

Abstract

The golf course at Scottsdale is situated near the centre of a dissected basalt plateau which has been deeply weathered to form a thick red soil, clay, and boulder cover. Previous investigation drilling of the Scottsdale basalt indicates that these rocks will produce limited supplies of good quality groundwater. A recently drilled contract bore 1.5 km south-west of the golf course penetrated 16 m of gravel and sand below the basalt. If such sediments are found between the basalt and the granodiorite at the golf course, bore yields are anticipated to be higher. Two resistivity probes and seismic refraction spreads failed to identify any such sediments because of the presence of a high velocity layer, thought to be unweathered basalt. Two bore sites were recommended, one of which should be drilled to the granodiorite.

INTRODUCTION

At the request of the Scottsdale Golf Club, a groundwater assessment of the golf course was made, for which some preliminary geophysics was requested. Two resistivity probes of 300 m length using a Wenner configuration and two 100 m seismic refraction spreads using the Nimbus ES1210 seismograph were completed on 24 November 1981.

LOCATION AND LANDSCAPE

The golf course is situated on the northern margin of the Scottsdale township [EQ425437] and is underlain by thick red soil which is derived from the weathering of the underlying basalt. The town is situated approximately near the centre of a low dissected plateau which is surrounded by the valleys of the Brid River to the west, Great Forester River to the south, Coxs Rivulet to the north, and Tuckers and Surveyors Creeks to the east (fig. 1). The flat, rolling landscape of the plateau generally ends with the steep valley sides of these streams and rivers.

GEOLOGY

The Scottsdale basalt plateau is the residual area of a far more extensive area of basalt that erupted from fissure vents to the west. The basalt probably extended to the coast in early Tertiary times. This basalt covered the Tertiary sedimentary basin between North Scottsdale and the coast, and probably most of the Springfield Basin that extends south of Scottsdale to the Mount Helen scarp and Sideling Range. Most of the basalt has been removed by erosion, leaving the small area around Scottsdale and isolated outliers at West and North Scottsdale (fig. 1). The thickness of the basalt seldom now exceeds 50 m, except where it flowed into old Tertiary age river valleys or leads. The basalt is frequently weathered to a considerable depth, and in some drill holes very little solid basalt rock is encountered; the entire thickness is usually clay and deeply weathered basalt kernels that form from large residual basalt boulders.

Below the basalt are white quartz sand, grit, and fine gravel, all mixed with a limited amount of clay, of the Tertiary aged sediments. Pure clay lenses up to two metres thick are known to occur within these sediments. Below the gravel and sand is the granodiorite of Devonian age. This granodiorite forms conspicuous outcrops of large, smooth, rounded blocks up to

2/14

6-8 m in height. These granodiorite outcrops occur in the valley floors of the surrounding rivers and streams.

The thickness of the basalt and the Tertiary sediment in the Scottsdale district is related to the subsurface topography of the granodiorite. In the township area, the granodiorite crops out close to the surface, the town being located on a buried granodiorite ridge. This granodiorite divide separates the two Tertiary sedimentary basins at Scottsdale, one extending from North Scottsdale to the coast, and the other extending from Springfield to the Mount Helen-Sideling Range scarp. The Tertiary sediments exposed around the margins of the Scottsdale plateau are thin, with less than ten metres thickness exposed. On the western area of the plateau it appears that the Tertiary sediments are not present, and the basalt may have flowed directly on to the granodiorite in some localities in this area.

GEOHYDROLOGY

Of the three rock types likely to be encountered beneath the golf course at Scottsdale (basalt, Tertiary sediments, and granodiorite), only the basalt and Tertiary sediments are considered as potential aquifers and worthy of drilling.

Granodiorite

No known bore drilled to date in the granodiorite of north-east Tasmania has yielded groundwater of a worthwhile quantity. This is not unexpected, as the granodiorite is an homogeneous, even-textured igneous rock, with few fractures present. The joints in exposures are few, widely spaced, and tight. In drill holes the granodiorite is generally overlain by Tertiary sediments and is covered by a thick clay layer of decomposed granodiorite, which gradually shows the igneous texture as the harder granodiorite rock is approached. This transitional layer is frequently 20-40 m thick and forms an impervious blanket or aquaclude above the granodiorite.

