BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD

Limited distribution

Record 1981/13

WATER SUPPLY FOR THE PROPOSED SECONDARY SCHOOL AT MATEWOULOU, ESPERITU SANTO, VANUATU

BY

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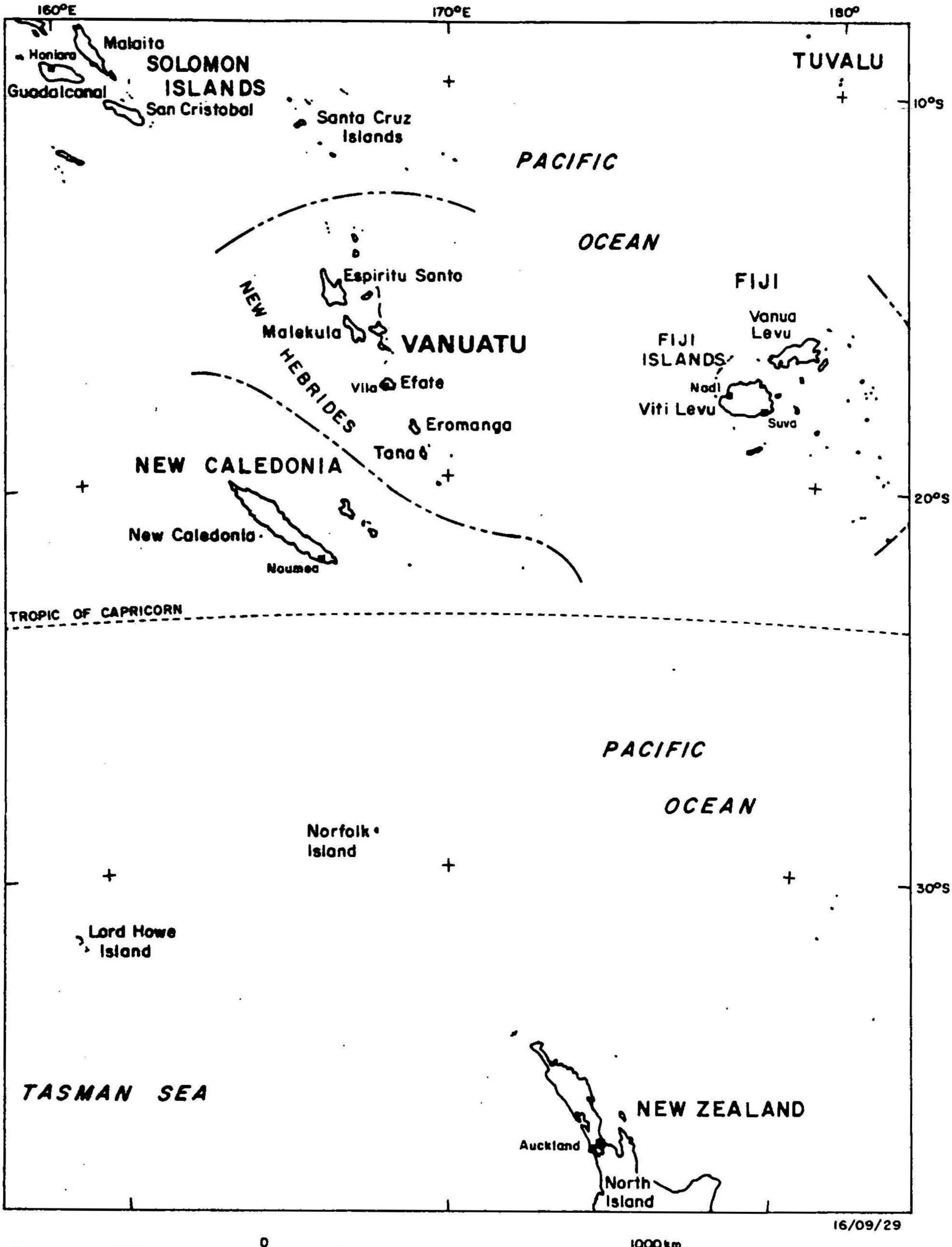

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Fig. I Location map

ABSTRACT

The proposed Esperitu Santo secondary school is sited on the edge of the Eastern Plateau, a Quaternary limestone plateau with little surface drainage. Two springs near the school site have large quantities of water but are affected by tides. The school water supply could be obtained from two low-yielding bores on the plateau.

