TR19_110_127

# 14. Hydrology of the Tertiary sediments near Port Sorell.

*W.C. Cromer*

The Department of Mines is currently engaged in a groundwater investigation programme of the Tertiary rocks in the Devonport-Sassafras-Port Sorell region, an area of approximately 250 $km^2$. The Latrobe Council through their consulting engineers, Gutteridge, Haskins and Davey, requested that the Port Sorell area in particular be studied since the town suffers from summer water shortages. During peak periods, the town uses approximately 1000 $m^3$/day. The council enquired whether sufficient amounts (about 300-600 *l*/min) of groundwater of acceptable quality occurred within economic pumping distance (about 3 km) of the town, or of the trunk main supplying water to it. The trunk main is 200 and 150 mm in diameter, and pipes water from a 23 000 $m^3$ storage reservoir constructed across a small tributary of Appleby Creek, 5 km south-west of the town. Any groundwater encountered along, or near its route, may be pumped into it and used to supplement the surface supply.

## GEOLOGY

A geological map of the area has been prepared by Gee and Legge (1971) and a simplified version of their work is included here (fig.31). Hydrologically, the most important rock unit is the series of interbedded Tertiary gravel, sand, clay and basalt which has been deposited in a deep north-south elongate depression (the Port Sorell Basin) underlain by harder relatively impervious basement rocks. The structure extends from Hawley to Sassafras, and ranges from 3-5 km in width. Jurassic dolerite is probably the predominant basement rock. It crops out at a number of places (fig.31) and its presence beneath the Tertiary cover has been inferred from regional gravity surveys (Leaman, 1973) and encountered during exploratory and water-well drilling in the area. Geological logs of some of these bores have been reported in a number of publications including Burns (1965), Gee and Legge (1974) and Leaman (1973). Descriptions of three deep holes drilled near the council trunk main are listed in Table 1.

The Tertiary sediments are variable in thickness, and their detailed lithology has not yet been established. The rocks are thinnest in the Hawley-Port Sorell area, and along the margins of the basin where they abut against, and in places overlap, the rising basement. They attain a thickness of nearly 350 m in the deeper parts of the basin west of Harford.

In the vicinity of Port Sorell and Hawley the sediments consist predominantly of gravel and sand (Cromer, 1974) but fine clayey sand and clay become increasingly prevalent to the south. Preliminary drilling results (Table 3) south-east of Parkers Ford indicate that the basement rock is fresh dolerite, although pockets of impervious clayey weathering products have developed in places.

The variation in thickness, lithology and lateral extent of favourable hydrological horizons (gravel) in the Tertiary sequences renders difficult the selection of water-bore sites. Surface mapping of these units is complicated by the absence of true exposures and the ubiquitous presence of sandy loam. Detailed geophysical and drilling surveys will alleviate the problem, but the possibility of an unsuccessful water-bore will always exist in such materials.

## SEISMIC SURVEY

A refraction seismic survey was undertaken as part of both the present study and of the regional groundwater programme. Sixteen spreads were fired

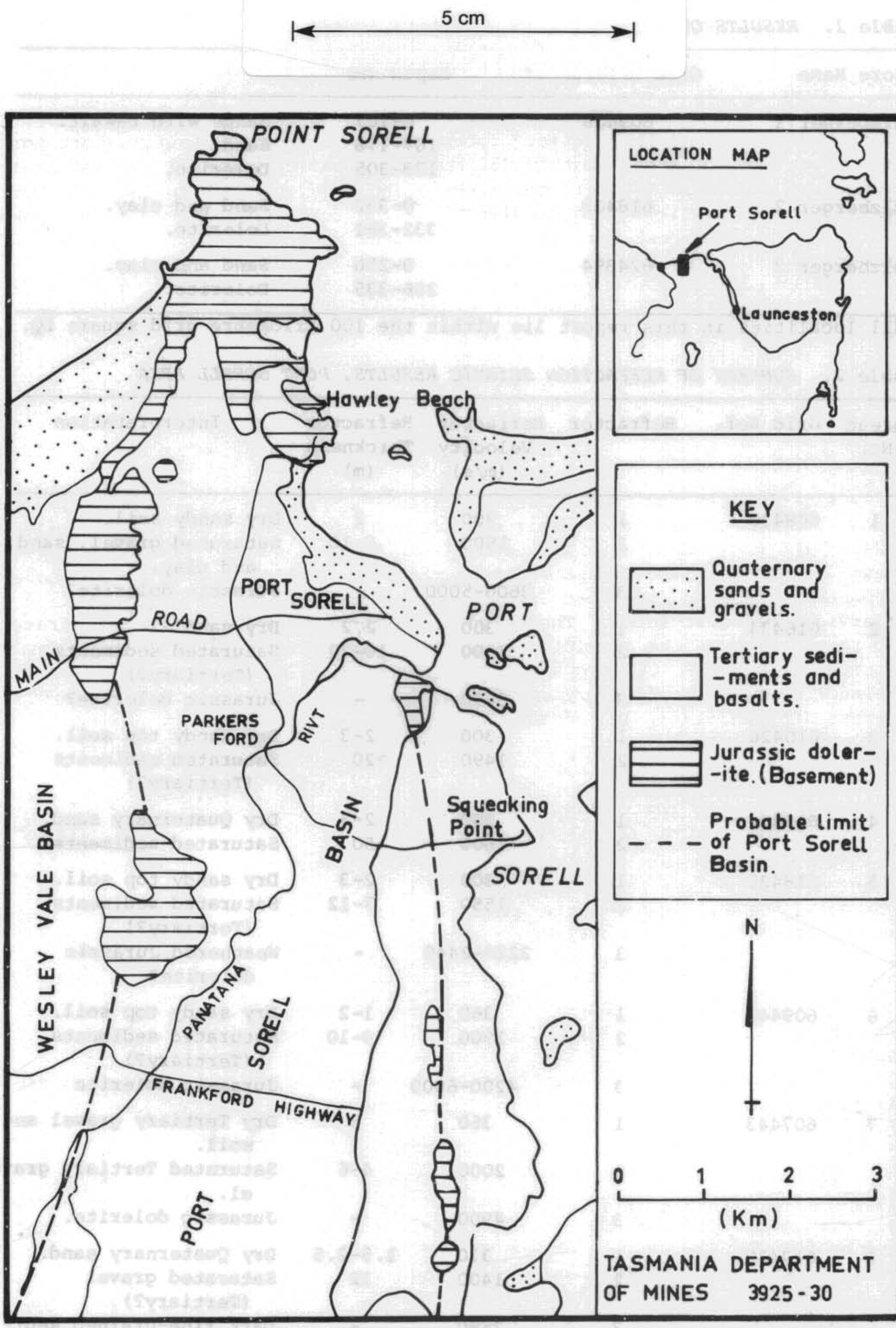



Figure 31. *Geological map of Port Sorell.*

*Table 1. RESULTS OF DEEP DRILLING NEAR PORT SORELL*

| Bore Name | Grid Reference* | Depth (m) | |
|---|---|---|---|
| Sulzberger 1 | 609408 | 0-107 | Sands with basalt. |
| | | 107-178 | Sand. |
| | | 178-305 | Dolerite. |
| Sulzberger 2 | 618400 | 0-332 | Sand and clay. |
| | | 332-381 | Dolerite. |
| Sulzberger 3 | 624394 | 0-256 | Sand and clay. |
| | | 256-335 | Dolerite. |

*All localities in this report lie within the 100 kilometre grid square DQ.

