

3. Deep drilling in Tertiary basins east of Devonport.

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The northern Tasmanian coastal region between the Mersey and Rubicon River estuaries, and extending south to the Bass Highway, is at present the subject of a regional groundwater investigation by the Department of Mines. This report presents the information obtained from two deep holes which were drilled to aid Tertiary correlation and supplement the bore log data from shallow later bores sunk during that programme. Unpublished data from a deep water bore drilled by the Department of Mines in 1964 are also included.

GEOLOGY

The geology of the region has been described by a number of workers including Reid (1924), Burns (1963, 1965), Gee and Legge (1971, 1974), Gulline et al. (1973) and Jennings et al. (1959). In addition, Longman and Leaman (1971), and Leaman (1973) conducted regional gravity surveys over the area. Cromer (1977) extended this coverage.

The eastern half of the region, south of Port Sorell, was extensively drilled for oil in the 1920s, 1930s and 1960s, and the general Tertiary sequence is now well established. The regional gravity surveys, using oil bore data for control and correlation, have delineated the major structural features. A thick Tertiary sequence of basalts and non-marine sediments occupies three structural troughs: the Port Sorell, Wesley Vale and Sassafras basins (fig. 8). Although Burns (1965) suggested that marine intercalations may be found north of the present coastline, this appears unlikely as recent gravity data indicate that the basins lack obvious large scale outlets and were apparently landlocked (Leaman, 1973, Cromer, 1977). South of Port Sorell the Tertiary sequence is at least 350 m thick, consisting predominantly of basalt, mudstone and carbonaceous shale with minor sand, gravel and lignite. Most of the early oil bores bottomed in Jurassic dolerite, which appears to underlie the whole area. It crops out in a number of widespread areas delineating the margins of the basins, which are separated by a partly buried basement high extending south from Northdown Beach to Thirlstane, and by a broad buried saddle west of Harford.

Burns (1965, p. 117) described the Tertiary sequence as a series of superimposed deep leads, and partly on the basis of oil bore logs defined the succession south of Port Sorell as:

	Rock unit	Thickness (m)
top:	Moriarty Basalt	>25
	Wesley Vale Sand	50-75
	Thirlstane Basalt	100-175
	Harford Beds	100-250

The Harford Beds are nowhere exposed. Microflora from lignite in the Wesley Vale Sand indicate a probable Upper Oligocene age (Burns, 1965, p. 119). Although he was aware of the problems inherent in correlating between successions in deep leads and across basin divides, Burns extended his classification to mappable units in the adjacent Wesley Vale Basin. Results of subsequent drilling (presented here) verify Burns' general conclusions regarding the stratigraphy, but indicate that only the Moriarty Basalt (and possibly the Wesley Vale Sand) formed lead systems.

DRILLING RESULTS

Prior to recent drilling by the Department of Mines, stratigraphic

controls in the Wesley Vale and Sassafras basins were sparse. Numerous private water bores exist, but few were extended deeper than 60 m. Data from most are suspect, and rather than clarify the situation they tend to obscure and complicate the overall stratigraphy.

The Wesley Vale basin is larger and deeper than the adjacent Port Sorell and Sassafras basins (fig. 8), where 330-350 m of sediments and basalt correspond to a residual Bouguer anomaly of about $50 \mu\text{m/s}^2$; the $120 \mu\text{m/s}^2$ anomaly associated with the Wesley Vale basin indicates a Tertiary sequence well in excess of 500 m (Leaman, 1973; Cromer, 1977).

Findlay's Bore (Wesley Vale basin)

This hole was sited on M. Findlay's property near the Wesley Vale cross-roads [543402]*, at a collar elevation of 50 m. Drilling by the F20C diamond rig commenced in July 1973 and was completed in February 1974. The hole bottomed in Tertiary mudstone at a depth of 365.6 m. A detailed log is given in Appendix 1. The general succession is interpreted as:

<i>Depth (m)</i>	<i>Rock Unit</i>
0-9	Wesley Vale Sand
9-149	Thirlstane Basalt
149-366	Harford Beds

Artesian water was struck in the Thirlstane Basalt and a flow estimated at 8 l/min continued for some months. Casing was pulled and the bore abandoned. The core is held by the Department of Mines.