Basalt

As an aquifer, basalt relies on its fractures, vertical joints, and gas vesicles (holes) for storing groundwater. This primary porosity and permeability deteriorates with the degree of weathering as the basalt breaks down to a clay. Because the basalt at Scottsdale is thin and deeply weathered, bore yields are low (15-45 l/min). If an area of thick and unweathered basalt (as in a lead) is drilled, the yield could be as high as 75 l/min (see holes 13, 12, and 108, Appendix 1).

The Scottsdale basalt plateau forms a perched water table which is drained by a series of permanent springs that occur at the base of the basalt along the river and creek valley slopes that form the plateau margins. The springs are formed at the chilled zone at the base of the lava flow and where the sediments are baked, particularly if they are clay. This baked horizon forms a sealing layer or aquaclude, above which the groundwater accumulates and drains as a series of permanent springs, marking the contact between the basalt and the underlying sediments.

The presence of this perched water table was exploited by the early settlers of Scottsdale for household and stock water supplies by the use of shallow hand dug wells. The wells on the plateau were dug through the red soil and the underlying clay into the weathered basalt rock. These basalt wells gave limited supplies of good quality water but were universally

reported to have dried up during dry summers.

The water quality of groundwater from the Scottsdale basalt is good and suitable for household purposes (see Holes 12, 13, 108, Appendix 2).

Tertiary sediments

In this sequence of sediments, each small sand, grit, and gravel bed or lense forms a small individual aquifer below the basalt. The clay beds and lenses, when mixed with the other sediments, form aquatards in the sedimentary sequence. These aquatards slow groundwater infiltration to the standing water level, generally towards the bottom of the sequence. The exception to this is where the sediments are free draining, as on a cliff face or steep valley side.

Given an adequate thickness of these sediments without a high percentage of clay in the sequence and a suitable confining structure, bore yields in excess of 75 l/min can be anticipated. With a thickness in excess of 50 m, 230 l/min are not exceptional (see Holes 23, 33, 34, Appendix 2).

The major cost deterrent for bores in these sediments is not the cost of drilling but the cost of casing. As the sediments are unconsolidated, it is necessary to case the holes for their entire length. A drill screen has to be placed below the water table if high yields are required. Both casing and screens are expensive, especially as the water table is frequently deep (see Holes 9, 13, 33, 34, Appendix 2).

The quality of water from Tertiary sediments is excellent, and is far better than most town supplies in Tasmania (see Holes 33 and 34, Appendix 2).

PREVIOUS DRILLING

In the exploratory drilling for the north-east Tasmania regional groundwater investigation, only a limited number of holes have been drilled on the Scottsdale basalt plateau area. The locations of all the known water bores in the basalt area at Scottsdale are shown on Figure 1, with the drilling details, lithological logs and yields etc. given in Appendix 1. The available chemical analyses of the water from these holes are given in Appendix 2.

1970-73

In the early holes drilled in 1970-73, Holes 13, 23, and 9 were started in basalt. The yield of water from the basalt was a secondary consideration in these holes, the primary target being to confirm the previous geophysical exploration and to find the thickness and lithology of the Tertiary sediments between the basalt and the basement granodiorite. Drilling unweathered basalt rock was avoided early in the investigation programme as only cable tool and rotary drilling machines were available. The drilling of hard rock with such machines was extremely slow and costly. The bores in 1970-73 tended to be sited on the outlier areas of the plateau where the basalt was expected to be thinner and weathered. With the introduction of down-the-hole hammers in 1977 it became possible to drill hard rock like basalt and granodiorite equally as well as the unconsolidated soft Tertiary sediments.

From the early holes of 1970-73 it was apparent that the Scottsdale basalt, in contrast to those of Ringarooma-Winnaleah and Pipers River, was

deeply weathered and the thickness of unweathered basalt was restricted. In Hole 9 on the red soil ridge east of Jetsonville, only basalt boulders were encountered in a total depth of 19 metres. The basalt lithology was also variable at Scottsdale and the groundwater yields from the basalt appeared low, as in Hole 13. In Hole 23, the basalt contributed little to no water, with all of the 150 l/min obtained coming from the underlying Tertiary sediments (Appendix 1).