*Table 2. SUMMARY OF REFRACTION SEISMIC RESULTS, PORT SORELL AREA*

| Spread No. | Grid Ref. | Refractor | Refractor Velocity (m/s) | Refractor Thickness (m) | Interpretation |
|---|---|---|---|---|---|
| 1 | 608430 | 1 | 300 | 2 | Dry sandy soil. |
| | | 2 | 1500 | 0-10 | Saturated gravel, sand and clay. |
| | | 3 | 3600-5000 | - | Jurassic dolerite? |
| 2 | 616434 | 1 | 300 | 2.2 | Dry sand. |
| | | 2 | 1500 | 16-20 | Saturated sediments (Tertiary?) |
| | | 3 | 3670 | - | Jurassic dolerite? |
| 3 | 610426 | 1 | 300 | 2-3 | Dry sandy top soil. |
| | | 2 | 1490 | >20 | Saturated sediments (Tertiary?) |
| 4 | 628424 | 1 | 300 | 2-3 | Dry Quaternary sand. |
| | | 2 | 1600 | >50 | Saturated sediments. |
| 5 | 618425 | 1 | 300 | 2-3 | Dry sandy top soil. |
| | | 2 | 1550 | 7-12 | Saturated sediments (Tertiary?) |
| | | 3 | 2220-2440 | - | Weathered Jurassic dolerite? |
| 6 | 609440 | 1 | 360 | 1-2 | Dry sandy top soil. |
| | | 2 | 1900 | 0-10 | Saturated sediments (Tertiary?) |
| | | 3 | 4200-6000 | - | Jurassic dolerite |
| 7 | 607443 | 1 | 360 | 3 | Dry Tertiary gravel and soil. |
| | | 2 | 2000 | 4-6 | Saturated Tertiary gravel. |
| | | 3 | 4900 | - | Jurassic dolerite. |
| 8 | 617429 | 1 | 330 | 1.5-2.5 | Dry Quaternary sand. |
| | | 2 | 1400 | 12 | Saturated gravel (Tertiary?) |
| | | 3 | 2590 | - | Dark fine-grained sediments (Permian?) |
| 9 | 609408 | 1 | 360 | 0-1 | Dry sandy top soil. |
| | | 2 | 1640-(?)1800 | ≥50 | Saturated Tertiary gravel, sand, clay. |
| | | 3? | 2980 | - | Tertiary basalt? |

*Table 2. (continued)*

| Spread No. | Grid Ref. | Refractor | Refractor Velocity (m/s) | Refractor Thickness (m) | Interpretation |
|---|---|---|---|---|---|
| 10 | 617402 | 1 | 370 | 1-2 | Dry sandy top soil. |
| | | 2 | 1580 | ≥40 | Saturated Tertiary sediments. |
| 11 | 626399 | 1 | 350 | 1-2 | Dry sandy top soil. |
| | | 2 | 1670 | ≥50 | Saturated Tertiary sediments. |
| 12 | 595398 | 1 | 360 | 1.5-2 | Dry top soil. |
| | | 2 | 1830 | variable (3-15) | Saturated Tertiary sediments. |
| | | 3 | 4800 | - | Jurassic dolerite. |
| 13 | 588405 | 1 | 360 | 2 | Dry top soil. |
| | | 2 | 1800 | 3.6-6 | Saturated Tertiary sediments. |
| | | 3 | 3800 | - | Tertiary basalt or weathered Jurassic dolerite. |
| 14 | 604386 | 1 | 350 | 1-3? | Dry sand. |
| | | 2 | 1720 | *c.*5? | Tertiary clay and sand. |
| | | 3 | 4200 | - | Jurassic dolerite? |
| 15 | 618392 | 1 | 305 | 0-1 | Dry sandy top soil. |
| | | 2 | 1700 | ≥20 | Saturated Tertiary sediments. |
| | | 3 | 2590 | - | Tertiary basalt? |
| 16 | 626410 | 1 | 360 | 3 | Dry sandy top soil. |
| | | 2 | 1450 | 18-21 | Saturated Tertiary sediments. |
| | | 3 | 5900 | - | Jurassic dolerite |

in and around Port Sorell and Parkers Ford (fig. 32). All were located on sites underlain by Tertiary sediments and were designed to indicate the position of the water table, the thickness of the deposits, and the nature of the basement rocks. Results of part of this survey were reported previously (Cromer, 1974), but all are summarised here (Table 2). Geophone spacings of 7.6 m were employed, and extension and centre shots fired when warranted. Seismic profiles of some of the spreads are presented in Figure 33.

## INTERPRETATION OF SEISMIC RESULTS

Seismic velocities in the region of 350 m/s are indicative of dry sandy top soil conditions above the water table. The position of the latter is probably represented by the interface between refractors 1 and 2 in Table 2. Saturated Tertiary sediments (either sand, clay, gravel or a mixture of any or all of these) are indicated by seismic velocities in the range 1400-1800 m/s and values for harder basement(?) rocks may range from 2500-6000 m/s. The higher end of this range is represented in the Port Sorell area by fresh Jurassic dolerite or Tertiary basalt. The lower values may be produced by the parent rock in various stages of weathering, and in at least one locality* is represented by siliceous fine-grained Permian(?) sediments.

*Beneath the Shearwater Golf Course at 615431.