Oliver's Bore (Sassafras basin)

This bore was sited on Mr Oliver's property on the eastern bank of Eastford Creek 3.5 km north of Sassafras [585327]. Drilling (F20C diamond rig) commenced in May 1974 at a collar elevation of 80 m, and the hole bottomed in Tertiary mudstone at 333 m in March 1975. The core was logged (Appendix 3) as follows:

<i>Depth (m)</i>	<i>Rock Unit</i>
0-6	Wesley Vale Sand
6-58	Thirlstane Basalt
58-333	Harford Beds

Artesian water was struck in the basalt. A flow of about 15 l/min continued for the duration of drilling. The core is held by the Department of Mines.

A.P.P.M. bore (Wesley Vale basin)

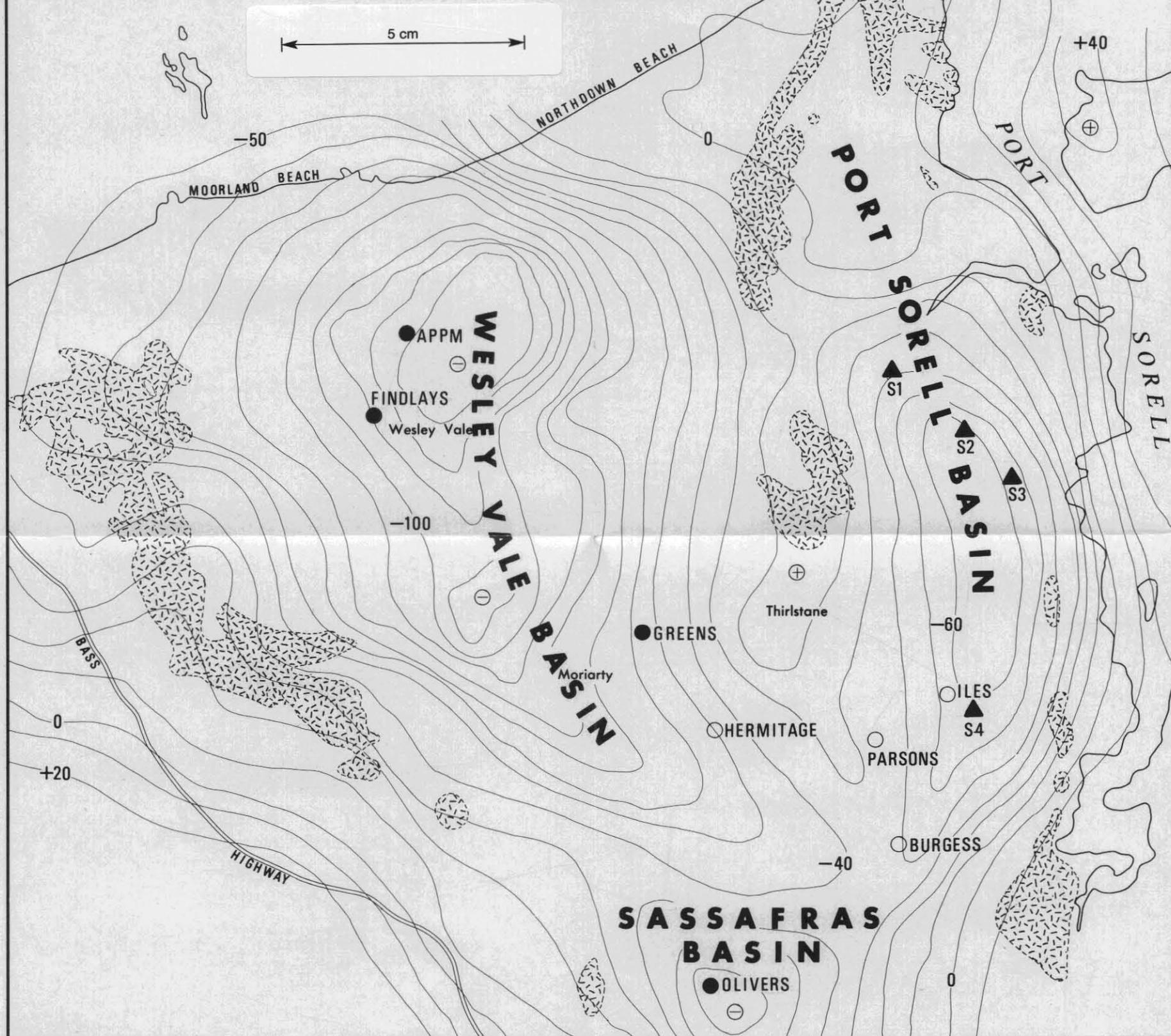
This percussion hole was drilled by the Department of Mines during the period May-December 1964, at the request of Australian Paper Pulp Mills at Wesley Vale. The hole was sited about 2 km north of the township [546413], adjacent to the Particle Board Mill at a collar elevation of 80 m. The previously unpublished log of the hole was obtained from Departmental records, and is included as Appendix 2. The succession is interpreted as:

<i>Depth (m)</i>	<i>Rock Unit</i>
0-9	Quaternary sand and clay
9-24	Moriarty Basalt

*All grid references lie within 100 km AMG square DQ.