1976-77

With the introduction into the Department of Mines of down-the-hole hammer drilling and greater lifting capacity bore pumps in 1976-77, it was decided to investigate in general the groundwater potential of the basalt plateaux of north-east Tasmania. In addition it was decided to attempt to trace the known buried valleys of the Scottsdale Tertiary sedimentary basin southwards beneath the Scottsdale basalt plateau. Two of these valleys, filled with sediments of over 100 m thick, drain to the coast between Bridport and Waterhouse. The Scottsdale Basin may also be connected by such a valley or lead with the smaller subsidiary Tertiary basin to the south, known as the Springfield Basin.

In 1976-77, a series of seismic spreads and long resistivity probes were undertaken between the railway line and the Bridport-Scottsdale Road looking for the southern extension of the western valley known as the 'Jetsonville Lead' (fig. 1). Two holes (33 and 34) were drilled at Last's property (west of Campbells Hill) in red soil and Tertiary sediments, while another (Hole 12) was drilled in basalt on Charleston's property, west of Saliers Hill.

The 'Jetsonville Lead' was traced through Last's, but the two bore yields were lower (225-295 l/min) than the bores to the north. This was due to the sediments containing a higher percentage of clay, and a shallowing of the granodiorite basement southwards. It appeared that the 'Jetsonville Lead' was dying out rapidly. The Charleston bore (12) appeared to confirm this view, as the basalt directly overlay the granodiorite with no Tertiary sediments present. The 40 m thickness of basalt at Charleston gave a yield of 45 l/min (Appendix 1).

15

The results of the drilling at Charleston's and Last's appeared to indicate there was no connection between the Springfield and Scottsdale Basins. Because of these conclusions, no further investigation drilling was undertaken on the Scottsdale basalt plateau at this time.

1979-1980

In 1979-80 a series of contract and investigation holes (107, 108, 109) were drilled by the Department of Mines for the farmers along Sledge Track at West Scottsdale. These holes were sited in basalt which forms an isolated outlier of the Scottsdale plateau, capping the ridge that separates the Brid and Little Brid Rivers. The area was considered to have a marginal groundwater potential and bore yields were anticipated to be low because of the limited area and thickness of the basalt. From surface evidence, there appeared to be little or no thickness of Tertiary sediments beneath the basalt. A series of springs along both valley sides showed that the basalt (and sediments if present) were free draining.

The yields from the drilled holes were low (7-20 l/min), but the thickness of sediment between the basalt and granodiorite (30-50 m) was far greater than had been anticipated (Appendix 1). Even though these sediments were dominantly clay, their presence indicated that a cover of Tertiary

sediments did exist over some of the granodiorite ridge between the Springfield and Scottsdale Basins when the basalts were extruded. There were also local highs or hills of granodiorite with no sediment cover, as at Charleston's bore.

1981; Tasmanian Drillers - Scott Dobson's Bore

In 1981 the Tasmanian Drilling Company Pty Ltd drilled a hole near the western town boundary at Scott Dobson's new house site (fig. 1). At the request of the drillers, the author visited the drill site and logged the cuttings. The bore was reported to have gone through 31 m of basalt, and clearly ended in Tertiary sediments with a minimum thickness of 15 m. No granodiorite cuttings were found. The sediments comprised coarse white quartz sand grit and fine gravel, with a low percentage of clay which is the characteristic feature of lead sediments. Even though the bore is reported to only yield 20 l/min, it is most likely that this yield could be increased by drilling to the granodiorite through the entire Tertiary thickness and by using bore screens rather than slotted casing.

This hole provided further evidence of Tertiary sediments beneath the Scottsdale plateau basalt, and these sediments were of the lithological type that usually give good supplies of groundwater, even though this particular hole's yield was low. As these were the lead type of sediment, it is possible that this hole was drilled on a southward extension of the 'Jetsonville Lead' connecting the Springfield Basin with the Scottsdale Basin.

GEOPHYSICAL INVESTIGATION

Because of the result of Dobson's bore, a limited geophysical exploration programme was recommended to the Golf Club committee. This included two refraction seismic spreads and two resistivity probes on the western and eastern margins of the golf course. The western seismic spread was run in NE-SW direction and the other seismic spread and the two resistivity probes in an east-west direction.