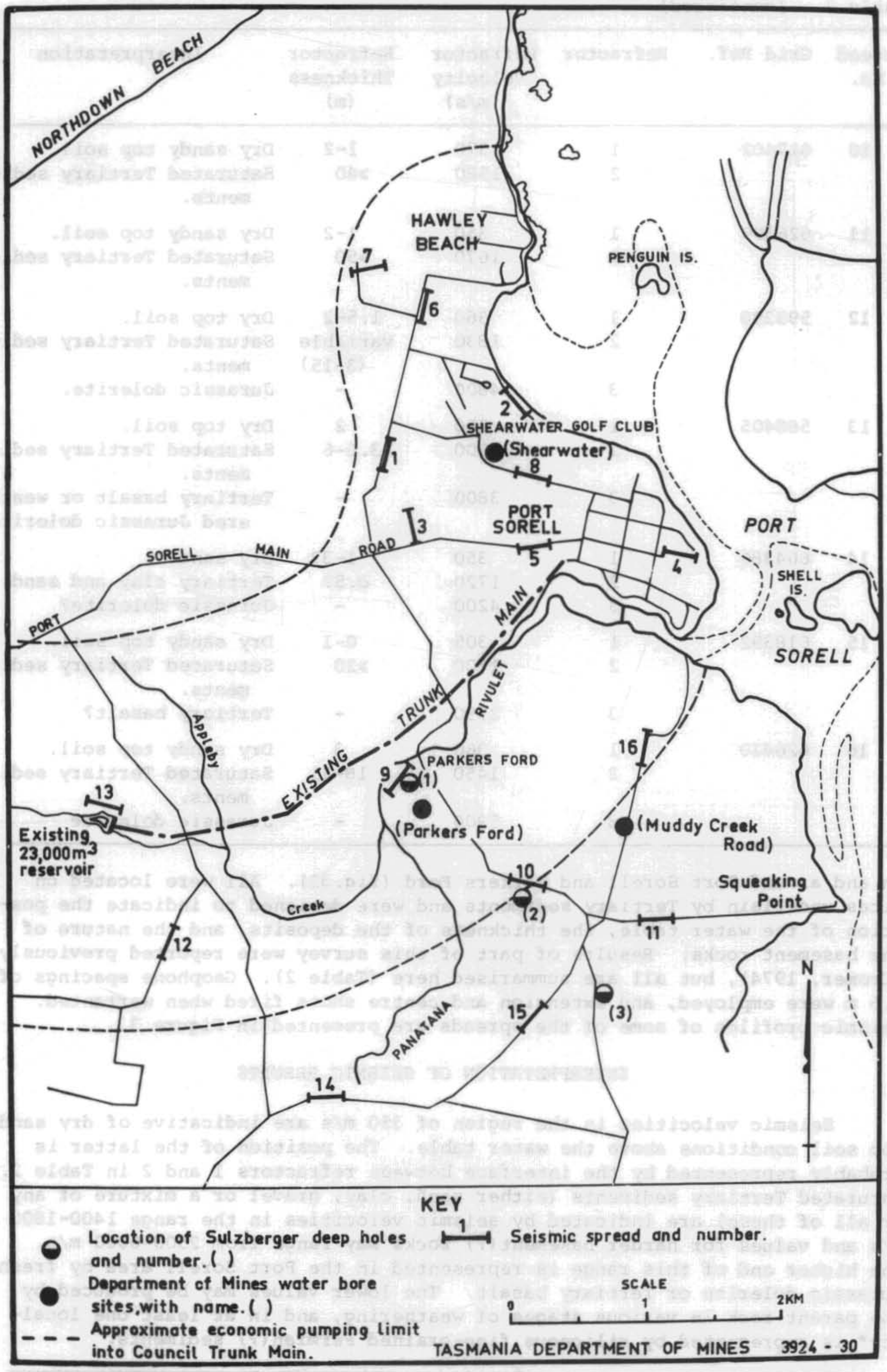



Figure 32. *Locality map, showing locations of seismic spreads.*

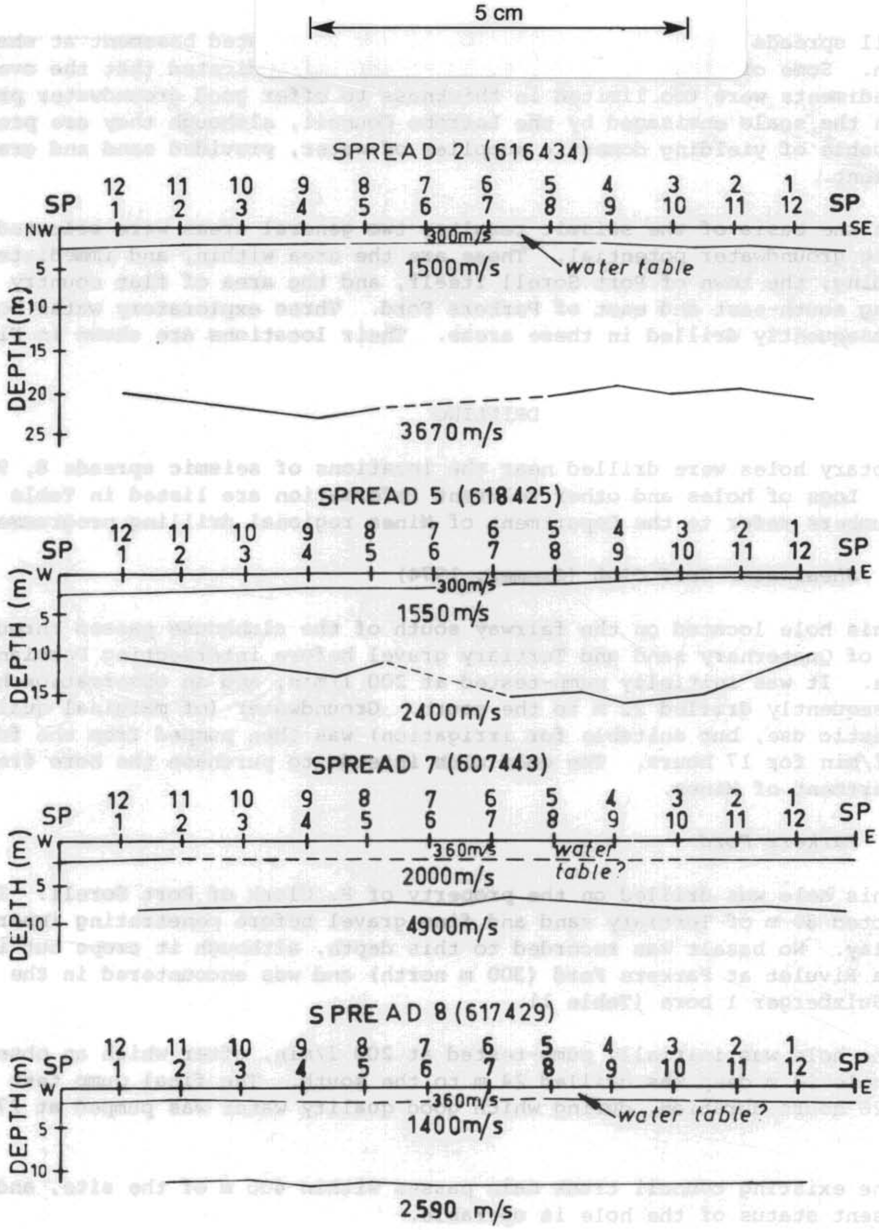



Figure 33. *Seismic profiles at selected sites near Port Sorell.*

All spreads except 3, 4, 9(?), 10, 11 and 15 located basement at shallow depth. Some of these (1, 5(?), 6, 13(?) and 14) indicated that the overlying sediments were too limited in thickness to offer good groundwater prospects on the scale envisaged by the Latrobe Council, although they are probably capable of yielding domestic supplies of water, provided sand and gravel are present.