INTRODUCTION

At the request of the Department of Housing & Construction and the Australian Development Assistance Bureau, the water supply situation at a proposed school site in Esperitu Santo (Fig. 1) was investigated from 28 January to 5 February 1981.

The school is to be constructed under the Australian bilateral aid program, and will be the first secondary school in the Northern District of Vanuatu. The site is at Matewoulou, 15 km north of Luganville (Fig. 2) and about 2 km inland from the east coast of Esperitu Santo. In its appraisal study, the Department of Housing & Construction (1980) expressed concern about the lack of an assured water supply at the site.

The terms of reference for the hydrogeological investigation were to assess the prospects for obtaining sufficient water of satisfactory quality for the school's various needs, including:

1. the assessment of geological conditions at the site;
2. detailed observations and testing of the spring at the site;
3. general observations of water supply installations in Vanuatu and determination of appropriate water quality and consumption standards;
4. assessment of the suitability, availability, and serviceability of drilling rigs;
5. recommendations for further investigations at the site;
6. consideration of alternative sites, if necessary.

HYDROGEOLOGY

The southeast corner of Santo is formed of raised reef limestone of Quaternary age (Mallick & Greenbaum, 1977). The limestone forms a terraced plateau (Qp_2 in Fig. 2), 60-170 m above sea level. There is a younger coastal limestone platform (Qr_1) a few metres above sea level.

One large river, the Sarakata River, cuts through the limestone and east of the Sarakata there is little surface drainage. Sinkholes and dry valleys are common on the plateau. The limestone is porous and fissured, and the infiltration of rainwater beneath the plateau probably results in a widespread freshwater aquifer.

Groundwater flow is generally eastwards, towards the sea, and freshwater is discharged at springs at the foot of the slope leading up to the plateau (Fig. 2). These springs are at or below sea level, and head tidal channels which are connected to the sea. Mixing of the waters causes the springs to be brackish, especially at high tide. The coastal plain is underlain by fresh groundwater which forms a wedge, thickening inland and overlying saltwater (Fig. 3).

The quality of groundwater beneath the plateau is not known, but it is expected to be good enough for most purposes. An analysis of groundwater from a similar geological and climatic situation on Niue Island is shown in Table 1.

SCHOOL WATER SUPPLY

The estimated requirements for the school supply are about 100 litres per head per day, which is about 30 m^3/day for 300 people. This estimated consumption is double the standard for Vanuatu village water supplies, according to information supplied by the Service des Mines.

