he had 'already done that'.

'We have had big meetings with them before, and we have disproved their arguments, as have the British Geological Survey,' he said.

Mr Langlois said that yesterday's report was 'scaremongering'. 'Public Services are just trying to frighten people because they want to control all the water on the Island,' he said.

Underground

He added: 'I don't think they will be able to introduce legislation anyway, because under old Jersey Norman law, water underground belongs to the owner of the land — you can't force people to have meters on their boreholes.'

Mr Langlois added that Mr Robins' claim that the Island had the highest density of boreholes in the world — 6,000 in its 45 square miles — was untrue.

'We have only got about 4,000,' he said. 'They are exaggerating.'

And he said that if the population of the Island did not increase much during the next 20 years, the reservoirs alone would be able to supply enough quality water without resorting to ground water.

'There are vast supplies of deep water down there if needed, and it is clean water with no nitrates or anything,' he said.

'Our water quality is not going to deteriorate. And you can always remove nitrates from water — it is expensive, but a lot cheaper than shipping water in.'

Department of Agriculture and Fisheries
P.O. Box No 327
Howard Davis Farm
Trinity, Jersey JE4 8UF.
Tel: (01534) 866200
Telex: 4192635 AGFISH G
Facsimile: (01534) 866201
Chief Officer: Peter Bastion

States of Jersey

your ref
our ref PB/JD/AN
date 13 January 1997

Mr G Baudains
Glen Moor
Le Bourg
St Clement
JE2 6SP

Dear Mr Baudains

Deputy Dorey has asked me to thank you very much for your letter and also the copy of your letter to the Jersey Evening Post, both of which he read with great interest.

I am enclosing a copy of the recent BGS report which I trust you will find most interesting!

As far as your last paragraph goes about the bringing over of an independent expert I think you will recall that in the end it was not to lack of funds but the person himself had been 'warned' not to come.

Kind regards

Yours sincerely

Peter Bastion
Chief Officer

Department of Agriculture and Fisheries
P.O. Box 327, Howard Davis Farm,
Trinity, Jersey, JE4 8UF
Tel: (0534) 866200
Telex: 4192635 AGFISH G.
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FACSIMILE COVER SHEET

TO: Mr. G. Baudains

FAX NO: 856150

ATTENTION OF:

DATE: 22 July - 93?

NOS OF PAGES (Including this one): 1

FROM: Fine

MESSAGE:-

Sincere apologies but the meeting due to be held at the Department this pm 22 July has had to be postponed.

Mr. Bastion will be in touch to arrange a new date

Could you please inform the well borers and divers who would have attended. With thank Fine. Carol + Mr. B +)

TOTAL P.01

GERARD BAUDAINS

Glen Moor
Le Bourg
St. Clement
Jersey, JE2 6SP, C.I.
Tel: 01534 855086
Fax: 01534 856150

servicing
overhauls
engine reconditioning
marine engineering
repair & alterations

V.A.Tomes Esq.
Pier Rd
St Helier.

11-1-'96

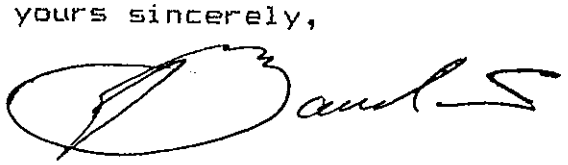
Dear Mr. Tomes,

Mr. G. Langlois informs me that Roger Culverwell has asked him on two or three occasions for information regarding deep water supplies. We find this surprising as Mr. Langlois has already advised him where deep water bores are located.
You may recall we were so amazed by B.G.S.'s statement that water did not penetrate below 40 metres (later ammended to 25), that we spent an hour or two assembling a list of 50 bores where water was first struck below this level. For some bores, this level is below 90 metres.
As this information comes from a well borer's confidential records, naturally people on that list would have to be consulted before information about their property could be released.
We asked P. Services to advise us which ones they would like to look at, and we would seek the clearance. This they declined to do, yet Mr. Culverwell continues to ask where these bores are, as if he doubts their existence.
In order to simplify matters, we have selected some bores from our list that happen to be in B.G.S.'s reports. As these bores are already being monitored by B.G.S. / P.S., we presume there is no problem regarding owner's consent.
It may come as a surprise to you that B.G.S. deny water exists below 40 metres on the one hand, whilst themselves monitoring bores that go to 400feet. It certainly seems strange to us.
If further information regarding the bores below is required, such as geology, the exact depth at which water was first struck, flow rates (B.G.S. have made significant errors in this latter area) etc., we will do our best to supply same.