On the basis of the seismic results, two general areas were selected as having groundwater potential. These are the area within, and immediately surrounding, the town of Port Sorell itself, and the area of flat country extending south-east and east of Parkers Ford. Three exploratory water bores were subsequently drilled in these areas. Their locations are shown in Figure 32.

## DRILLING

Rotary holes were drilled near the locations of seismic spreads 8, 9 and 16. Logs of holes and other relevant information are listed in Table 3. (Bore numbers refer to the Department of Mines regional drilling programme).

*Bore 4. Shearwater Golf Club* (Cromer, 1974)

This hole located on the fairway south of the clubhouse passed through 14-15 m of Quaternary sand and Tertiary gravel before intersecting Permian(?) mudstone. It was initially pump-tested at 200 *l*/min, and an observation hole was subsequently drilled 22 m to the south. Groundwater (of marginal quality for domestic use, but suitable for irrigation) was then pumped from the former at 400 *l*/min for 17 hours. The golf club intends to purchase the bore from the Department of Mines.

*Bore 5. Parkers Ford*

This hole was drilled on the property of P. Clark of Port Sorell. It intersected 30 m of Tertiary sand and fine gravel before penetrating impervious clay. No basalt was recorded to this depth, although it crops out in Panatana Rivulet at Parkers Ford (300 m north) and was encountered in the nearby Sulzberger 1 bore (Table 1).

The hole was initially pump-tested at 200 *l*/min, after which an observation hole 20 m deep was drilled 24 m to the south. The final pump test was of 26 hours duration, during which good quality water was pumped at 270 *l*/min.

The existing council trunk main passes within 400 m of the site, and the present status of the hole is operable.

*Bore 6. Muddy Creek Road*

Three closely spaced bores were drilled on this site. Each passed through fine clayey sand, gravel and clay, and struck fresh dolerite at shallow depth. The holes revealed that the surface of the dolerite was one of considerable relief prior to the deposition of the Tertiary sediments, as the rock was struck at depths ranging from 11-19 m in holes only 30-40 m apart. The two dolerite outcrops some distance to the north and south of the site (fig.31,32) probably represent the surface expression of a buried N-S trending Tertiary fault scarp. Strong gravity gradients (Leaman, 1973) along the line of dolerite outcrops support this view. Drilling to the west of Muddy Creek Road will avoid this shallow dolerite structure and intersect a greater thickness of sediments.

*Table 3. BORE HOLE DATA, PORT SORELL AREA*

| | SHEARWATER GOLF CLUB | PARKERS FORD | MUDDY CREEK ROAD |
|---|---|---|---|
| GRID REFERENCE | 615431 | 611407 | 625405 |
| SITUATION | Level, gently undulating | Level, falls gently north | Level |
| COLLAR ALTITUDE (m, asl) | 7-10 | 20 | *c.* 10 |
| LOG (depths in metres) | 0-0.3 Grey sandy loam.<br>0.3-5.0 Medium-grained Quaternary sand.<br>5.0-14.5 Well rounded Tertiary quartz gravel.<br>14.5- Dark fine-grained siliceous sediments. | 0-0.4 Grey sandy loam.<br>0.4-27.0 Tertiary sand and fine rounded quartz gravel.<br>27.0-39.0 Tertiary clay. | 0-0.2 Top soil.<br>0.2-6.0 Fine clayey Tertiary sand.<br>6.0-9.0 Fine sand.<br>9.0-15.0 Fine rounded gravel, and sand, with some clay.<br>15.0-18.0 Sticky blue-green clay.<br>18.0*- Fresh Jurassic dolerite (basement). |
| DIAMETER (m) | 0.15 | 0.15 | 0.15 |
| CASING (m) | 0-6.0 Solid<br>6.0-14.5 Slotted | 0-9.0 Solid<br>9.0-27.0 Slotted | 0-3.0 Slotted<br>3.0-6.0 Solid<br>6.0-9.0 Slotted<br>9.0-15.0 500 μm Johnson screen<br>15.0-18.0 Solid |
| STATUS | OPERATING | OPERATING | ABANDONED |
| SAFE YIELD (*l*/min) | 300-400 | 200-250 | <10 |

*Depth to basement is extremely variable at site.

Prospects of obtaining groundwater at the site are not good. Fine clayey sand and dense sticky blue-green clay are the predominant rock types, and both are too impermeable to ensure a reliable supply. Water was struck in all three holes, and the water table was in all cases within 0.5 m of the surface. The water quality was good (160 ppm). However, all holes were bailed dry during development, and safe yields are probably in the range 5-15 *l*/min. The site was subsequently abandoned.

## HYDROLOGY

The behaviour of an aquifer under any given set of pumping conditions is determined not only by bore design but also by two fundamental properties of the material: its ability to store and transmit water. The former is described by the *storage coefficient (S)** which is the percentage, by volume, of water which will drain from a unit volume of the material under gravity. Unconfined aquifers containing water under atmospheric pressure have values of $S$ in the range 0.1-0.3 (*i.e.* 10-30%). Confined aquifers, where the water pressure is greater than atmospheric pressure, exhibit $S$ values in the range of $10^{-3}$-$10^{-5}$. For the calculation of the storage coefficient, data from an observation bore must supplement those from the pumped bore.

The ability of an aquifer to transmit water is known as its *transmissivity (T)*, defined as the rate at which water is transmitted through a unit width of the aquifer under a unit hydraulic gradient. It is measured in cubic metres per day per metre, which reduces to square metres per day ($m^2$/day). $T$ can be calculated from observations in a pumped hole alone. Values for Tertiary sediments in Tasmania range widely, from 1-2 $m^2$/day in fine clayey sand, to about 2000 $m^2$/day in coarse clean gravel.

*Bore 4. Shearwater Golf Club* (Cromer, 1974)

*Initial pumping test*

An 18-hour pumping and 5-hour recovery test was conducted on the bore. Total drawdown was approximately 4 m at a pumping rate of 200 *l*/min. The salinity of the water was tested at frequent intervals using a portable meter and the quality remained constant at 700 ppm of total dissolved solids. Two water samples were collected, at the start and end of the pumping period, and the analyses of these are shown in Table 5. The temperature of the water remained constant at 13.4°C. An observation hole was subsequently drilled 21.5 m to the south.