DEEP DRILLING AND RESIDUAL BOUGUER ANOMALY TERTIARY BASINS EAST OF DEVONPORT

W.C. CROMER 1975



JURASSIC DOLERITE

SULZBERGER OIL BORES

OIL BORES

DEPT OF MINES BORES

0 1 2 3 4 Km

CONTOUR INTERVAL $10\mu\text{m}/\text{s}^2$

TASMANIA DEPARTMENT OF MINES NOVEMBER 1975

FIGURE 8

TR20-45-52

Tech. Rep. Dep. Mines Tasm. 20.

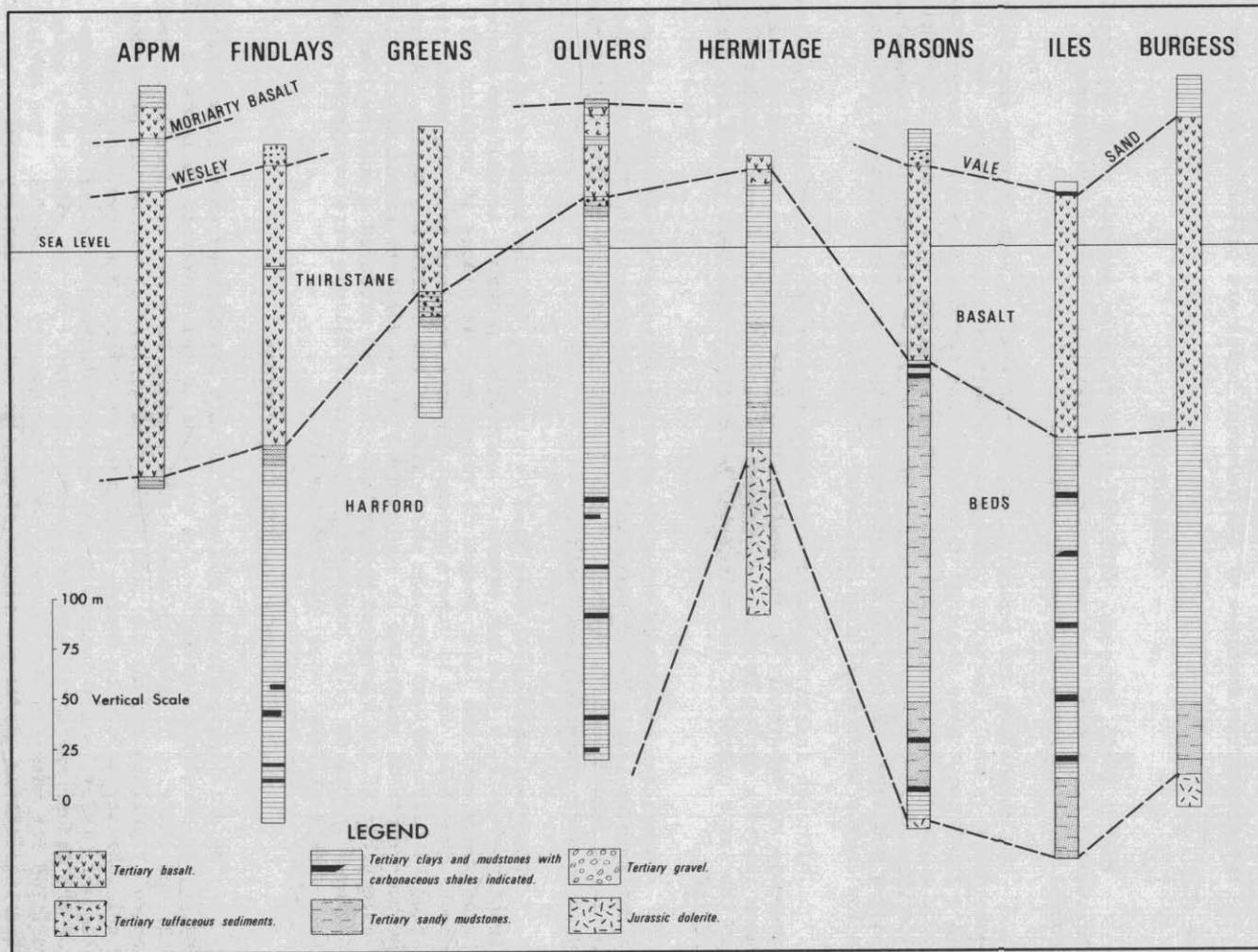


Figure 9. Stratigraphic correlations in the Port Sorell, Wesley Vale and Sassafras Basins.