The seismic results are shown in Table 1. Both spreads show a high velocity layer present at depths of 19-24 metres. This layer is interpreted as basalt. The high velocity could equally be that of unweathered granodiorite, but the presence of a thick intermediate layer with velocities in the range of 1250-1900 m/s is not the normal velocity for weathered granodiorite. No great significance is given to the asymmetry of spread 1, which is thought to be the result of a thinning of the surface layer northwards. The presence of the high velocity layer in both spreads, if correctly interpreted as basalt, makes both spreads worth drilling for limited supplies of groundwater.

The resistivity probe shows no great change of apparent resistivity values which remain constant except for a thin superficial dry surface layer (fig. 2). The apparent resistivity values are 100-180 Ω m for the western spread and 230-310 Ω m for the eastern spread. These values and the shape of the curve indicate a water layer below a moist clay surface layer. The water is not saline because of the resistivity values in the 100-300 Ω m range. With such low values, the high seismic velocity hard-rock layer was not reached by the resistivity probes.

As both the resistivity and seismic surveys appeared to be confined to the basalt and were not seeing through to the granodiorite, no further geophysical survey was warranted. The proposal for resistivity mapping

Table 1. RESULTS OF SEISMIC REFRACTION SURVEY, SCOTTSDALE GOLF COURSE.

| Spread No. and direction | Geophone spacing (m) | Shot point distance (m) | Velocity layers (m/s) | Calculated thickness of layers (m) | Symmetry of velocity curves | Geological interpretation |
|--------------------------|----------------------|-------------------------|--------------------------|------------------------------------|-----------------------------|--|
| 1 NE-SW | 7.5 | 15 NE | V ₀ 450-550 | V ₀ - NE 8 | Assymetrical | V ₀ Clay |
| | | 7.5 NE | V ₁ 1250-1900 | - SW 10-11 | Thicker V ₀ | V ₁ Weathered basalt |
| | | 7.5 SW | V ₂ 5000-6000 | V ₁ 24-27 | layer at the SW end | V ₂ Unweathered basalt |
| 2 E-W | 7.5 | 7.5 E | V ₀ 500-550 | V ₀ 19-22 | Symmetrical | V ₀ Clay and/or deeply weathered basalt |
| | | 7.5 W | V ₁ 3000-4000 | | | |