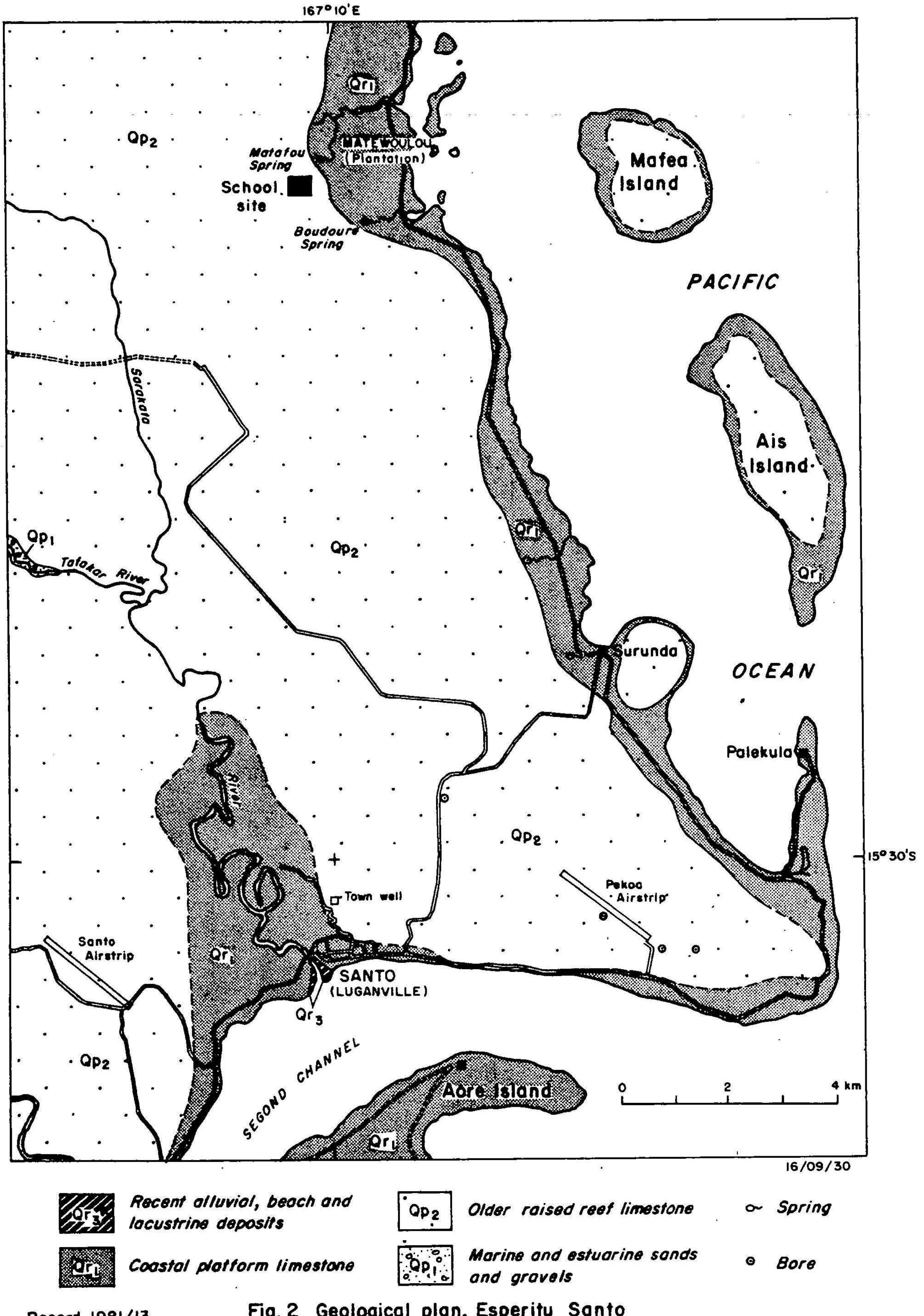

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Fig. 2 Geological plan, Esperitu Santo (after Mallick and Greenbaum, 1977)