*Final pumping test* (Table 4; fig. 34, 35)

The bore was pumped at 400 *l*/min for 17.25 hours, and drawdown and recovery measurements were taken in both the pumped and observation holes. Total drawdown was 5 m in the former, and 3 m in the latter. Water quality remained constant at 700 ppm, except for a salinity of 900 ppm recorded towards the end of the test. A sample was collected for analysis at the commencement of the pumping period, but a pump failure at 17.25 hours prevented the taking of a second sample. An 8-hour recovery test was conducted on both holes.

*Bore 5. Parkers Ford*

The bore sustained a drawdown of 4.7 m when initially tested at 200 *l*/min for 5 hours. Recovery was measured for 2 hours. In the final test, it was pumped at 270 *l*/min for 26 hours. Drawdown (11 m) and recovery (for

**Specific capacity* is the corresponding term for unconfined aquifers.

6 hours) measurements were recorded in both the pumped and observation holes. Pumping data are summarised in Table 4. Time-drawdown curves of the data in Table 4 are plotted in Figures 34, 35.

Two water samples were collected for analysis (Table 5) and the results are shown diagrammatically in Figure 36.

The temperature of the bore water remained constant at 13.0°C.

## INTERPRETATION OF PUMPING RESULTS

Values of *T* and *S* are calculated from time-drawdown or time-recovery data plotted on semi-logarithmic graph paper (fig. 34, 35). The graphs also have predictive value in that provided no unaccounted boundary conditions exist they enable the radius of influence of the bore, and drawdowns after extended pumping periods, to be calculated.

It is evident from the average *T* (120-160 $m^2$/day) and *S* (*c.* $10^{-4}$) values for the Tertiary gravel that confined or semi-confined aquifer conditions exist. This implies that an impermeable or semi-permeable horizon (probably fine clayey sand, or clay) separates the main water-bearing strata from an overlying perched water table. It has been found difficult to unequivocally establish this fact in the field without the use of geophysical logging techniques, since the rotary drilling method uses mud to support the hole, and thin clayey horizons are thus difficult to identify. Aquifer types must therefore be assumed on the basis of *S* and *T* values. The latter are a function of drawdown during pumping (the greater the drawdown, the smaller the *S* and *T* values) and it is possible that design factors of the bores themselves, as well as aquifer characteristics, have contributed to excessive drawdowns.

Two design factors are considered significant. The 140 mm diameter slotted casing used has less than 1% open area, compared with an open area of 25% for the same diameter Johnson well screen. The small intake area of the casing results in excessively high entrance velocities and a greater than normal head loss and drawdown; and poor distribution of slot openings results in abnormal convergence of water flow near individual openings, producing a marked effect on drawdown and recovery.

It is probable that construction factors, as distinct from design factors, were not a major reason for the low *T* and *S* values: the aquifers were cased to their full depth, and the pump intake settings were the most efficient for the situations. (It was originally intended that the observation bore at Shearwater be used for pumping tests since the lower 6 m of it was cased with 500 μm Johnson well screens. Unfortunately, the latter did not have sufficient internal clearance for the pump used. The efficiency of the pumped hole was estimated from distance-drawdown data to be about 55%.)

A knowledge of the storage coefficient of the aquifer permits an approximate calculation of storage to be calculated. If a catchment area of 2 $km^2$ (a conservative figure) is assumed to extend around the bore at Shearwater, then for an aquifer depth of 10 m and storage coefficient of $10^{-3}$-$10^{-4}$, the sediments contain about 50 000 $m^3$ of accessible water. In the vicinity of Parkers Ford, the sediments are a reservoir for at least 1 000 000 $m^3$. These figures are likely to be conservative, since they fail to account for the influence of bore design factors on the value of the storage coefficients. (These calculations do not include natural recharge figures, which are at present unknown).

