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UNDERGROUND WATER SUPPLIES ON FLINDERS AND CAPE BARREN ISLANDS

Introduction

The question of underground water supplies for Flinders Island has occupied the attention of officers of the Mines Department occasionally since 1930 when the first investigation was carried out by P.B. Nye, then Government Geologist. At that time, Nye recommended that certain boring be done to test theories advanced to and by him relative to underground water supplies at Wingaroo in the Five Mile Lagoon area. These bores were put down and Nye's report of January 1931, embodies conclusions relative to supplies and quality of water then obtained. Several minor investigations have since been carried out both on Flinders Island and on Cape Barren Island.

There is no reason to doubt that adequate supplies of water are available over the greater part of Flinders Island and parts of Cape Barren Island, but the quality of the water is found to vary with seasonal changes and the positions from which it is drawn.

Location and Access

Flinders Island and Cape Barron Island are the two largest islands of the Furneaux Group. They are situated immediately to the north of the north-eastern corner of the mainland of Tasmania, from which the nearest point on Cape Barron Island is distant about 20 miles. The islands together extend in a general northerly direction a distance of approximately sixty miles with a maximum width of 26 miles on Cape Barron Island and a slightly lesser width about the middle of Flinders Island. Together they have an area of 623,000 acres of which Flinders Island covers 513,000 and Cape Barron Island covers 110,000 acres.

Communication with the mainland of Tasmania is maintained in a bi-weekly aerial service by Australian National Airways from Launceston, whose 'planes arrive and depart at Whitemark each Monday and Friday. The same company provides an aerial freight service as required. Sea communication is maintained by the Auxiliary Motor Vessel Loatta which maintains an irregular service between Launceston and Whitemark, and by the Ketch Shearwater which trades between Hobart and Whitemark and occasionally to Launceston. The sailing of both vessels is governed by weather conditions which, as far as Flinders Island is concerned, are most unreliable.

Topography

Flinders Island. There are few topographical features on Flinders Island to break the general low relief which characterises it. In the south-western portion of the Island the highest mountains, Strzlecki Peaks, rise to a height of 2,550 feet above sea level. With Mt. Razorback, 2,250 feet, and Mt. Belstead, this group of mountains forms an area whose high relief is exaggerated when compared with the extensive plain country bordering its eastern flank. The main drainage from the area is effected by Samphire Creek flowing to the south-east to enter Adelaide Bay and by Reddins Creek which flows southerly into Franklin Sound.

The Darling Range is situated to the east of Whitemark, its main features beings Mts.Leventhorpe, Counsel and Pillingers Peaks. This range and its north-westerly extension, the Broughton Sugar Loaf, and Mt Arthur, forms a central area of high relief whose drainage is effected by Pats River and its tributaries which flow westerly into Parry's Bay.

The relief of the north-western portion of the Island is formed by the group of mountains Killicrankie, Blyth, Boyes and Tanner, whose highest peak, Killicrankie, rises to 1,035 feet.

The area of high relief would not exceed one third of the total area of the Island, which in general is characterised by extensive flats on which are developed numerous swamps and lagoons. Typical of these flats is the eastern side of the Island where, except for the occurrence of the comparatively low hills known as the Patriarchs, the flats extend for the full length of the Island and have a width of several miles to extend easterly to the foothills of the Darling Range.

Cape Barron Island. The general relief of Cape Barron Island is much higher than is the case with Flinders Island. The highest mountain is Mt. Munro, 2,348 feet, which with Double Peak, 1,679 feet, forms the main features of the topography of the north-western portion of the Island. The central portion of the Island is generally fairly rugged without any prominent features whilst the eastern portion is characterised by a chain of hills trending more or less northerly with Mt. Kerford, 1,644 feet, and Hogan Hill at the southern extremity.

Several rivers of appreciable length occur on Cape Barron Island. The Modder River rising in Mt. Munro flows generally south-westerly to Thunder and Lightning Bay. Rooks River also rises in Mt Munro to flow northerly to enter Deep Bay. The central hills give rise to Dover River which flows northerly and to Rice River which flows southerly into Kent Bay.

The areas of low relief are in the main associated with the river system and so in Rice River and the streams to the east small areas of flat land occur. The south-western section of the Island provides the greatest area of low relief where a comparatively narrow strip of plain flanks the western and southern slopes of the hill system.