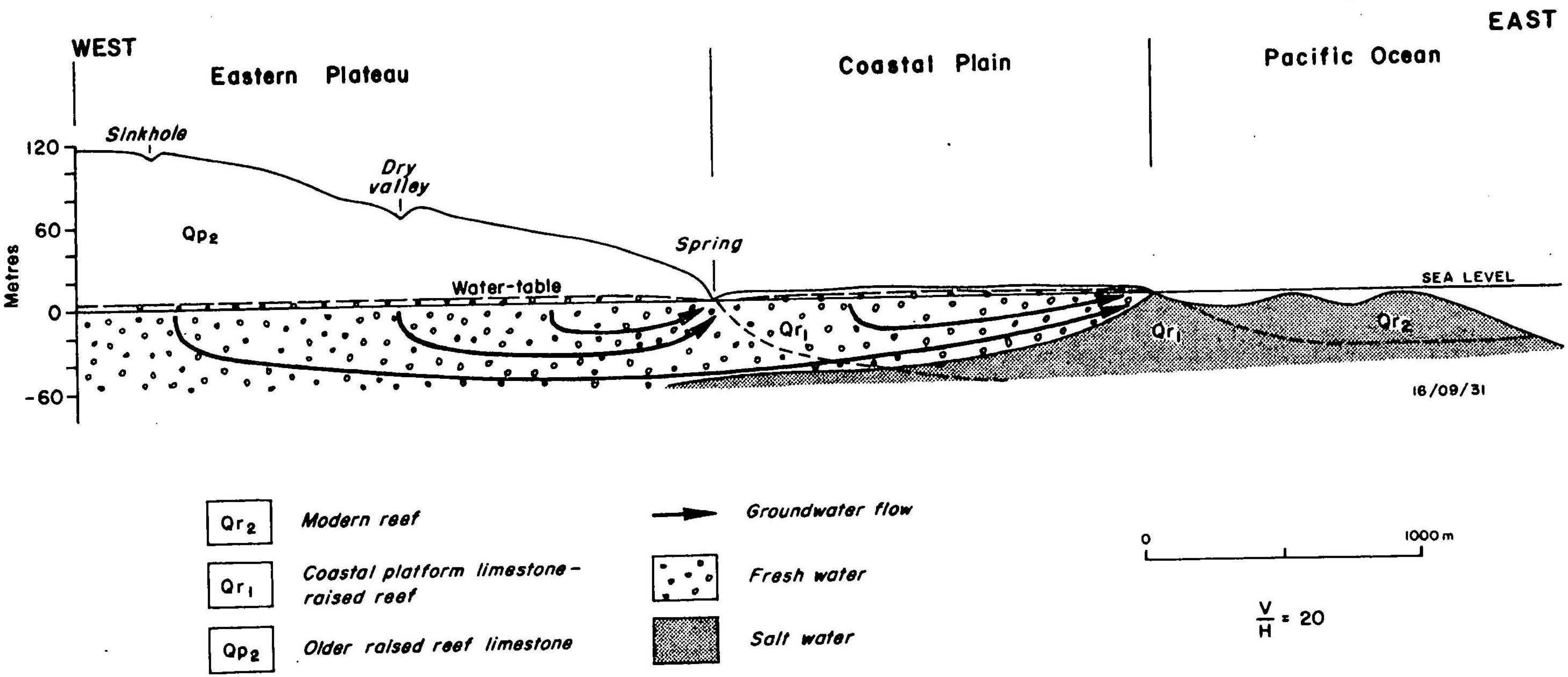

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Fig. 3 Hydrogeology of a limestone coast, Esperitu Santo; cross-section through Matafou spring (for location see Fig. 5)