2-6

6/14

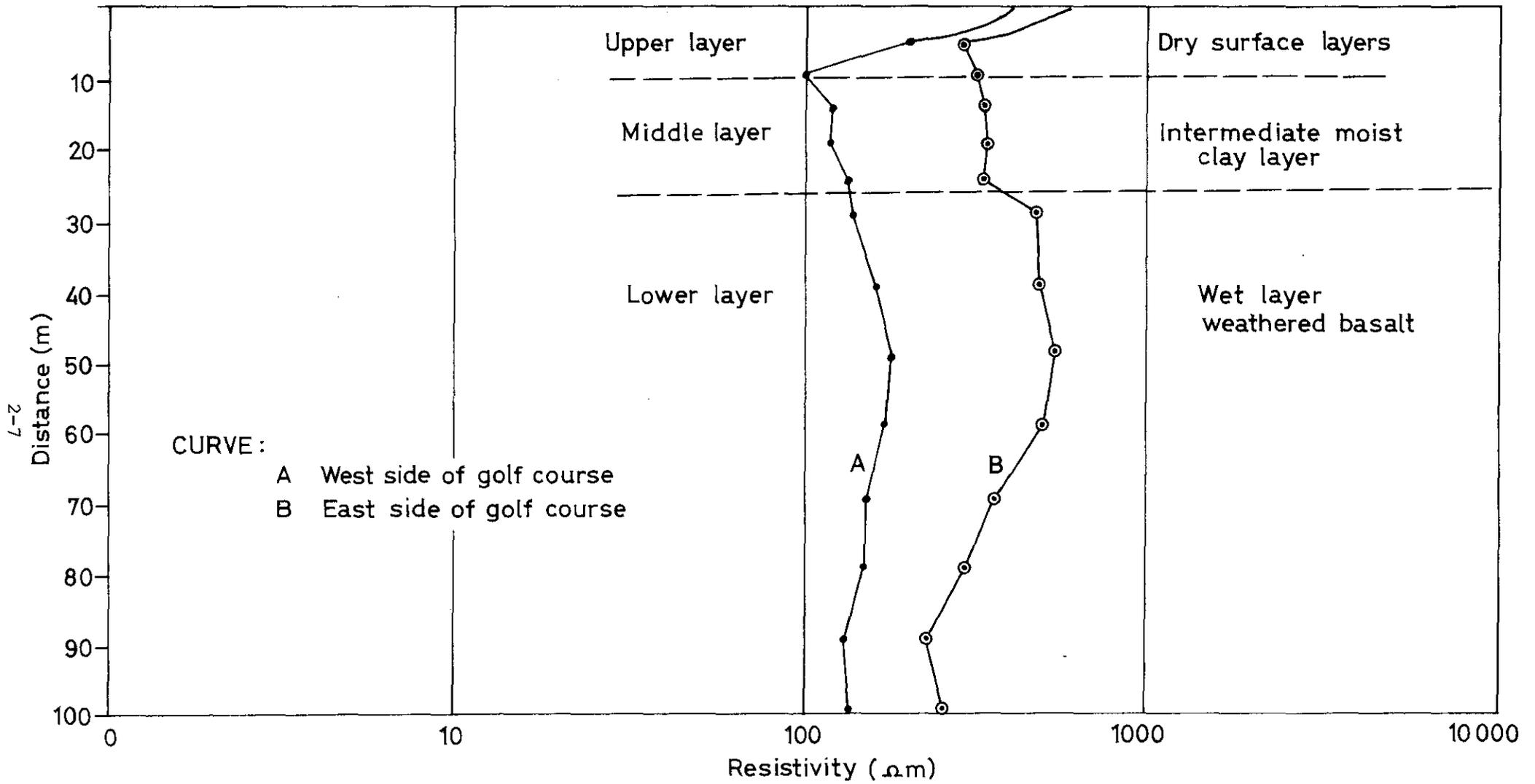


Figure 2. Resistivity probe (Wenner configuration), Scottsdale Golf Course.

5 cm

made to the Golf Club committee by the author was not undertaken. Any resistivity anomaly resulting from such traversing would probably not have represented the granodiorite basement profile, but rather differences in clay thickness above the basalt. Because of the presence of a hard rock layer, the geophysical methods failed to establish the presence of any Tertiary sediments beneath the basalt.

CONCLUSIONS

- (1) From the previous holes drilled in the Scottsdale plateau area, the basalt will give good quality groundwater of limited quantities. Yields of 20-45 l/min can be anticipated if the basalt is 30-40 m thick.
- (2) The two seismic spreads both show the presence of a high velocity layer at a depth of 19-24 m. This high velocity layer is interpreted as unweathered basalt overlain by weathered basalt and clay.
- (3) The resistivity values indicate a wet layer in the rock, and the value range is between clay and weathered but solid basalt. The curve has not the two layer shape, nor the values of a thick red soil layer overlying granodiorite found in a previous investigation north of the golf course between the railway line and Jetsonville.
- (4) Previous drilling in the Scottsdale area indicates that the basalt of the area can overlie either granodiorite directly, or with Tertiary sediments present between the basalt and the granodiorite. At West Scottsdale, the Tertiary sediments beneath the basalt are clay, but in a recently drilled hole two kilometres south of the golf course, these sediments were white quartz gravel, grit, and sand.
- (5) To establish if these sediments are present below the basalt will require drilling and any proposed hole should be drilled to the granodiorite if sediments exist below the basalt.
- (6) Little or no water has been obtained from drilling into the granodiorite in north-east Tasmania.

RECOMMENDATIONS

- (1) Two holes be drilled on the golf course, one on each of the seismic and resistivity spreads.
- (2) The first hole to be drilled should be on the western side of the golf course. This hole should be drilled through to the granodiorite. If no Tertiary gravel and sand is encountered, the hole should be collapsed to the base of the basalt. If gravel and sand is encountered in any thickness greater than 3-5 m, the hole should be cased and pump tested. Slotted casing should be used in the hole. If the yield warrants, the slotted casing should be replaced by steel bore screens in the sediment section of the hole.
- (3) The second hole should be drilled to a depth of 3-5 m below the water table. The first hole should be then pumped for four hours and the second hole used as an observation hole. If the water level only moves slightly in the observation hole, the hole should be drilled to granodiorite with the same procedure as indicated for the first hole.