Geology

The oldest rocks in the Furneaux group of Islands are granites of Palaeozoic age. These rocks form the chief topographical features and in general constitute the greatest part of the hills and mountains. Less extensive and in places flanking the granite hills but also themselves forming portion of the mountain system is a series of quartzites and slates of Silurian age.

Tertiary sediments consisting of limestones and sandstones with intermediate facies occupy the greater part of Flinders Island and a fairly extensive area of Cape Barron Island. These sediments occur generally as flat or slightly undulating country, often swampy, and on which numerous lagoons occur but which at times reach altitudes of 100 feet or more.

Upper Tertiary sediments, granitic in nature and often tin-bearing, occur at many points throughout the Islands and it is from these sediments that the tin ore is produced.

Underground Water Supply

The underground water supply of Flinders and Cape Barron Islands will be derived mainly from the Tertiary sediment. To a lesser extent the older rocks by weathering may yield sediments in sufficient quantity to act as aquifer beds and so become productive of water. There is little doubt that supplies of water in sufficient quantity for all agricultural purposes can be won from the Tertiary sediments, for over the greater portion of the area on which they occur the water table is at surface level and swamps and lagoons are common features. Extensive areas on Flinders Island have been drained to render them suitable for agriculture and grazing and where this has been done the water table has been lowered only to the depth of the bottom of the drains which now appear as running streams. In one instance the drainage of lagoons affected the water supply so that shallow surface wells yielded insufficient water for stock purposes and boring was resorted to. Adequate supplies were won at that position from comparatively shallow depths. The boring was carried out in 1931 under the supervision of Mr. P.B. Nye, then Government Geologist. Sections of the strata passed through by boring in 1931 show :-

Feet	
0 - 1	Sandy Soil.

1 - 4	Brownish clay
4 - 5	Black clay with white calcareous nodules.
5 - 6.5	Brown Sand
6.5 - 8	Yellowish-brown sandy clay (with one piece of sea-shell).
8 - 12	Calcareous clay giving place to white earthy limestone
12 - 13	Dark clayey sand
13 - 18	Dark sandy clay with calcareous nodules
18 - 22	Clay and sand
22 - 23	Clay
23 - 24	Sand
24 - 27	Sandy becoming coarser with quartz pebbles up to $\frac{1}{8}$" diameter
27 - 29.5	Gravel with pebbles up to $\frac{1}{8}$"
29.5 - 31	Clay and sandy clay
31 - 33	Fine greyish-green sand. Consists of fine quartz grains and darker minerals and small broken pieces of sea shell.

Mr. Nye comments that - "The only section of strata below the fine sand is that given in the No. 1 bore-hole. The fine sand was passed through and then alternating beds of fine sand and coarse sand containing almost perfect sea shells were passed through to a depth of 78 to 80 feet. Between 65 and 68 feet there was a bed of compact fine white sand".

The foregoing section had been quoted as a guide to the type of strata to be expected in any future boring. It is not anticipated that any great amount of boring will be undertaken for the numerous shallow wells already constructed appear to more than satisfy the present demands and should the demand appreciably increase then additional shallow wells could be sunk.

In the event of large scale drainage operations being carried out in furtherance of an extended agricultural project, it is more than probable that shallow wells will suffice but should they fail then boring to slightly greater depths will augment supplies sufficiently.

On those parts of the country where tertiary rocks do not occur the question of underground water supplies is slightly more complex. In the hill country the water supply will depend to a large extent on the nature of the rocks met with and the supplies cannot be expected to be as well assured as on the flats. In areas where granitic rocks occur the possibility of a water supply will depend on the extent to which the rocks have been weathered and the nature of the material produced by weathering. From the numerous gravel pits in the area, opened up for the purpose of road making, it is obvious that the weathered granitic material is fairly porous and is suitable as an aquifer. In such areas, therefore, the quantity of water available will depend on the area of decomposition and the depth to which decomposition has proceeded.

In 1945 the then Government Geologist, Dr. S.W. Carey, selected a well site for the school at Whitemark. The site for this well was on the slope of a granitic hill and was dependent on the decomposed granitic material as the aquifer. Dr. Carey then insisted that the well be carried to bedrock for, in general, the water will percolate to bedrock if other than saturated conditions prevail.