1. La Moye golf course	200ft.
2. La Moye radar station	325ft.
3. Quennevais campsite	400ft.
4. Besco laundry	305ft.
5. Overdale hospital	200ft.
6. States farm	400ft.
7. Jersey milk	180ft.
8. Royal golf club	200ft.
9. Strawberry farm	400ft.

yours sincerely,

cc D. Carter.



pollution (especially nitrate) are in places seve[illegible]nd saline intrusion is also observed in some low-lying coastal areas. Representative chemical analyses of Jersey groundwater from the main aquifers are presented in Table 2. The analyses reveal that the groundwater is principally of Na–Ca–Cl–HCO_3 type. The importance of Na and Cl ions reflects the island's maritime aspect. High concentrations of these solutes in Jersey rainfall (Table 3) suggest that recharge concentrations are likely to be high. The mean Cl content of Jersey groundwaters sampled in summer 1990 was 88 mg l^{-1}. Given that average annual rainfall is 877 mm and potential evapotranspiration is estimated at 648–754 mm $year^{-1}$ (see above), Cl inputs to the Jersey aquifer should be concentrated by a factor of between 3.8 and 7.1. The few Cl data data for rainfall given in Table 3 are insufficient to give a reliable weighted mean Cl concentration for Jersey rainfall and no other rainfall data are available for the island at present. However, a weighted mean Cl value for rainfall at the Camborne Meteorological Station in Cornwall over the period 1986–1988 is 11.7 mg l^{-1} (Edmunds et al., 1988; Smedley et al., 1989). Assuming that Cornish rainfall chemistry is comparable to that of Jersey, the input of Cl to the aquifer using the Cornish data would amount to between 44– 83 mg l^{-1}. The mean Cl content of 88 mg l^{-1} in shallow Jersey groundwater is slightly above this range and suggests that additional Cl inputs may have been made to the aquifer. Anthropogenic pollution (agricultural and domestic) is one potential source.

Jersey groundwaters are mostly acidic, 80% having pH values less than 7. Almost all are undersaturated with respect to calcite. The distribution of pH values is given in Fig. 3. Values are notably lower in the northern part of the island than further south. This is partly attributable to aquifer lithology, groundwater from the Jersey Shale Formation having slightly higher pH values than other lithologies (mean Shale value, 6.57), although most lithologies have similar pH values (mean pH for the Northwest and Southwest Granites, 6.00; mean for volcanic rocks, 6.06; conglomerate, 6.06). The low pH is indicative of the paucity of carbonate in the aquifers and suggests that the waters have had relatively short residence times in the bedrocks. The pH values of groundwater in the Southeast Granite and diorite (mean value, 6.89) in the Grouville – St Clement areas are higher. This is probably the result of minor saline intrusion effects in this low-lying part of the island.

Total dissolved solids (TDS) concentrations largely show the inverse distribution,

Table 3
Major-element composition of composite rainfall samples collected from Jersey Airport over the intervals indicated during 1990

Sample		1	2	3
Date sampled		2.5.90–7.6.90	8.6.90–21.6.90	29.10.90–2.11.90
Ca	(mg l^{-1})	2.1	1.1	1.3
Mg	(mg l^{-1})	1.0	0.7	1.8
Na	(mg l^{-1})	6.7	5.0	14.9
K	(mg l^{-1})	1.8	1.3	0.8
Cl	(mg l^{-1})	11.1	8.6	27.5
SO_4	(mg l^{-1})	19.5	9.7	7.0