<i>Depth (m)</i>	<i>Rock Unit</i>
24-55	Wesley Vale Sand
55-190	Thirlstane Basalt
190-195	Harford Beds

Non-artesian water was obtained from the bore, which was pumped at a rate of about 70 l/min.

Stratigraphic sections of the relevant holes are presented in Figure 9.

SEDIMENTATION

Burns' (1965) original Tertiary classification appears to be applicable throughout the region, and sufficient stratigraphic control now exists to postulate a tentative sedimentary history.

The morphology and sedimentology of the Harford Beds suggest that basin subsidence in early Tertiary times was concomitant with deposition. The unit is a thick monotonous sequence of mudstone and carbonaceous shale suggestive of a quiet shallow, lacustrine and at times reducing, environment. Although its base extends 300 m below present sea level, the presence of carbonaceous shales and lignites resting directly on Jurassic dolerite basement indicates a low energy environment from the onset of deposition.

Although initial deposition of these beds probably occurred contemporaneously but separately in the Wesley Vale, Port Sorell and Sassafras basins, each shared a common provenance leading to virtually identical lithologies. In the later stages of sedimentation, basement divides were topped and partly buried.

Subsequent widespread volcanic activity interrupted sedimentation and a thick sheet-like pile of lavas and minor pyroclastics (the Thirlstane Basalt) was laid down on a surface of shallow lakes and marshes (the top of the Harford Beds contains plant roots).

The overlying Wesley Vale Sand (a misnomer, for the sequence is predominantly clay) is a thin but extensive unit which probably accumulated contemporaneously with the later stages of volcanism. In places it contains tuffaceous sequences, and in others appears to have resulted from the remobilisation of clays derived from the weathering of the Thirlstane Basalt. A subsequent epoch of volcanism is represented by the Moriarty Basalt which filled valleys cut in the dissected Wesley Vale Sand and produced a shallow lead system. In places (e.g. Northdown, Sassafras?) valleys were overtopped and thin sheets of lava formed plateau basalts.

HYDROLOGICAL IMPLICATIONS

The drilling programme has conclusively established that the volcanic rocks are excellent aquifers - far superior to the sediments in terms of quality and quantity of potable water. The Harford Beds are too deep to be economically drilled and in any case their fine-grained clayey nature precludes their ability to supply useful quantities of water. With two exceptions (Cromer, 1975), holes drilled in the Wesley Vale Sand were failures because of the widespread occurrence of impermeable clay. On the other hand, holes drilled for water in the volcanic rocks are usually successful. The Moriarty Basalt contains useful quantities of good to excellent quality water, but with the exception of the Northdown and Sassafras plateaux, is of limited extent and catchment areas are small. Moreover, it is thin and extensively weathered.

In contrast, the Thirlstane Basalt is generally unweathered, and is a thick sequence of lavas of large area and enormous storage. Water quality is excellent, and although the unit is only partly exhumed, the overlying Wesley Vale Sand is thin and readily penetrated by drilling.

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APPENDIX 1

Geological log, Findlay's bore

LOCATION: Wesley Vale [DQ543402]