During the present investigation a number of samples of water were taken in an endeavour to have water representative of the whole Island. The samples were taken from creeks or existing wells and bores and at the end of a period of dry weather which had lasted for upwards of four weeks. It is known that some of the waters deteriorate in dry weather and water which is quite palatable during wet weather becomes unpalatable after dry weather, even though it is such that use may be made of it in an emergency.

It may be stated, therefore, that the water as sampled was in its worst condition and a normal season would be much better than the analyses suggest.

A series of ten samples were taken and forwarded to the laboratory at the Mines Department. in Launceston where the analyses were carried out. The sample numbers and the position from which the samples were taken are as follows :-

No. 1 The well of the Interstate Hotel at Whitemark. This water is used for bathing and septic tank purposes and in a normal season is used generally for domestic purposes.

No. 2 Taken from No. 2 Bore at Wingaroo cattle station in the Five Mile Lagoon area. The water is used generally for cleaning and stock purposes and is used on the gardens. There was a slight smell of sulphuretted hydrogen but the water was not unpalatable.

No. 3 From a well on the block owned by R.H. Blyth of an area of 486 acres 2 roods 19 perches on the main Whitemark to Palana Road, and about one mile north from the road turn-off to the Five Mile Lagoon area. The water is used for stock purposes.

No. 4 From a well on the 931 acres 0 rood 27 perches block of A. Stackhouse on the main Whitemark-Palana Road. The water is used for stock and domestic purposes.

No. 5 From a well at the Blue Rocks township. The well is situated in the corner of a 50 acre block in the name of G. Hammond. The water is used for domestic and stock purposes.

No. 6 From the well of the butter factory at Whitemark. The water is used generally at the factory and for the washing of the butter.

No. 7 From a deep well on Martin's property at the junction of the road from Whitemark to Lady Barron with the road to Trousers Point. The water level is here 45 feet from surface.

No. 8 From a well which supplies the fish cannery at Lady Barron. The well is situated about three - quarters of a mile from the township on the Whitemark Road.

No. 9 From Malinga Creek which crosses the Whitemark - Lady Barron Road about two and a half miles from Whitemark.

No. 10 From a well on L.C. Bailey's property of 138 acres 1 rood 11 perches about one mile from Whitemark.

With the exception of the bore at Wingaroo, No. 2 sample, and the well on Martin's property, No. 7 sample, all the samples were taken from levels only a few feet below the ground. The water level at the well on Martin's property was 45 feet below ground level whilst the bore at Wingaroo was reputed as 78 feet deep.

A table has been prepared to show the analyses of the samples, the result being recorded as both parts per million and as grains per gallon. In that table is also shown the assumed composition of the salts in solution, the hardness of the water as calculated by a method described later, and also the factor "S" calculated to show the suitability of the water for purposes of irrigation.

Quality of Water

In any general discussion on the quality of water, many factors must be considered. Usually water is good or bad according to whether or not it is suitable for the particular purpose of the individual requiring it and what may be good water for one may be useless for another person's requirements.

It has been the custom to refer to water as being either fresh, brackish or salt, but these terms are too indefinite as a basis of comparison between waters from differant districts. It has also been customary to refer to water as being either hard or soft. Again these terms are indefinite unless some method of establishing degrees of hardness is instituted.

In the absence of data based on Tasmanian conditions, reference has been made to work done by others in the mainland States of Australia. Although it is anticipated that water of lower grade could be successfully used in

Tasmania owing to a higher average rainfall than that enjoyed by either South Australia or Western Australia, the data gathered there should serve as a useful guide to the quality of water and the purposes to which it could be placed in Tasmania.

In the transactions of the Australasian Association for the Advancement of Science at its Perth meeting in 1926, Dr. E.S. Simpson, D.Sc., B.E., A.A.C.I., published a paper on "Problems of Water Supply in Western Australia".

In 1946, the Geological Survey Department of South Australia published its Bulletin No. 23 entitled "The Occurrence, Composition, Testing and Utilisation of Underground Water in South Australia", and the search for further supplies by L. Keith Ward, I.S.O., B.A. B.E., D.Sc. Both these writers have referred to other published works to which further reference can be made.