[12 February 1982]

APPENDIX 1

Results of water bore drilling, Scottsdale area

DEPARTMENT OF MINES - INVESTIGATION HOLES, 1970-73

HOLE 13

Method; Cable tool
 Location; Bungana, North Scottsdale
 AMG reference; EQ462491
 Date drilled; 20.10.70-4.12.70
 Owner; Brown
 Lithological log (depths in metres);
 Red soil and clay 0 - 1.7)
 Decomposed basalt 1.7-15.5) Basalt 47 m
 Basalt 15.5-47.2)
 Clay, gravel, sand
 and rotten wood 47.2-55 Tertiary sediments 8 m
 Standing water level; 12.2 m
 Yield; Bail tested 15 l/min approximately
 Salinity (TDS); 250 mg/l
 Hole not pump tested because bent casing shoe would not allow pump to be installed.

HOLE 23

Method; Cable tool
 Location; Lower Bungana, North Scottsdale
 AMG reference; EQ465494
 Date drilled; 9.11.71-7.12.71
 Owner; Brown
 Lithological log (depths in metres);
 Weathered basalt 0 -10.4 Basalt 10 m
 Clay, gravel, sand
 and rotten wood 10.4-79.2 Tertiary sediments 69 m
 Standing water level; 17 m
 Yield; 15 l/min, pump tested 5 hours
 Salinity (TDS); 178 mg/l

HOLE 9

Method; Rotary
 Location; Foress, Jetsonville
 AMG reference; EQ399489
 Date drilled; 11.10.71-22.10.71
 Owner; Jetson
 Lithological log (depths in metres);
 Red soil and clay 0 - 14) Basalt 19 m
 Basalt boulders 14 - 18.9)
 Clay, sand and 18.9-143.9 Tertiary sediments 125 m
 gravel
 Decomposed granite
 with soft and hard
 layers 143.9-158.5 Granodiorite 15 m
 Standing water level; 76.5 m
 No water analysis sample collected
 Too deep for available pumps to reach at that time

Appendix 1 (continued)

DEPARTMENT OF MINES - INVESTIGATION HOLES, 1976-77

HOLE 12

Method; Down-the-hole hammer
 Location; West Scottsdale, junction Sledge Track and Tasman Highway
 AMG reference; EQ409411
 Date drilled; 8.6.76-17.6.76
 Owner; Charleston
 Lithological log (depths in metres);
 Red soil and clay 0 - 1.8) Basalt 40 m
 Basalt 1.8-39.6)
 Decomposed granite 39.6-42.7 Granodiorite 3 m
 Water struck; 35 m
 Standing water level; Not recorded
 Yield 45 l/min, pump tested 5 hours
 Salinity (TDS) 210 mg/l

HOLE 33

Method; Rotary
 Location; Jetsonville, near wild waterfowl reserve, south boundary of property
 AMG reference; EQ403465
 Date drilled; 18.7.77-31.7.77
 Owner; D. Last
 Lithological log (depths in metres);
 Red soil 0 - 1.5 Basalt? 2 m
 Gravel grit and clay 1.5-60.0 Tertiary sediment 58 m
 Clay and deeply weathered granodiorite 60.0-81.0 Transition to granodiorite 21 m
 Hard granodiorite 81.0
 Standing water level; 18 m
 Yield; 230 l/min
 Salinity (TDS) 150 mg/l

HOLE 34

Method; Rotary
 Location; Jetsonville, north boundary of property in valley floor
 AMG reference; EQ401469
 Date drilled; 1.9.77-22.9.77
 Owner; D. Last
 Lithological log (depths in metres);
 Red soil 0 -1.5 Basalt? 2 m
 Gravel clay 1.5-73 Tertiary sediment 73 m
 Standing water level; 19 m
 Yield; 295 l/min
 Salinity (TDS); 130 mg/l

Appendix 1 (continued)