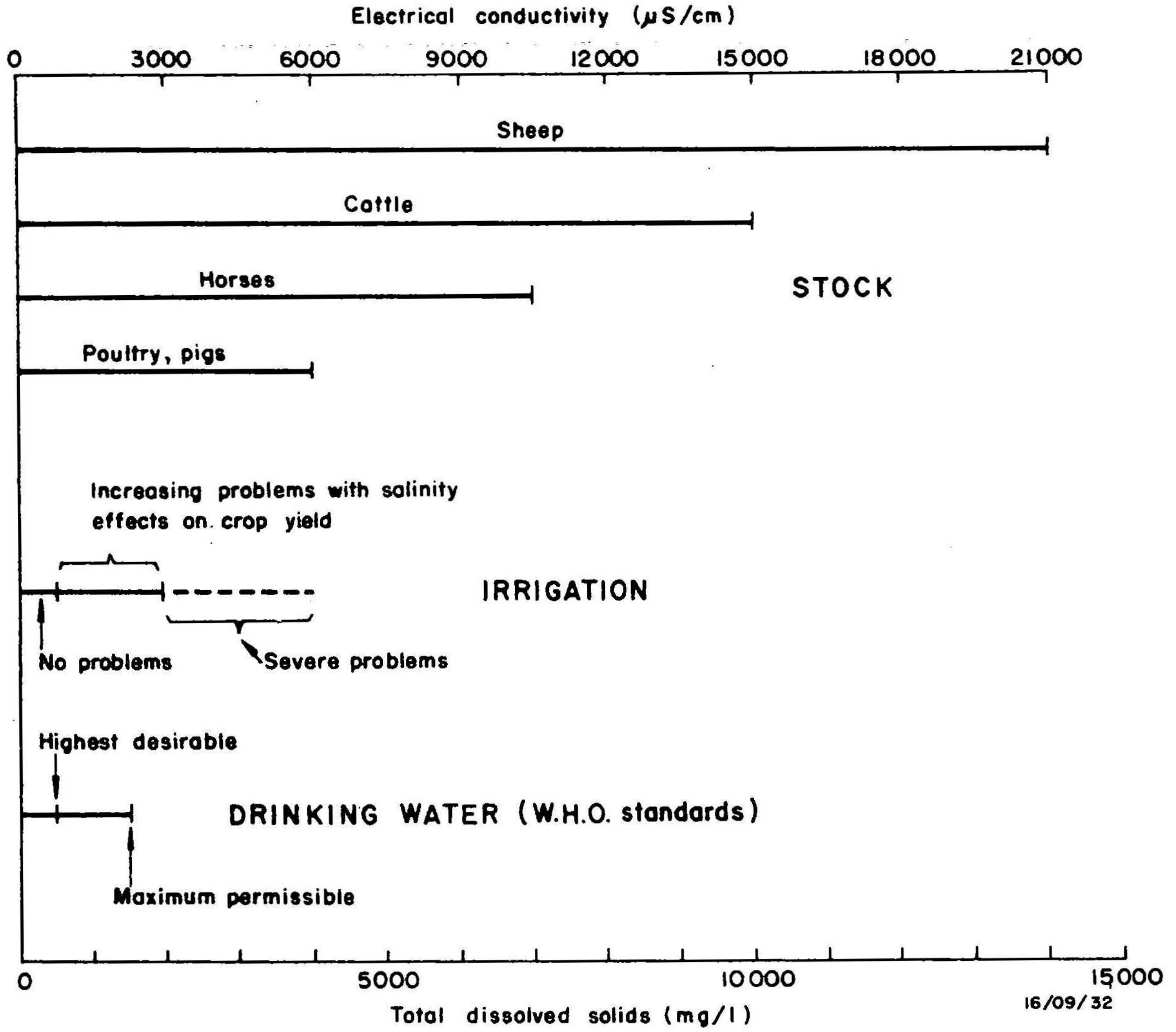

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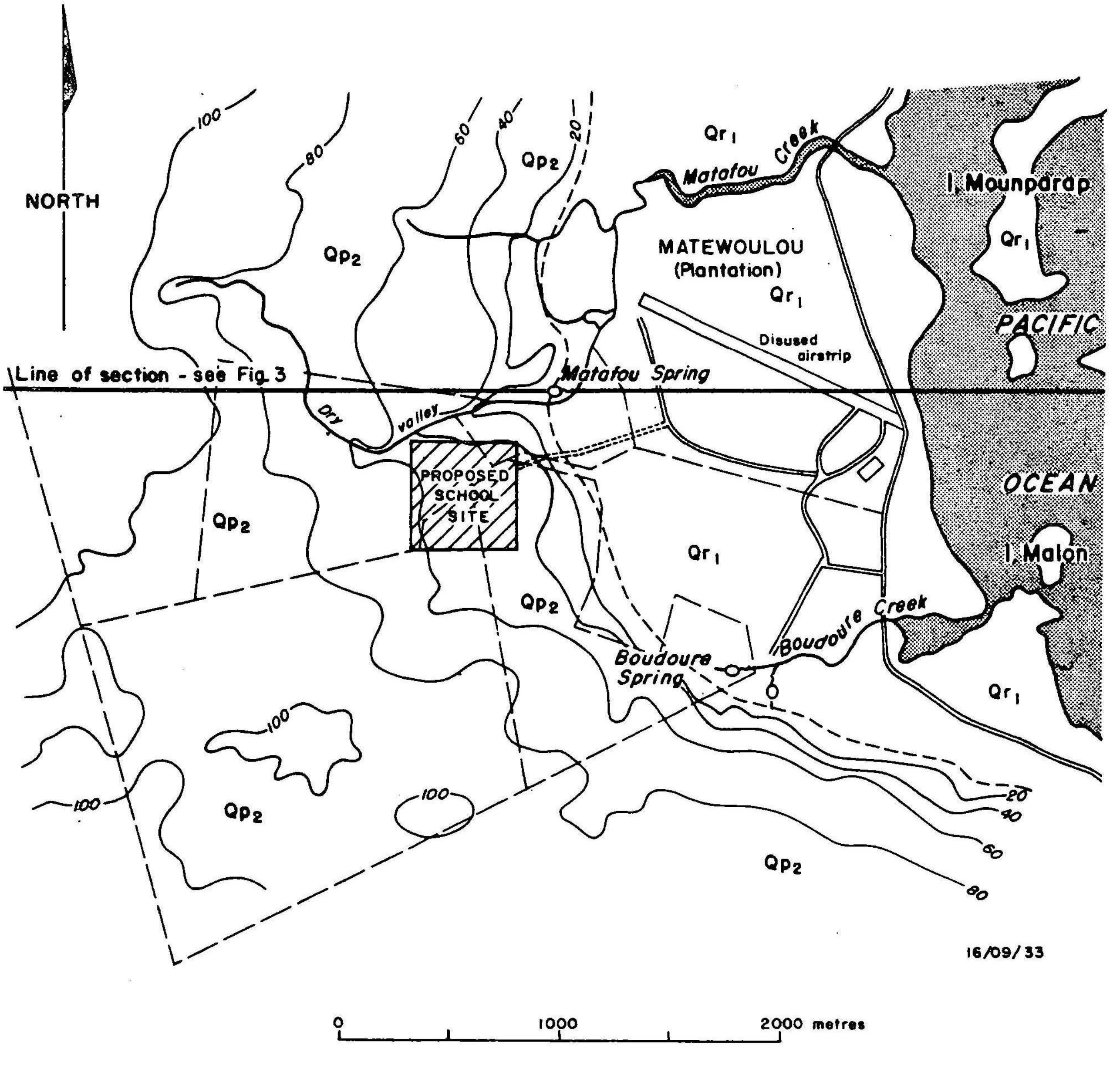
Fig. 4 Water quality for various uses