The following quotation is an extract from Bulletin No. 23 of the Geological Survey of South Australia:
"Chemical Analyses:

Many chemists exhibit a preference for the statement of results in parts per 100,000 or in parts per million. The latter can readily convert the figures showing grains per Imperial gallon into those for parts for 100,000 by multiplying the number of grains by 10 and dividing the product by 7. Since there are 7,000 grains in one pound avoirdupois, and oneImperial gallon weighs 10 lbs., figures for grains per Imperial gallon are equal to the number of parts per 70,000. The ounce, avoirdupois, contains 437.5 grains.

The following table is provided to enable results to be converted readily from one mode of expression to another :-

Unit	Grains per Imperial Gallon	Grains per U.S. gallon	Parts per 100,000	Parts per million
1 grain per Imperial gallon	1.00	0.835	1.43	14.3
1 grain per U.S. gallon	1.20	1.000	1.71	17.1
1 part per 100,000	0.70	0.583	1.00	10.0
1 part per million	0.07	0.058	0.10	1.0

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(1) Method of Calculating and Showing Composition in Water Analyses.

In the analytical tables it is the practice to set out separately the result obtained, in two forms - the ions and radicles, and combinations of the acids and bases according to an order of preference that is to some degress arbitary ...... All the results obtained by the consistent use of this method are strictly comparable among themselves .... The procedure is as follows :-

The calcium, Ca, is first calculated to the carbonate, $CaCO_3$. If there is any excess of calcium it is assigned to the sulphate, $CaSO_4$ and the remaining calcium, if any, is calculated to the chloride, $CaCl_2$.

The magnesium is first calculated to the carbonate, $MgCO_3$ (if the CO_3 is in excess of that required by the calcium). The excess of magnesium is assigned to the sulphate, $MgSO_4$; and any magnesium remaining to the chloride, $MgCl_2$.

Any excess of carbonate, CO_3, sulphate, SO_4 and/or chloride, Cl, and also nitrate, NO_3, are then calculated to the sodium salts...........

Thus it is seen that the acid radicles are allotted in the following orders of preference :

Carbonate, CO_3	-	(Iron), Calcium Magnesium, Sodium (Potassium).
Sulphate, SO_4	-	(Iron and Aluminium), Calcium Magnesium, Sodium, (Potassium)
Chloride, Cl	-	Calcium, Magnesium, Sodium (Potassium)
Nitrate, NO_3	-	Sodium, (Potassium).

The samples taken have been listed in the accompanying table according to the above procedures.

(2) Determination of Hardness

Hardness is calculated from the calcium and magnesium salts (.......) shown in the figures obtained for the "assumed composition", and is expressed in degrees, one British degree of hardness representing the equivalent of one grain of calcium carbonate, $CaCO_3$.

This convention requires that the salts of calcium, magnesium, iron and aluminium must be expressed in terms of the equivalent amounts of calcium carbonate, $CaCO_3$. The required factors are given in the following table :-

Ca X 2.497 = the amount equivalent to $CaCO_3$

Mg X 4.115 = " " " " "

Fe X 1.792 = " " " " "

Al X 5.566 = " " " " "

The hardness due to carbonates is termed "temporary hardness" or "carbonate hardness" while that due to sulphates or chlorides is termed "permanent hardness" or non carbonate hardness".

Applying this method of calculating the hardness for samples of water taken from Flinders Island (see table of analyses), it is found that for samples No. 1 and 2, the following figures are obtained :

	No. 1	No. 2
Calcium as carbonate :	18.8 gpg.	36.7 gpg.
Calcium as sulphate :	9.5 gpg.	0.7 gpg.
Magnesium as sulphate :	11.8 gpg.	3.4 gpg.
Magnesium as chloride :	19.9	8.5

The hardness expressed in English degrees would be -

Ca 18.8 X 2.497 =	46.94	36.7 X 2.497 = 91.5
Ca 9.5 X 2.497 =	23.74	0.7 X 2.497 = 1.74
Mg 11.8 X 4.115 =	48.4	3.4 X 4.115 = 13.9
Mg 19.9 X 4.115 =	81.8	8.5 X 4.115 = 35.0
Total	200.88	142.14
of which - Temporary Hardness is	46.94	91.5
Permanent hardness is	153.94	50.65
Hardness due to Calcium is	70.68	93.24
Hardness due to Magnesia is :	130.20	48.9

From the same South Australian Bulletin is quoted the results of research by R.L. Jack, B.E., on the salinity of water to be used for purposes of stock.