DEPARTMENT OF MINES CONTRACT AND INVESTIGATION HOLES -
1979-80

HOLE 107

Method; Down-the-hole hammer
 Location; West Scottsdale
 AMG reference; EQ386408
 Date drilled; 2.4.79-4.4.79
 Owner; B. Millwood
 Lithological log (depths in metres);
 Red soil and clay 0 - 4.6)
 Basalt boulders and decomposed basalt 4.6-16.8) Basalt 17 m
 Gravel and clay 16.8-54.8 Tertiary sediments 38 m
 Yield; Dry

HOLE 108

Method; Down-the-hole hammer
 Location; West Scottsdale
 AMG reference; EQ388407
 Date drilled; 9.4.79-12.4.79
 Owner; B. Millwood
 Lithological log (depths in metres);
 Red soil and clay 0 - 1.5)
 Decomposed basalt and basalt 1.5-15.2) Basalt 24 m
 Basalt 15.2-24.4)
 Gravel and clay 24.4-74.6 Tertiary sediment 50 m
 Granite 74.6-77.7
 Water struck; 24 m
 Yield; 20 l/min
 Salinity (TDS) 71 mg/l

HOLE 111

Location; West Scottsdale
 AMG reference; EQ376406
 Date drilled; 1.5.79-3.5.79
 Owner; D. Gladman
 Lithological log (depths in metres);
 Red soil and clay 0 -27.4)
 Broken basalt 27.4-30.5) Basalt 38 m
 Solid basalt 30.5-38.1)
 Clay 38.1-39.6 Tertiary clay
 Yield; 7.5 l/min

Appendix 1 (continued)

TASMANIAN DRILLERS - 1981

| | |
|--------------------------------------|-----------------------------------|
| Method; | Down-the-hole hammer |
| Location; | Tasman Highway, Scottsdale |
| AMG reference; | EQ424421 |
| Date drilled; | July, 1981 |
| Owner; | Scott Dobson |
| Lithological log (depths in metres); | |
| Red soil and clay | 0 -12.2 |
| Basalt | 12.2-30.5 Basalt 31 m |
| Gravel and clay | 30.5-45.8 Tertiary sediments 15 m |
| Yield; | 20 l/min |
| Salinity (TDS); | Not known |

APPENDIX 2

Chemical analyses of water bore samples, Scottsdale area

| Registered No. | 712801 | 720986 | 761257 | 780573 | 780574 | 792083 |
|---------------------------------------|---------------|------------|----------------------|-------------|-------------|----------------------|
| Hole No. | 13 | 23 | 12 | 33 | 34 | 108 |
| Owner | Brown | Brown | Charleston | D. Last | D. Last | G.D. Millwood |
| Locality | North Bungana | Scottsdale | West Scotts- dale | Jetsonville | Jetsonville | West Scotts- dale |
| pH | 7.5 | 5.8 | 7.4 | 6.6 | 5.9 | 4.6 |
| Conductivity (µS/cm) | | | 275 | 210 | 200 | 95 |
| <i>Item (mg/l)</i> | | | | | | |
| CO ₃ | Nil | Nil | Nil | Nil | Nil | Nil |
| HCO ₃ | 104 | 38 | 120 | 18 | 19 | 13 |
| Cl | 86 | 54 | 24 | 42 | 39 | 15 |
| SO ₄ | 13 | 17 | 5 | 11 | <5 | 5 |
| SiO ₂ | 30 | 14 | 70 | 8 | 7 | 8.6 |
| Ca | 12.0 | 6 | 14 | 4.8 | 5.0 | 1.4 |
| Mg | 20 | 6 | 15 | 4.4 | 5.0 | 1.6 |
| Fe | Nil | 0.1 | 0.7 | <0.1 | <0.1 | 0.1 |
| Al | Nil | 0.1 | 0.2 | <0.2 | <0.2 | 0.2 |
| K | 3.3 | 3 | 4.6 | 1.6 | 1.5 | 0.7 |
| Na | 44 | 40 | 20 | 27 | 23 | 13 |
| Total dissolved solids | 250 | 178 | 210 | 150 | 130 | 71 |
| Alkalinity (as CaCO ₃) | 85 | 31 | 98 | 14 | 15 | |
| Hardness (as CaCO ₃) | 12 | 40 | | | | 11 |
| Permanent hardness | | 9 | | 16 | 18 | |
| Temporary hardness | | 31 | | 14 | 15 | Nil |
| Total ions | | 178 | | | | 10 |
| Sample date | 21.9.71 | 7.3.72 | 25.6.76 | 10.3.78 | 10.3.78 | 3.10.79 |