Qr1	*Coastal platform limestone*
Qp2	*Older raised reef limestone*

- - - - *Geological boundary*

—20— *Contour (metres)*

— — *Land boundaries*

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Fig. 5 Geology of the school site, Matewoulou

The water should contain less than 500 mg/L total dissolved solids, to ensure its suitability for drinking and irrigation (Fig. 4). It should be bacteriologically pure, to avoid the cost of treatment.

The school site is on the edge of the Eastern Plateau of Santo, overlooking the coastal platform, and is at an elevation of 55-65 m above sea level. Three alternative sources can be considered for the school water supply - rainwater, spring water, and groundwater from bores.

Rainwater

Rainfall averages 3100 mm, and rainwater catchments and tanks could be constructed to supply sufficient drinking water for the school's needs. It is unlikely that irrigation or stock water could be thus supplied. Tanks should be earthquake-resistant as Santo experiences a major earthquake once a decade.

Spring water

Large amounts of water are available at two springs - the Matafou Spring, about 400 m northeast of the school site, and the Boudoure Spring, about 1200 m southeast (Fig. 5). Both these springs are at the head of tidal creeks, and consequently the salinity of the water varies with the tides. A tidal range of about 0.5 m was observed in the Boudoure Spring (Fig. 6).

The Matafou Spring water has an electrical conductivity ranging from 2000 to 3000 microsiemens per centimetre (Fig. 6), approximately equivalent to 1300-1900 mg/L total dissolved solids. The Boudoure Spring water has an electrical conductivity ranging from 1000 to 2000 microsiemens per centimetre, approximately equivalent to 600-1300 mg/L total dissolved solids. The waters of both these springs are suitable for stock, and the Boudoure Spring is potable at low tide. The Matafou Spring is currently used for watering cattle.

Groundwater

Groundwater beneath the school site can be extracted if required, and is expected to be suitable for all purposes. The water table is expected to be close to sea level and therefore the groundwater must be developed by bores. Groundwater of good quality has been extracted from the older, raised reef limestone (Qp_2) at three bores near the Pekoa Airstrip (Fig. 2), and pump tests indicated yields of 5-12 m^3/hour. The Luganville town water supply is untreated groundwater with a high degree of bacteriological purity, extracted from a large well in coastal platform limestone.

Two bores on the school site should suffice for the school's needs. The bores should be drilled to sea level. Windmills operating 24 hours per day would need to pump about 0.4 L/sec to supply the school. Electric or diesel borehole pumps would need to pump about 10 m^3/h for 3 hours daily.

The actual sites for bores should be fixed when the layout of school buildings is definite. Factors to be considered are:

1. Boreholes will need to be about 65 m deep if they are on the west side of the site, or about 55 m deep on the east side.

2. The east side, on the edge of the plateau, is exposed to the easterly winds and therefore suitable for windmills.

3. Groundwater flow is eastwards, towards the coast, and any pollution from septic tanks will spread in that direction. Bores on the west side, or to the north or south of the school buildings, would therefore be safer.