Jack concludes that in terms of total solids dissolved in the water :-

Horses, at grass, can use water containing up to 546.875 grains, or 1¼ oz. per gallon ;

Horses, at work, can use water containing up to 437.5 grains, or 1 oz. per gallon;

Cattle can use water containing up to 656.25 grains or 1½ oz. per gallon;

Sheep, on saltbush feed, can use water containing to 875 grains, or 2 oz. per gallon;

Sheep. on grass feed can use water containing up to 1093.75 grains, or 2½ oz. per gallon.

Opinions in the mainland States vary considerably as regards the quantity of total solids permissable for stock purposes.

In Western Australia, Dr. E.S. Simpson states that the following standards have been adopted in that State, the figures in each case being the maxima permissable :-

	Horses.	Cattle	Sheep.
Total salts, grains per gallon	450	700	900
Magnesium, Mg, grains per gallon	18	28	36
Aluminium, Al, grains per gallon	0.35	0.5	0.7
Iron, Fe, grains per gallon	0.07	0.07	0.07
Nitric Nitrogen, grains per gallon	1.5	2.0	3.0

pH value in all cases should lie between 5.5 and 8.6

In New South Wales the following conclusions have been reached by H.H. Dare in water conservation in Australia;

Horses will thrive on water containing 400 grains of salt, NaCl, per gallon, and 550 grains of total solids per gallon and if they are not working can be kept alive on water with 950 grains of total solids per gallon. They have lived on water with 1,022 grains of total solids per gallon for three months without ill effects.

Cattle will thrive on water with 800 grains of salt, NaCl, or 1,000 grains of total solids per gallon, but are injuriously affected with the salinity rises to 970 grains of NaCl or 1,300 grains of total solids per gallon.

Sheep will thrive on water with 800 grains of salt, NaCl, and will do well even up to 1.197 grains of NcCl, and 1.350 grains of total solids per gallon. They are injuriously affected when the concentration reaches 1,277 grains of NaCl or 1,868 grains of total solids per gallon.

The upper limits quoted in this statement are considered to be higher than South Australian pastoralists would accept.

The results of a systematic examination carried out in Oklahoma, U.S.A., by V.G. Hiller have been set out by W.J. Spafford, Director of Agriculture, in Bulletin 369 of the South Australian Department of Agriculture. The conclusions reached by this American investigator after six years' work include the following:

(a) All animals are injuriously affected when salinity is exeessive, and the quantity of total soluble salts is the controlling factor. The limits of tolerance depended on the kind of animal, its age, the season of the year, whether in milk production, etc.

(b) Sheep are most resistent than cattle, and cattle more than pigs. Sheep can exist on water with 1,750 grains of sodium chloride per gallon. Cattle, not in milk production, have existed on water with 1,400 grains of sodium chloride per gallon, but 1,050 grains per gallon should be regarded as the upper limit. For lactating animals the limit is lower. When pigs get accustomed to the saline water they are not injured by 700 grains of sodium chloride to the gallon. Young pigs died within 30 days on water with 1,050 grains of sodium chloride to the gallon. As regards poultry, laying hens can tolerate 1,050 grains of sodium chloride per gallon although egg production ceases temporarily when they are first placed on such water; but, when the salinity rises to 1,400 grains per gallon, they cease to lay, lose weight and some die.

Reference to the table of analyses will show that all the samples are of water whose saline contents are well within the limits of tolerance for all animals and sample No. 1, which has the highest content of dissolved solids, shows only 188.6 grains of salts per gallon and this figure is regarded as being within the limits of tolerance of human beings. In actual practice the water represented by No. 1 sample is not palatable. It has a slight saline taste but is in use for drinking purposes.

Water used for Irrigation

It has to be remembered that plants exhibit marked differences in their tolerance of salts in solution. At one extreme there are such plants as mangroves and samphire which are, of course, not cultivated. Yet asparagus requires abundant salt (NaCl) for its successful cultivation. Of the fodder plants, lucern is tolerant of much more saline matter than most trees, shrubs and edible vegetables. Among the common vegetables, French beans are regarded as the least tolerant.