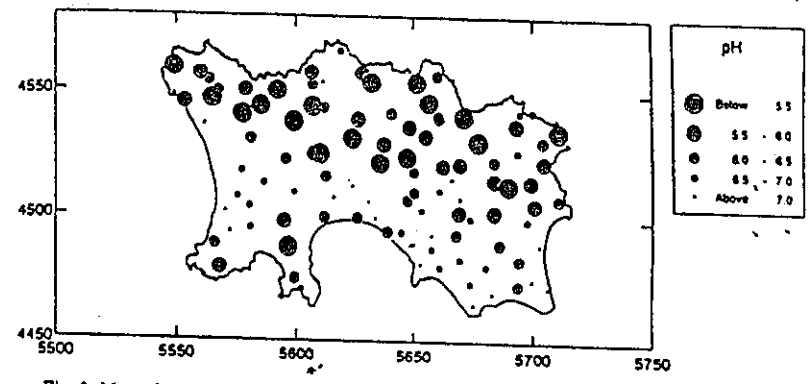


Fig. 3. Map of Jersey showing the regional distribution of pH values in shallow groundwater.

with highest values observed in the south and particularly the south-east (Fig. 4). The high-TDS waters in the low-lying south-east have higher Cl, SO_4, Mg, Na and Br concentrations and are indicative of minor amounts of saline intrusion. Groundwater samples from Sefton Nursery (e.g. Table 2, sample 14) have the highest observed seawater component (SEC, 1800 μS cm^{-1}; Cl, 143 mg l^{-1}; SO_4, 401 mg l^{-1}; Sr, 608 μg l^{-1}). The background Cl concentration in Jersey groundwater away from the coast is about 65 mg l^{-1} and Cl in seawater is 19 000 mg l^{-1} (Hem, 1985), in the worst cases sampled, the mixing ratio is about 99.6% freshwater to 0.4% seawater. This indicates that seawater intrusion in the south-eastern part of Jersey is apparent but minor. However, even such small amounts of saline mixing have had a significant impact on groundwater chemistry.

Most of the Jersey groundwaters are oxidising with redox potentials greater than 250 mV, detectable dissolved oxygen concentrations and appreciable nitrate contents (Table 2). A few are reducing with low redox potentials down to a minimum recorded value of 80 mV (Sefton Nursery) as well as low or zero dissolved oxygen, low nitrate

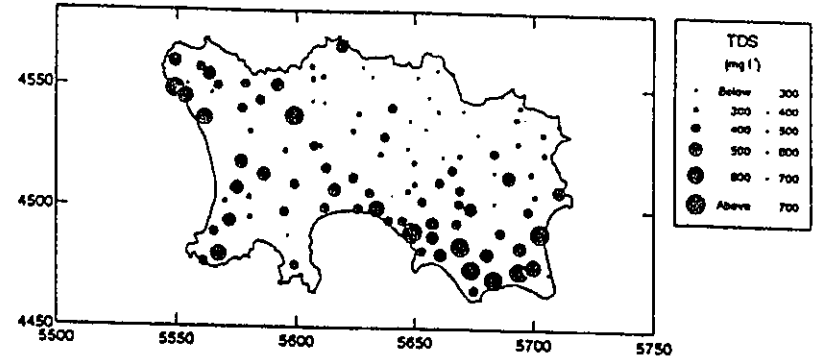


Fig. 4. Map of Jersey showing the regional distribution of Total Dissolved Solids in shallow groundwater.

ed support from 83 per cent of the teachers.

Panel chairman Bob Newbury said that the results highlighted the anger felt by teachers over the 13-month pay dispute. 'It means that they are annoyed. There is a case that we are taking one step forward and back, we shall be in a position to start action.

'There are two ways to approach it, and it m ter to have a one-off strike and not to get cor

REPORT SHOWS THAT SUPPLY IS STILL CONTAMINATED BY PESTICIDES AND HERBICIDES

Water pollution law may be introduced

J.E.P. 29-11-'94

A WATER pollution law may be introduced following the results of the latest British Geological Survey report which says that the Island's water supply is still contaminated with pesticides and herbicides.

However, Public Services Committee president Deputy Dereck Carter said that good news was also contained in the fourth annual BGS report — there is no evidence that water is in short supply in Jersey, or likely to be in the immediate future.

Because of this, Deputy Carter said, his committee were discussing pushing forward with plans to introduce the pollution-control aspects of the new water law which have been pending for some years, leaving the more controversial parts of the law — particularly the metering of boreholes, which would put private wells and boreholes under States control — until a later date.

BY JACKIE HONE

Concern has been expressed over the problem of contamination of water supplies with pesticides and herbicides for some time. Two months ago Ian James, the new manager of the Jersey New Waterworks Company (JNWC), said that the levels of pesticides — and to a lesser extent nitrates — should be addressed, and earlier this year a working party including representatives of Public Services, Agriculture and Fisheries and the JNWC was set up to investigate the problem.