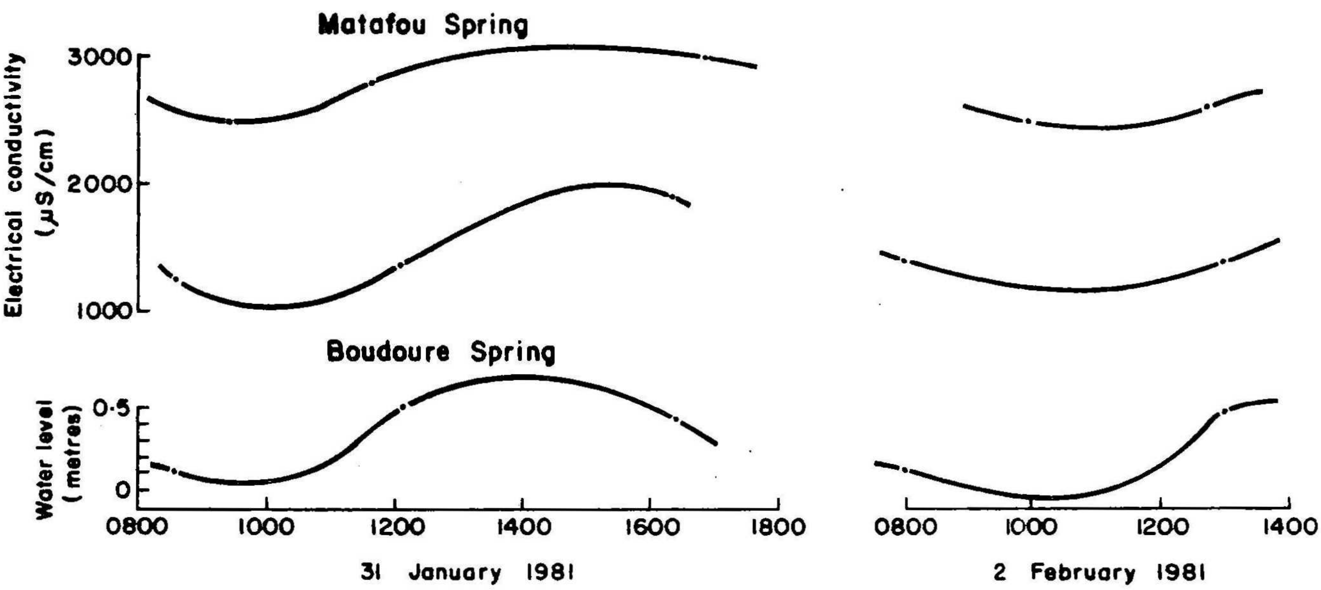

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Fig. 6 Variations in electrical conductivity of spring waters with tides

LOCAL DRILLING CAPABILITY

The Service des Mines has considerable experience in developing rural water supplies, and has a drilling rig on Santo. This is an old, but serviceable Southern Cross percussion rig, which can drill to 70 m. The drilling rate is estimated at 2-8 m per day depending on the difficulty of the ground. It would be necessary to fund the wages and expenses of the 4-man drilling crew at a rate of 800 Vatu/day/man. Allowing for 2 months' work, the cost of two bores would be:

Drilling crew	192 000 Vatu
Plastic casing (120 m x 150-mm)	90 000
Travel	30 000
Freight, etc.	20 000
	332 000 Vatu

or about $A4000

CONCLUSIONS

The school's water supply requirements can be met by two bores on the site. These could be drilled by an experienced rural water supply team of the Vanuatu Government, at a cost of 332 000 Vatu ($A4000).

REFERENCES

DEPARTMENT OF HOUSING & CONSTRUCTION, 1980 - Santo secondary school, Republic of Vanuatu, appraisal study. Report for Australian Development Assistance Bureau.

JACOBSON, G. & HILL, P.J., 1980 - Hydrogeology of a raised coral atoll - Niue Island, South Pacific Ocean. <u>BMR Journal of Australian Geology & Geophysics, 5, 271-8</u>.

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TABLE 1

CHEMICAL ANALYSES OF WATERS

	Groundwater beneath limestone plateau Niue Island*	Matafou Spring Low tide 2/2/81	Boudoure Spring Tide ebbing 2/2/81
Calcium	44	40	30
Magnesium	9	33	21
Sodium	6	250	150
Potassium	2	8	5
Bicarbonate	163	331	271
Sulphate	4	81	45
Chloride	10	440	272
Total Dissolved Solids	179	-	-
Total hardness	149	163	107
Total alkalinity	134	271	215
Electrical conductivity	321	2050	1300
pH	7.7	7.2	7.5

Analyses in mg/L; electrical conductivity in microsiemens per centimetre

*Jacobson & Hill, 1980

APPENDIX I

Itinerary, G. Jacobson, Field trip to Vanuatu

28 Jan	Canberra-Noumea.
29 Jan	Noumea-Port Vila. Meetings Australian High Commission, Education Dept (W. Romanas), Mines Dept (J. Laurent). Inspected Mines Dept drilling capability, and obtained Geological Survey information.
30 Jan	Port Vila-Esperitu Santo. Field work on Santo.
31 Jan-3 Feb	Field work, Santo school site. Inspected Santo water supply, drilling rig, and bores in the area.
4 Feb	Inspected school site with H. Coles of A.D.A.B., and the District Education Officer (K. Nial). Santo-Port Vila.
5 Feb	Port Vila-Canberra.