Again the nature of the soil and the drainage are important, since sandy, well-drained soils permit the use of more saline waters than are suitable for heavy clayey soils. The incidence of rainfall also is important, especially where the soil is heavy since the failure of the normal rains means that the saline matter which accumulates on the surface on the evaporation of the water, does not get washed away.

Provided always that the water does not carry exceptionally high proportions of calcium and magnesium chlorides, sulphates of sodium and magnesium and/or sodium carbonates, the following table shows the limiting figures of total salinity under ordinary conditions of soil character and drainage :-

Plants	Limits of Toleration in grains of total solids per gallon
French beans, lettuce, cucumbers and citrus fruits:	65 - 70
Tomatoes under glass:	70
Flowers and shrubs:	75
Fruit trees generally:	75 - 80
Most vegetables:	80
Root growths, including potatoes	90
Almond trees:	100
Lucerne:	210

Under the heading "Irrigation", Dr. E.S. Simpson in "Problems of Water Supply in Western Australia" quotes :-

"The problem is complicated by considerations of rainfall, drainage, and the varying toxicity of different salts. In the first place an analysis having been stated in terms of common salts by the usual method, all $CaCO_3$, $MgCO_3$, $CaSO_4$, KCl, and $NaNO_3$, or KNO_3 should be cut out, as in the small proportions in which they are present they are beneficial and not injurious. From the remaining salts we build up a factor, "S", from the following formula :

$$S = NaCl + NaSO_4 + 2CaCl_2 + 2MgCl_2 + 2MgSO_4 + 3NaCO_3$$

all being expressed in parts per million.

If "S" is less than 500, the water is considered excellent on any type of soil with high or low rainfall.

If "S" is between 500 and 1,000 the water is good for irrigation on loose soil or well-drained heavy soil with fair rainfall (not less than 15 ins.)

If"S" is between 1,000 and 1,500 the water can only be used on well-drained light to medium soils with high rainfall.

If "S" is above 1,500 the water is probably valueless for irrigation.

In addition to the above factors, a water is condemned for irrigation if its hydrogen ion concentration does not lie between 6.2 and 8.2, this figure being measured,