Deputy Carter said that the new BGS report confirmed that the pesticide problem was still in existence, although 'not widespread', and that his committee were more worried about this than about nitrates.

'Tests have shown that about 50 per cent of our water has nitrate levels above so-called EC safe limits,' he said, 'but this has probably been true for the past few centuries. There is only one known medical effect of high nitrate levels, and that is blue baby syndrome, of which there has never been a case reported in Jersey.'

Deputy Carter said that his committee were all in agreement about the parts of the new water law relating to pollution, despite being divided — 'as the rest of the Island is' — on other aspects like borehole metering.

'We are not rejecting the rest of the law, but we think it would be better to bring forward the non-contentious parts first and then squabble over the rest later,' he said.

'We need to sort out some pollution control measures urgently,' he added.

towards a decreasing number of discharge points. The Hasa springs in eastern Saudi Arabia well up in a most arid region, yet have an average yield of 14 m³/sec, while the largest spring in the world, Ras-el-Ain with some 40 m³/sec., discharges in semi-arid northern Syria. The springs of the Syrian-Lebanese massifs discharge from limestones and are also surprisingly large; Ain Sinn averages 10.5 m³/sec, Ain Figeh 7.5 m³/sec and Ain Barada 3.2 m³/sec. Even in the Djebel Akhdar of Cyrenaica, Ayn Dabussis, yielding some 200 l/sec, greatly exceeds the other springs. This concentrated mode of discharge is a characteristic indicating that the aquifer is of a karstic nature. Karst aquifers in Syria are discussed by Burdon & Safadi (1964).

Submarine spring discharge

Submarine springs of different types occur in the Mediterranean and in the Gulf; it is not known if they occur in the Arabian sea or in the Red Sea. There are some 26 identified submarine springs off the coast of Lebanon, while near the island of Rouad there is the famous upwelling described by Lucretius as 'vomiting out fresh amid the salt'. These springs generally discharge Turonian-Cenomanian groundwater through a carapace of Senonian marl; they differ from the open limestone drowned springs of the Turkish and Grecian coasts. One submarine spring reported from Cyrenaica, through Ayn Zayanah, near Benghazi (Guerre 1981) is almost a submarine spring, with typical mingling of sea and fresh waters in its cavernous supply circuits. There are also many submarine springs in the Gulf off the Hasa littoral. They represent discharge of fresh groundwater held under artesian conditions in the confined aquifers; they do not seem to entrain sea water. The most notable occur around Bahrain island, whose name of 'the two seas' refers to the 'waters over the earth and the waters under the earth' of Genesis.

The qanat discharge

The qanat (falaj, kharaz, fogarra, sahzidj, chain-of-wells, etc.) is a simple yet sophisticated method of groundwater development, evolving from the natural springs of unconfined aquifers. The aquifer is tapped by an infiltration gallery which leads out the water at a slope less than both that of the piezometric surface and that of the ground surface. In this way the discharge is brought to surface, where it can command the lands to be irrigated. The qanat is very sensitive to

Borehole discharge

Boreholes now provide innumerable groundwater discharge/extraction structures, varying from shallow in the alluvium of a wadi bed, to deep boreholes exceeding 2000 m and akin to oilwells. To a great extent, the economic viability of the deeper bores depend on the artesian/confined nature of the water tapped; otherwise pumping lifts would be too great for pump and purse. Where artesian pressures are great and the aquifer is comparatively shallow, upward seepage around the casing can cause great trouble, as in times past in the Qasim oases of central Saudi Arabia. In other cases, the drilling can so affect the hydraulic regime that the ground around a borehole can be cracked and opened up to allow groundwater to upwell, as around certain boreholes in the Wadi Shatti of *Fezzan*.

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Proceedings

Coastal hydrology

Meeting of the Hydrogeological Group held at Burlington House on 16 April 1985

The meeting commenced with the Annual General Meeting, where a new Group Secretary and four Committee Members were elected. The Chairman outlined the future programme for meetings.

The first hydrogeological presentation was given by [illegible] the GEMS system at RAF Farnborough. Colour contouring software had enabled temperature anomalies to be highlighted. Five anomalies had been found; two had been confirmed by water quality analyses and sidescan sonar as