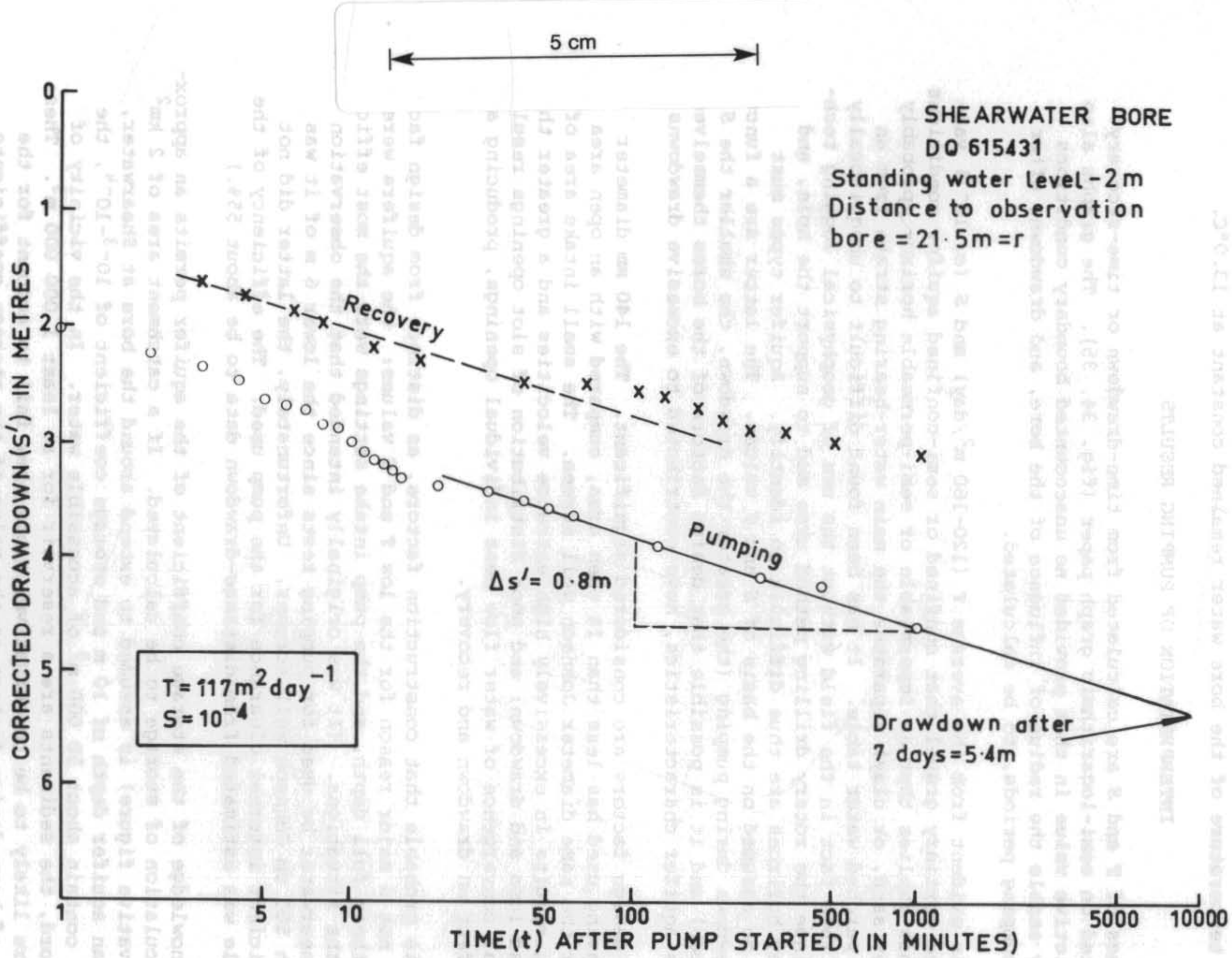



Figure 34. *Time-drawdown and recovery graph. Shearwater bore.*

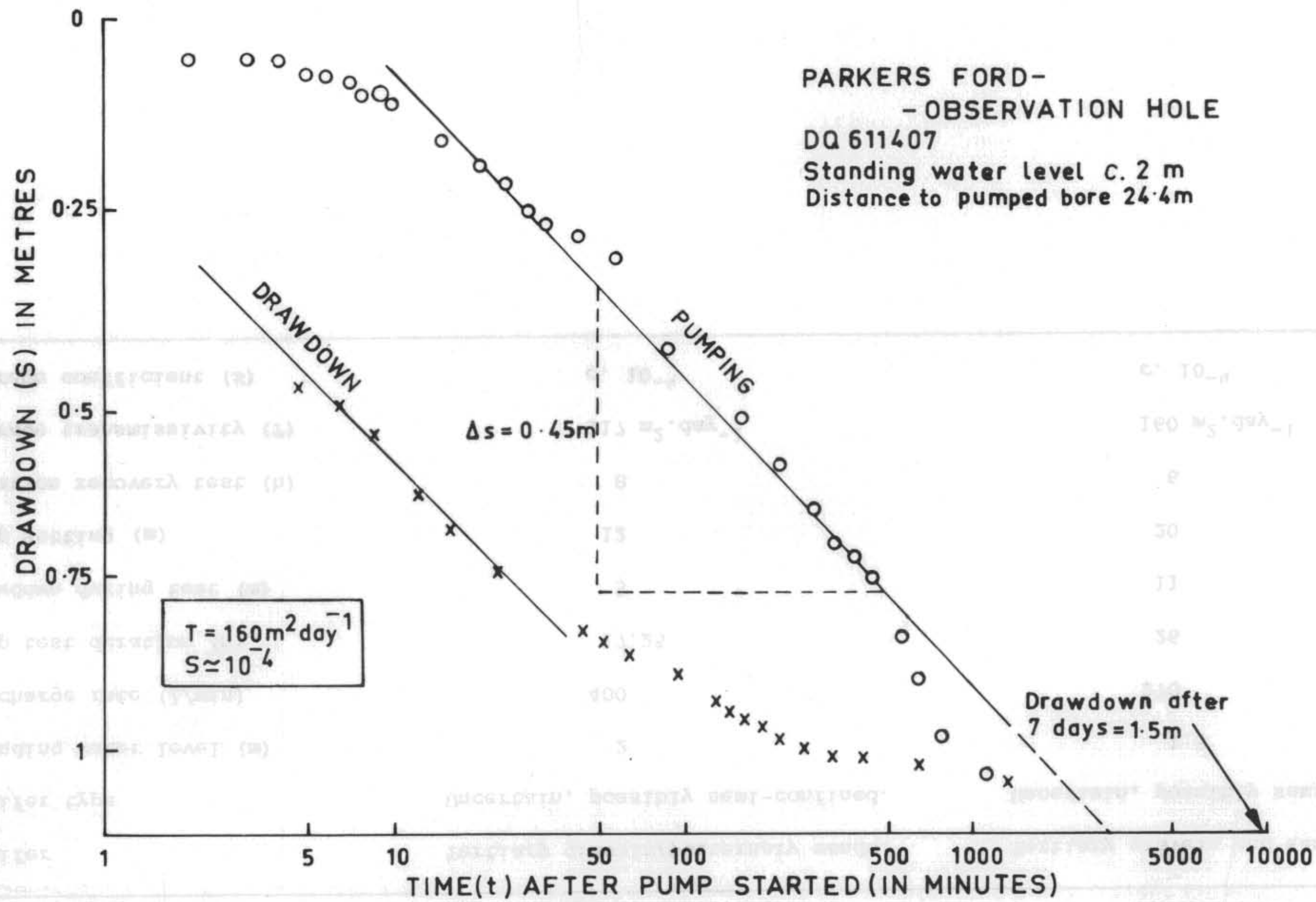



Figure 35. *Time-drawdown and recovery graph, Parkers Ford observation hole.*

5 cm

Table 4. *PUMPING AND RECOVERY TEST DATA, PORT SORELL AREA*

| Bore name | SHEARWATER GOLF CLUB | PARKERS FORD |
|---|---|---|
| Aquifer | Tertiary gravels/Quaternary sands. | Tertiary gravels and sand. |
| Aquifer type | Uncertain, possibly semi-confined. | Uncertain, possibly semi-confined. |
| Standing water level (m) | 2 | 1.5 |
| Discharge rate (*l*/min) | 400 | 270 |
| Pump test duration (h) | 17.25 | 26 |
| Drawdown during test (m) | 5 | 11 |
| Pump setting (m) | 12 | 20 |
| Duration recovery test (h) | 8 | 6 |
| Average transmissivity (*T*) | 117 $m^2.day^{-1}$ | 160 $m^2.day^{-1}$ |
| Storage coefficient (*S*) | *c.* $10^{-4}$ | *c.* $10^{-4}$ |