ANALYSES - FLINDERS ISLAND WATER - 1949

SHOWING ANALYSES, ASSUMED COMPOSITION, HARDNESS AND IRRIGATION FACTOR-S

Sample Number.	1.		2.		3.		4.		5.		6.		7.		8.	
	p.p.m.	g.p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g.
Tot.dis. Solids.	2697.0	188.6	1659.0	116.0	1417.0	99.0	1657.0	116.0	957.0	66.9	1093.0	77.7	700.0	48.9	412.0	28.5
Ions & Radicles SiO_2	14.0	1.0	35.0	2.4	11.3	0.79	8.7	0.50	31.0	2.1	17.0	1.2	16.0	1.1	11.0	0.79
Fe_2O_3 & Al_2O_3	4.0	0.27	3.3	0.23	2.7	0.18	2.0	0.13	14.0	1.0	3.0	0.21	5.0	0.34	4.0	0.27
Ca.	148.0	10.3	213.0	14.8	107.0	7.4	140.0	9.7	42.0	2.9	92.0	6.4	86.0	6.0	4.0	0.27
Mg	106.0	7.4	41.0	2.8	48.0	3.3	41.0	2.8	32.0	2.2	30.0	2.1	17.0	1.1	12.0	0.83
(calc) Na.	614.0	42.9	304.0	21.3	353.0	24.6	397.0	27.7	263.0	18.3	274.0	19.1	145.0	10.1	78.0	5.4
Cl.	1154.0	80.7	559.0	39.0	524.0	36.6	657.0	45.9	346.0	24.1	284.0	19.8	192.0	13.4	156.0	10.9
SO_4	233.0.	16.2	46.1	3.2	64.5	4.5	113.0	7.8	53.0	3.7	99.0	6.9	42.0	2.9	9.9	0.6
(calc) CO_3	162.0	11.3	315.0	22.0	257.0	18.0	203.0	14.1	160.0	11.1	282.0	19.7	171.0	11.9	Nil	Nil
Assumed Composit-ion.																
$CaCO_3$	270.0	18.8	525.0	36.7	268.0	18.7	238.0	16.6	105.0	7.3	230.0	16.0	215.0	15.0	-	-
$CaSO_4$	137.0	9.5	10.2	0.7	-	-	17.0	1.1	-	-	-	-	-	-	13.6	0.9
$MgCO_3$	-	-	-	-	135.0	9.4	-	-	112.0	7.8	105.0	7.3	59.0	4.0	-	-
$MgSO_4$	170.0	11.8	49.0	3.4	45.0	3.1	120.0	8.3	-	-	-	-	-	-	-	-
$MgCl_2$	285.0	19.9	1230.0	8.5	-	-	67.0	4.6	-	-	-	-	-	-	47.0	3.2
Na_2CO_3	-	-	-	-	-	-	-	-	30.0	2.0	122.0	8.5	-	-	-	-
Na_2SO_4	-	-	-	-	42.0	2.9	-	-	78.0	5.4	146.0	10.2	62.0	4.3	-	-
NaCl	1560.0	109.0	757.0	52.9	863.0	60.3	1005.0	70.2	567.0	39.6	443.0	30.9	316.0	22.0	200.0	13.9
pH	8.0	-	7.6	-	7.9	-	8.0	-	7.9	-	7.8	-	8.4	-	4.1	-
HARDNESS																
TOTAL	200.88		142.14		97.5		96.9		50.05		70.25		53.8		15.46	
TEMPORARY	46.94		91.5		84.8		41.3		50.05		70.25		53.8		-	
PERMANENT	153.94		50.64		12.7		55.6		-		-		-		15.46	
DUETO Ca.	70.66		93.24		46.5		44.0		18.2		39.95		37.4		2.24	
DUETO Mg.	130.20		48.9		51.0		52.9		31.85		30.3		16.4		13.2	
IRRIGATION FACTOR. S.	2,370		1,101		1,249		1,379		735		955		378		294	

NOTE: p.p.m. Parts per million.

g.p.g. Grains per gallon.

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SHOWING ANALYSES, ASSUMED COMPOSITION, HARDNESS AND IRRIGATION FACTORS

	2.		3.		4.		5.		6.		7.		8.		9.		10.	
p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g.	p.p.m.	g.p.g
8.6	1659.0	116.0	1417.0	99.0	1657.0	116.0	957.0	66.9	1093.0	77.7	700.0	48.9	412.0	28.5	2629.0	113.9	645.0	45.1
1.0	35.0	2.4	11.3	0.79	8.7	0.50	31.0	2.1	17.0	1.2	16.0	1.1	11.0	0.79	16.0	1.1	20.0	1.3
0.27	3.3	0.23	2.7	0.18	2.0	0.13	14.0	1.0	3.0	0.21	5.0	0.34	4.0	0.27	3.0	0.21	3.0	0.21
0.3	213.0	14.8	107.0	7.4	140.0	9.7	42.0	2.9	92.0	6.4	86.0	6.0	4.0	0.27	165.0	11.5	63.0	4.4
7.4	41.0	2.8	48.0	3.3	41.0	2.8	32.0	2.2	30.0	2.1	17.0	1.1	12.0	0.83	82.0	5.7	14.0	1.0
2.9	304.0	21.3	353.0	24.6	397.0	27.7	263.0	18.3	274.0	19.1	145.0	10.1	78.0	5.4	654.0	45.7	149.0	10.4
0.7	559.0	39.0	524.0	36.6	657.0	45.9	346.0	24.1	284.0	19.8	192.0	13.4	156.0	10.9	1172.0	81.2	163.0	11.3
6.2	46.1	3.2	64.5	4.5	113.0	7.8	53.0	3.7	99.0	6.9	42.0	2.9	9.9	0.6	174.0	12.1	64.0	4.4
1.3	315.0	22.0	257.0	18.0	203.0	14.1	160.0	11.1	282.0	19.7	171.0	11.9	Nil	Nil	202.0	14.1	145.0	10.1
8.8	525.0	36.7	268.0	18.7	238.0	16.6	105.0	7.3	230.0	16.0	215.0	15.0	-	-	336.0	23.4	158.0	11.0
9.5	10.2	0.7	-	-	17.0	1.1	-	-	-	-	-	-	13.6	0.9	105.0	7.3	-	-
-	-	-	135.0	9.4	-	-	112.0	7.8	105.0	7.3	59.0	4.0	-	-	-	-	49.0	3.4
1.8	49.0	3.4	45.0	3.1	120.0	8.3	-	-	-	-	-	-	-	-	125.0	8.7	-	-
.9	1230.0	8.5	-	-	67.0	4.6	-	-	-	-	-	-	47.0	3.2	224.0	15.6	-	-
-	-	-	-	-	-	-	30.0	2.0	122.0	8.5	-	-	-	-	-	-	27.0	1.8
-	-	-	42.0	2.9	-	-	78.0	5.4	146.0	10.2	62.0	4.3	-	-	-	-	-	-
.0	757.0	52.9	863.0	60.3	1005.0	70.2	567.0	39.6	443.0	30.9	316.0	22.0	200.0	13.9	1660.0	116.0	302.0	21.1
-	7.6	-	7.9	-	8.0	-	7.9	-	7.8	-	8.4	-	4.1	-	8.1	-	7.8	-