2-13

13/14

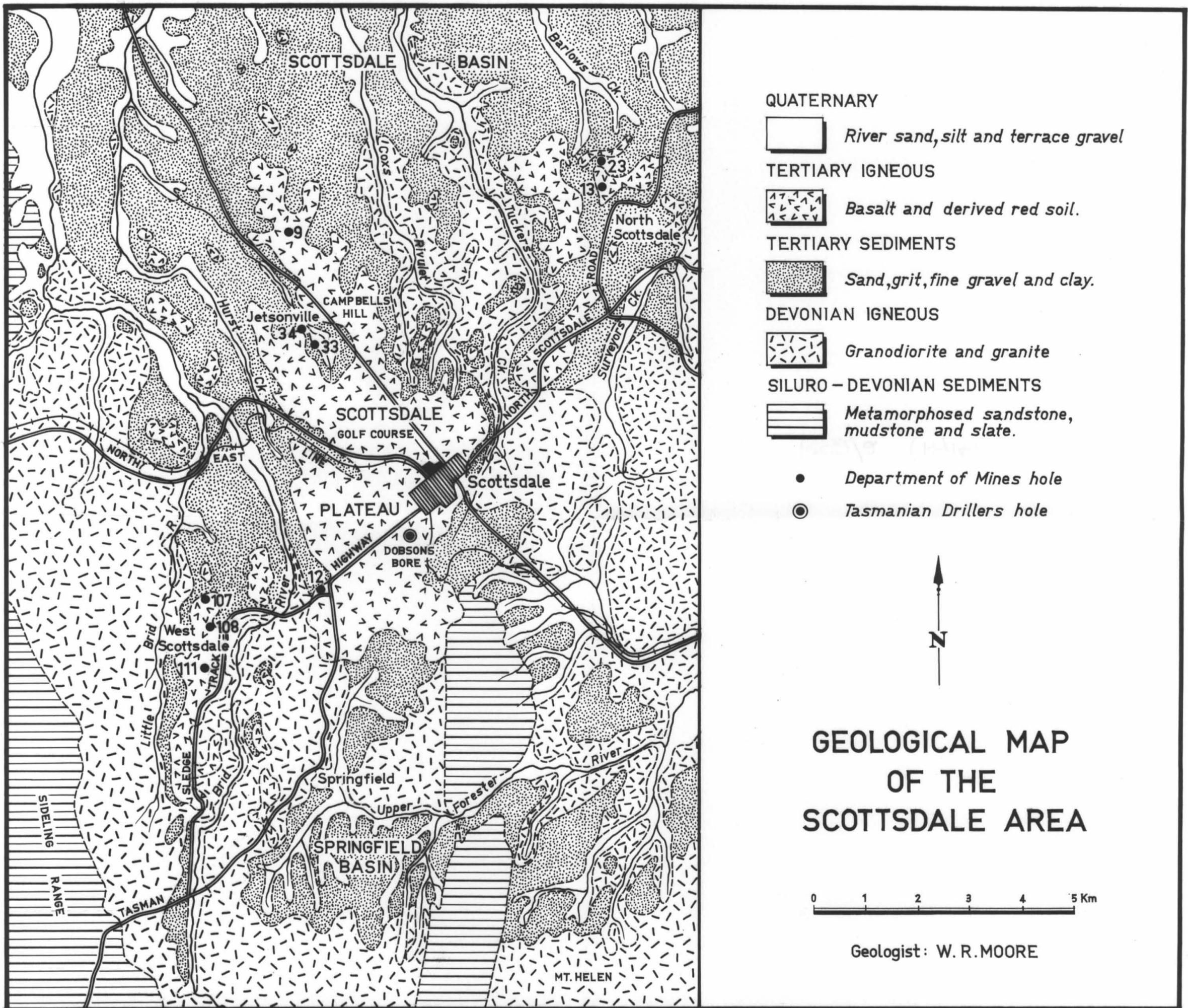


Figure 1