*Table 5. CHEMICAL ANALYSES* OF GROUNDWATER FROM PORT SORELL AREA.*

| CONSTITUENT | | 742039† | | 742038 | | 742106 | | 742243 | | 742244 | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | mg/l | meq/l | mg/l | meq/l | mg/l | meq/l | mg/l | meq/l | mg/l | meq/l |
| Silica | ($SiO_2$) | 10 | - | 13 | - | 13 | - | 20 | - | 20 | - |
| Iron | (Fe) | <0.1 | 0.0 | <0.1 | 0.0 | 0.5 | 0.02 | 0.7 | 0.02 | 0.3 | 0.01 |
| Calcium | (Ca) | 50 | 2.5 | 43 | 2.15 | 43 | 2.15 | 23 | 1.15 | 23 | 1.15 |
| Magnesium | (Mg) | 43 | 3.5 | 43 | 3.5 | 40 | 3.3 | 10 | 0.82 | 10 | 0.82 |
| Sodium | (Na) | 250 | 10.9 | 265 | 11.5 | 200 | 8.7 | 31 | 1.34 | 31 | 1.34 |
| Potassium | (K) | 18 | 0.46 | 18 | 0.46 | 16 | 0.41 | 5 | 0.13 | 5 | 0.13 |
| Bicarbonate | ($HCO_3$) | 200 | 3.38 | 180 | 2.95 | 205 | 3.38 | 130 | 2.14 | 140 | 2.30 |
| Sulphate | ($SO_4$) | 50 | 1.04 | 44 | 0.92 | 41 | 0.85 | <10 | <0.2 | <10 | <0.2 |
| Chloride | (Cl) | 460 | 13.0 | 460 | 13.0 | 410 | 11.6 | ≃46 | 1.28 | ≃34 | 0.95 |
| Total dissolved solids | | 1050 | - | 1040 | - | 950 | - | 220 | - | 220 | - |
| Permanent hardness | | 140 | - | 130 | - | 110 | - | nil | - | nil | - |
| Temporary hardness | | 160 | - | 150 | - | 160 | - | 100 | - | 100 | - |
| Alkalinity as $CaCO_3$ | | 160 | - | 150 | - | 160 | - | 120 | - | 120 | - |
| pH | | 7.3 | | 7.0 | | 7.4 | | 6.3 | | 6.3 | |
| Sodium Absorption Ratio (S.A.R.) | $= \frac{Na}{\sqrt{\frac{Ca + Mg}{2}}}$ | = 6.3 | | 6.9 | | 5.3 | | 1.4 | | 1.4 | |

| *Reg. No.* | *Bore* | *Date* | *Time* |
|---|---|---|---|
| 742039 | Shearwater | 18.9.1974 | 1700 hrs |
| 742038 | Shearwater | 19.9.1974 | 0175 hrs |
| 742106 | Shearwater | 24.9.1974 | 1515 hrs |
| 742243 | Parkers Ford | 16.10.1974 | 1000 hrs |
| 742244 | Parkers Ford | 16.10.1974 | 1515 hrs |

*Analyses by Department of Mines Laboratories, Launceston. All samples were collected during pump tests.

†Department of Mines registered number.

## QUALITY OF THE WATER

Chemical analyses of water collected during pumping from the Shearwater (3 samples) and Parkers Ford (2 samples) bores are presented in Table 5. Results are expressed both in milligrams per litre (mg/*l*) and milliequivalents per litre (meq/*l*).

Generally there are only minor differences in water quality between samples taken from the same bore; and they are probably the result of analytical error. The exception is the progressive change in the Na and Cl content of the Shearwater bore, which may be significant and may indicate a gradual improvement in quality. However no definite conclusions can be based on the data collected so far. It has been recommended (Cromer, 1974) to the Shearwater Golf Club that any changes in water quality be monitored by regular and frequent sampling over an extended period.

The data presented in Table 5 are represented by Stiff diagrams in Figure 36. Four horizontal axes graduated in milliequivalents per litre extend from each side of a vertical zero axis; analyses plotted on it produce a distinctive polygonal shape which can be readily compared with other water analyses. The width of the pattern is an approximate indication of the total ionic content, and hence of water quality.

The diagrams show that significant differences in quality and proportion of constituents exist between the water from both localities even though the aquifer in each case is Tertiary gravel. It is possible that the higher values of Na and Cl in the Shearwater sample are due to minor salt-water contamination caused by the bores proximity to the coast.

### *Water quality criteria for domestic use*

Hart (1974) has discussed in detail the acceptability criteria for domestic water supplies. This report does not deal with obvious health factors such as the presence or otherwise of pathogenic organisms (faecal coliforms and viruses), toxic biological organisms such as algae and fungi and toxic chemicals including arsenic, cadmium, mercury and radioactive substances. The following comments taken from Hart's work relate to the physical and chemical criteria affecting public acceptability of the bore waters.

### *Colour, odour and taste*

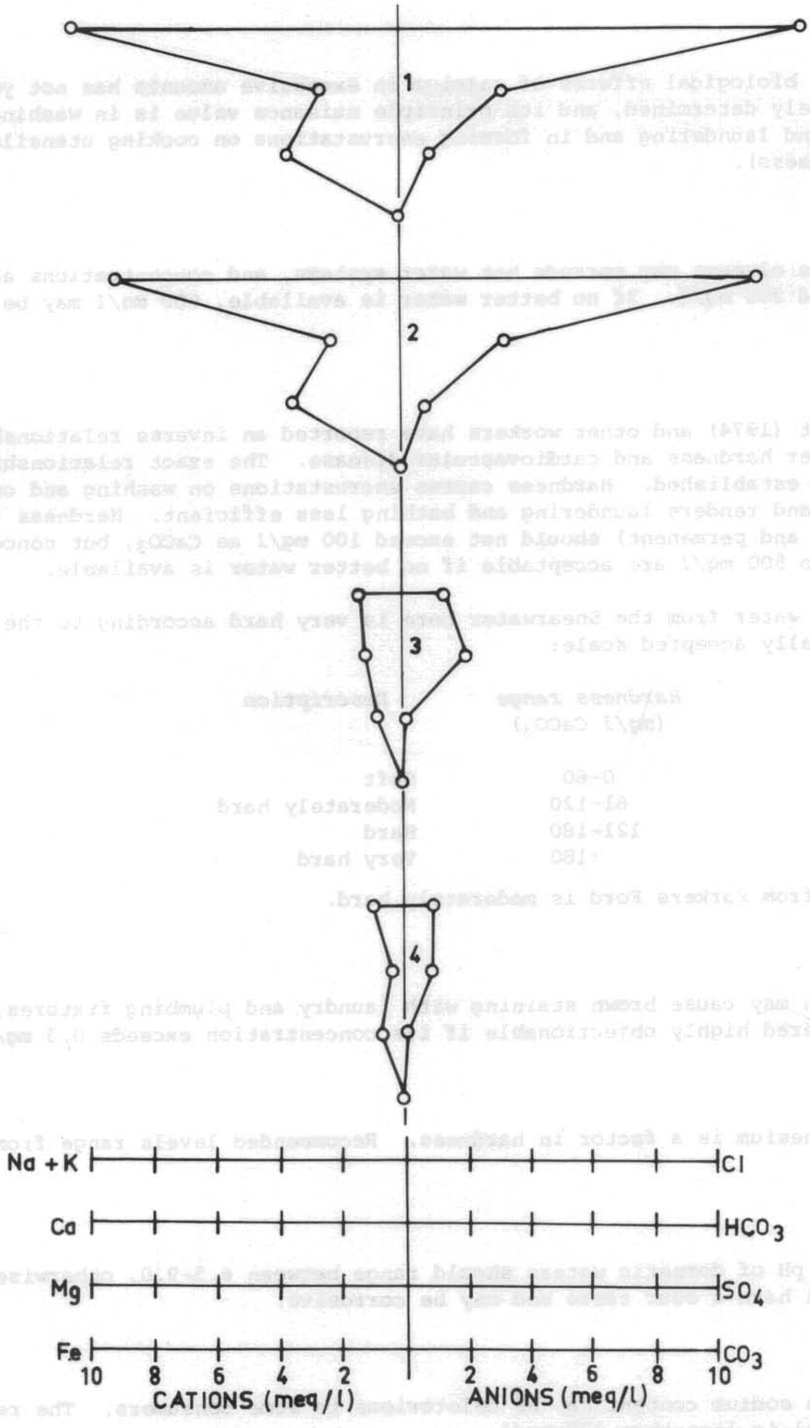
Although the Shearwater water has a slight taste, both bores are acceptable with regard to these three factors.