2.	3.	4.	5.	6.	7.	8.	9.	10.
142.14	97.5	96.9	50.05	70.25	53.8	15.46	175.1	41.4
91.5	84.8	41.3	50.05	70.25	53.8	-	58.2	41.4
50.64	12.7	55.6	-	-	-	15.46	116.9	
93.24	46.5	44.0	18.2	39.95	37.4	2.24	76.45	27.4
48.9	51.0	52.9	31.85	30.3	16.4	13.2	98.7	14.0
1,101	1,249	1,379	735	955	378	294	2,358	329

rts per million.

ains per gallon.

in the case of bore water, 24 hours after escaping from the ground.

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In calculating the figures for "S" for the samples of water taken, it is noticed that in only two instances does the factor for "S" exceed the limit, 1,500, above which water is regarded as unfit for irrigation. Sample 9 was taken from a running stream and was not being used except for stock. Sample No. 1 was used at the hotel but as there was no garden the effects on plant life have not been seen. All the other waters are regarded as fit for irrigation and in several instances are being used for that purpose.

It was reported during this examination that the quality of some of the waters varied directly with the weather conditions and that after rain the water became more palatable. This is the case with the water at the Whitemark Hotel, where in the course of a few weeks the water deteriorated to such an extent that, though still fit for use, it was decidedly unpalatable. This variation in quality would be expected in the shallower wells producing surface water for, after rains, the aquifer beds would be saturated and the average salt content would be comparatively low. With the deeper wells and the bores the conditions are slightly different for the aquifer beds are generally saturated and the dissolved salt content would remain more or less constant and any variation would take an extended time to appear and would depend on the amount of water drawn off.

The bore from which Sample No. 2 was taken was put down in 1930. A sample of water taken in 1930 was analysed with the following result which is here compared with the recent analysis :-

	1930	1949
Total Solids	4532.0 ppm.	2697.0 ppm.
SiO_2	28.0	14.0
Fe	4.2	4.0
Al	83.6	
Ca	270.0	148.0
Mg	108.3	106.0
Na	1090.1	614.0
Cl	1884.8	1154.0
SO_4	246.9	233.0
CO_3	344.8	162.0
H_2S	9.82	
Volatile	295.2	
Assumed Composition:		
$CaCO_3$	575	270
$CaSO_4$	136	137
$MgSO_4$	189	170
$MgCl_2$	277	285
NaCl	2780	1560

Note :- This appears to be analysis of Hotel Bore [illegible]

These analyses show that over a period of years the quality of the water has improved to such an extent that where in 1930 the water was hardly fit for the purposes of stock raising, it is now of a quality suitable for general purposes and is being used for irrigation of the home gardens.

It has, therefore, been concluded that there is available on Flinders Island an underground supply of water adequate for all present requirements. The water supply is well distributed over the Island, where, except for the higher granitic hills, the country is, in general, water logged necessitating, in many places, artificial drainage to enable agriculture to proceed. Most of the wells are shallow but a few deeper wells and bores have shown the cross section of the strata passed through and have proved that deeper wells are also aquifers from which water can be drawn. The analyses have shown that the quality of the water is moderately good despite the fact that the samples

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were taken at the end of a long, dry period.

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