ELEVATION: 50 m

TOTAL DEPTH: 365.6 m

DATE DRILLED: 27.6.1973-5.2.1974

Depth (m)	Description	Rock Unit
0-9.2	Variable assemblage of ironstone quartz-gravels, and gravelly clay containing rounded quartz grains (2-3 mm) and ironstone fragments.	Wesley Vale Sand
9.2-19.6	Fresh fine-grained Tertiary basalt; vesicular, amygdaloidal (zeolitic) and in places porphyritic.	Thirlstane Basalt
19.6-28.8	Generally deeply weathered basalt, producing iron-stained red, brown, grey and white clays. Original texture retained. Vesicularity variable; basalt coarser grained at 25 m.	
28.8-61.5	Alternating sequence of fresh mainly non-vesicular basalt and weathered vesicular basalt; in zones 1-2 m thick. The latter is clayey in places. Calcite and chabazite are common in vugs and vesicles.	
61.5-62.1	Thin but distinctive zone of compact buff-brown volcanic material; base of layer appears to be chilled friable basalt; probably represents boundary between separate flows.	
62.1-63.5	Top of lower flow; very vesicular fine-grained weathered basalt at top passing into fresh material; small chabazite veins present; coarse-grained weathered pegmatite veins at 62.9 m.	
63.5-147.4	Interval similar to 28.8-61.5. Alternating distinctive sequence (in zones of from 1-3 m thick) of fresh non-amygdaloidal basalt and friable weathered amygdaloidal (chabazite) basalt.	
147.4-148.5	Base of basalt at 148.5 m. Weathered vesicular basalt (with sulphide blebs and globules) grading down into scoriaceous tuffaceous basalt. Tuffaceous material (above) in sharp contact with grey fine-grained baked quartz-pebble clay containing plant roots.	
148.5-165.3	Predominantly tuffaceous sequence including grey pebbly clay, agglomerate (150-150.5 m, with rounded sub-angular basalt pebbles in	

Depth (m)	Description	Rock Unit
148.5-165.3	a quartz-pebble clayey matrix), grey-green clays (150.5-153 m), volcanic breccia (angular fragments of basalt (some >10 cm) tuff, clay and sandstone in dark fine-grained matrix) and fine-grained tuffaceous sediments.	
165.3-365.6	Buff, grey, brown and black fissile finely laminated mudstone and rarer interbedded fine sand. Carbonaceous partings and leaf impressions common.	Harford Beds

APPENDIX 2

Geological log, A.P.P.M. bore

LOCATION: 2 km north of Wesley Vale, at entrance to A.P.P.M. Particle Board mill [DQ546413].

ELEVATION: 80 m

TOTAL DEPTH: 195 m

DATE DRILLED: 22.5.1964-11.12.1964

Depth (m)	Description	Rock Unit
0-1.0	Sandy topsoil.	Quaternary?
1.0-8.5	Sandy clay and silty sand.	
8.5-22.9	Weathered Tertiary basalt	Moriarty Basalt
22.9-52.5	Blue-green clay and gravelly clay, in places containing plant and shell remains.	Wesley Vale Sand
52.5-190.0	Tertiary basalt, composed of rhythmic sequence of hard and soft bands; deeply weathered in places.	Thirlstane Basalt
190.0-195.0	Sand, gravel and green-grey clay.	Harford Beds

APPENDIX 3

Geological log, Oliver's bore

LOCATION: Eastford Creek, 3.5 km north of Sassafras [DQ585327]
 ELEVATION: 80 m
 TOTAL DEPTH: 333 m
 DATE DRILLED: May 1974-March 1975

Depth (m)	Description	Rock Unit
0-3.7	No recovery.	
3.7-6.0	Yellow friable clayey sands, poorly sorted in places and containing quartz pebbles up to 1 cm.	Wesley Vale Sand?
6.0-9.0	Blue-grey coarse-grained Tertiary basalt. Generally massive and hard to 8 m, but in places finely fractured and weathered. Below 8 m, coarsely amygdaloidal, commonly with clayey and zeolitic amygdales up to 5 cm. Chilled and friable basal zone at 9 m.	Thirlstane Basalt
9.0-24.5	Green poorly compacted sub-basaltic tuffaceous(?) sand (section contains 20 cm dolerite boulder) grading down into grey-green and red-brown clay below 12 m.	
24.5-53.0	Tertiary basalt; variation in degree of vesicularity and weathering produces rhythmic sequences of hard non-vesicular basalt and amygdaloidal (zeolitic) basalt, each about 1 m thick. At 26.4, a clayey zone 2 m thick may represent deeply weathered basalt, or an inter-basaltic tuffaceous layer.	
53.0-57.7	Sub-basaltic red and green clay pellet conglomerate, rounded-angular pellets of clay and jasper up to 5 cm in diameter in a fine green-red clayey matrix may represent partly transported weathered amygdaloidal basalt.	
57.7-78.4	Pale grey-brown sandy mudstone with rare plant fragments and vivianite nodules.	Harford Beds
78.4-81.0	Grey-black tuffaceous(?) sandstone, with rare plant impressions.	
81.0-328.0	Thick monotonous sequence of grey-brown and pink mudstone. Thin carbonaceous shale bands are common, especially in lower parts, and plant impressions and vivianite nodules are present. Rare thin sandy mudstone horizons occur.	
328.0-333.0	Mottled grey and white coarse-grained sediments, composed predominantly of sand-size clay particles. Carbonaceous shales occur.	