### *Temperature*

The water temperature at Shearwater remained steady during pumping at 13.4°C, and that at Parkers Ford at 13.0°C. Temperature affects the taste and odour characteristics of drinking water (lower temperatures inhibiting taste) but no problems are expected. The water temperature in the bores will in any case bear little relationship to its temperature when piped and consumed.

### *Alkalinity*

Alkalinity in the range 30-500 mg/*l* $CaCO_3$ is generally acceptable. Excessive amounts may cause gastro-intestinal irritation.




1. Shearwater bore, start of pump test.
2. Shearwater bore, end of pump test.
3. Parkers Ford bore.
4. Water in gravel near Wesley Vale football oval.

Figure 36. *Chemical analyses of water from Tertiary gravel near Port Sorell represented by Stiff diagrams.*

*Calcium*

The biological effects of calcium in excessive amounts has not yet been conclusively determined, and its principle nuisance value is in washing, bathing and laundering and in forming encrustations on cooking utensils, etc., (see Hardness).

*Chloride*

This element may corrode hot water systems, and concentrations should not exceed 200 mg/*l*. If no better water is available, 600 mg/*l* may be tolerated.

*Hardness*

Hart (1974) and other workers have reported an inverse relationship between water hardness and cardiovascular disease. The exact relationship has yet to be established. Hardness causes encrustations on washing and cooking utensils and renders laundering and bathing less efficient. Hardness (both temporary and permanent) should not exceed 100 mg/*l* as $CaCO_3$, but concentrations up to 500 mg/*l* are acceptable if no better water is available.

The water from the Shearwater bore is very hard according to the following generally accepted scale:

| *Hardness range* (mg/*l* $CaCO_3$) | *Description* |
|---|---|
| 0-60 | Soft |
| 61-120 | Moderately hard |
| 121-180 | Hard |
| >180 | Very hard |

and that from Parkers Ford is moderately hard.

*Iron*

Iron may cause brown staining with laundry and plumbing fixtures, and is considered highly objectionable if its concentration exceeds 0.3 mg/*l*.

*Magnesium*

Magnesium is a factor in hardness. Recommended levels range from 30-150 mg/*l*.

*pH*

The pH of domestic waters should range between 6.5-9.0, otherwise the water will have a sour taste and may be corrosive.

*Sodium*

High sodium content may be deleterious to some consumers. The recommended level is less than 270 mg/*l*.

*Sulphate*

Excess sulphate causes catharsis in humans, and although communities seem to be able to adapt to high levels, concentrations should be less than 250 mg/*l* (as $SO_4$).

*The acceptability of the bore waters*

The water from Parkers Ford is generally acceptable for domestic consumption although it has a high Fe content and low pH values. The water from Shearwater is very hard and has a high chloride content. In addition, its total dissolved solids content (*c.* 1000 ppm) is of marginal acceptability. Recommended figures quoted by Hart (1974) are about 500 ppm total dissolved solids, although this figure varies both with the nature and proportion of dissolved solids and with the local adaptions of consumers. As the groundwater will be added to the existing surface water supply any deleterious constituents in the groundwater will be diluted so that the combined supply could be within acceptable limits.

## CONCLUSIONS AND RECOMMENDATIONS

The Tertiary sand and gravel near Port Sorell and Parkers Ford contain adequate supplies of groundwater for the township of Port Sorell. The quality (before dilution) may be marginal, however, and may be related to the proximity of the coast.

If economically feasible, it is recommended that a reliable water supply for the town be obtained by purchasing the Parkers Ford bore, and by drilling another hole in either of the two areas investigated. The Parkers Ford bore is capable of delivering 270 *l*/min of reasonable quality water for extended periods. A second bore placed not less than approximately 250-300 m from it (preferably to the south) will probably tap the same aquifer. If properly constructed with approved stainless steel screens installed at appropriate depths, enhanced yields can be expected. The two bores pumping simultaneously will yield the required amounts of water. Alternatively, a bore may be drilled in the Port Sorell township (preferably on the western approaches to the town to minimise any salt-water encroachment), where coarse Tertiary gravel should be encountered. In such an aquifer, with a well constructed bore, yields of 500-800 *l*/min can be expected.

If a bore is contemplated, adequate, extended pump and recovery tests should be made, and water samples collected for chemical and biological analyses.

## REFERENCES


BURNS, K.L. 1965. One mile geological map series. K/55-6-29 Devonport. *Explan.Rep.geol.Surv.Tasm.*

CROMER, W.C. 1974. Groundwater investigations at the Shearwater Golf Club, Port Sorell. *Unpubl.Rep.Dep.Mines Tasm.* 1974/73.

GEE, R.D.; LEGGE, P.J. 1971. Geological atlas 1 mile series. Zone 7 Sheet 30 (8215N). Beaconsfield. *Department of Mines, Tasmania.*

GEE, R.D.; LEGGE, P.J. 1974. Geological atlas 1 mile series. Zone 7 Sheet 30 (8215N). Beaconsfield. *Explan.Rep.geol.Surv.Tasm.*

HART, B.T. 1974. A compilation of Australian water quality criteria. *Tech. Pap.Aust.Wat.Resour.Counc.* 7.

LEAMAN, D.E. 1973. Devonport-Port Sorell gravity survey. *Tech.Rep.Dep.Mines Tasm.* 16:97-105.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