east. At the "12-Mile" and "Dud" Bores, the Series is at least 1,045 feet thick, it has decreased in thickness to 800 feet at the "4-Mile" Bore, and in the vicinity of the Querrie Hills and Mt. Forrest it is only from 350 feet to 450 feet as shown by the No. 1 East and No. 2 East Bores in this vicinity. Generally speaking it may be said that, going westward from the vicinity of Querrie Hills, the depth to water increases at the rate of about 30 feet to the mile. Water in the No. 3 Bore should be found at a depth of about 450 feet; at Winning homestead the same water horizon should be met with at a depth of approximately 700 feet.

Mt. Forrest-Querrie Hills Area.—In this area the No. 1 East and No. 2 East Bores both obtained sub-artesian supplies at the base of the Winning Series at depths of 474 feet and 357 feet respectively. Having regard to the arrangement of the bed as shown in the accompanying cross section, water should be obtained at the No. 3 Site at approximately 400 feet. This depth has, however, already been passed, and it appears that some local folding is present causing the water-bearing horizon to be at a greater depth in this locality. I would expect water in No. 3 Bore at any depth below 400 feet, and almost certainly not deeper than 450 feet.

Three shallow unsuccessful bores marked on the plan "A," "B," and "C" have not gone deep enough to cut the water-bearing strata, although Bore "A" has met with salt water belonging to the same horizon as the salt water obtained in Nos. 1 and 3 Bores. Good water should be obtained in Bore "A" at a depth of approximately 350 feet; at Site "B" the water should be obtained between the depths of 475 feet and 525 feet; at Site "C" between 275 feet and 325 feet.

In stating the above probable depths to water a factor of uncertainty of 50 feet has been allowed because of the lack of accurate knowledge of the relative surface elevations of the bore sites. The depths given also assume that the water-bearing bed lies on an evenly sloping plane, and no allowance has been made for changes of dip which probably occur but to determine which, not sufficient data is available. The quoted figures are only approximate, and the failure to obtain water at these depths should not cause discouragement.

Nine-Mile Paddock Area.—In the Querrie Hills, Mt. Forrest Area, a salt water horizon occurs about 250 feet above the good water horizon at the base of the Winning Series. In the 9-Mile Paddock Area three shallow bores have obtained intensely salt water at depths between 100 feet and 150 feet, and a fourth bore obtained salt water at a depth of 32 feet. This salt water horizon is presumably the same as that met with in the Querrie Hills-Mt. Forrest bores, and on this assumption, good water should be obtained in the 9-Mile Paddock at a depth of approximately 400 feet. Some uncertainty, however, exists because comparison of the Winning 4-Mile Bore, Mia Mia No. 3 and Mia Mia No. 6 Bores suggests that the depth to good water in the 9-Mile Paddock is between 800 and 900 feet. As it is almost certain that the salt water horizon met with in the 9-Mile Paddock is the same as that cut in the Querrie Hills-Mt. Forrest Area, I would expect good water to be met with at the shallower depth (400 feet), but in the event of good water not being obtained in the 9-Mile Paddock at a depth of less than 600 feet, it is probable that the good water will not be met with until the greater depth (800 to 900 feet) is obtained.

The first test bore in this area should therefore be planned to go down to 600 feet, with a great probability of obtaining good water between 400 feet and 600 feet. In the event of this failing, it would of course be necessary to obtain a heavier plant than that at present in use, but the possibility of this being necessary is, in my opinion, remote.

Bannawong-Pleiades Area.—The paddocks in this area are underlain by Cretaceous Winning rocks on the eastern side along the Rabbit-Proof Fence, but it is doubtful whether any great thickness exists, and the possibility of obtaining sub-artesian water at the base is not as bright as elsewhere. Several tests within one or two miles of the Rabbit-Proof Fence would, however, be justified as the depth is not likely to be great, and one positive result would lead the way to the development of a number of similar supplies. The western paddocks in this area are underlain by older Palaeozoic rocks, and as a general rule, wells in sandstone areas are the most likely to meet with success. A Road Board well on Kialawibri Creek obtained a small supply of good water in a sandstone bed dipping westward. A station well on the same creek, two miles further north-west, has a very poor supply, which is obtained from a flat fissure in a shale band of the Lyons Glacial Stage of the Permo Carboniferous rocks. The rocks at both well sites dip westwards, but the angle of dip is not clear. It is certain, however, that the sandstone in the Road Board well passes underneath the shales of the Station well. This sandstone could be penetrated at the site of the Station well by boring, the depth necessary being governed by the angle of dip of the sandstone, which, unfortunately, is not known.

A bore at the Station well put down with the object of cutting the sandstone of the Road Board well is well worth while, as at this increased distance from the outcrop, the water supply in the sandstone will be under a greater pressure and therefore likely to give better supply. Further search for water in the older rocks would best be confined to boring in sandstone areas, with the object of obtaining supplies in porous sandstones such as those in the well near Windalia Pool and near Round Hill.

To obtain supplies in the western paddocks of Winning Station it will be necessary to bore to depths of between 800 and 1,100 feet as indicated on the accompanying cross section, the shallower water being obtained nearer the Homestead and the deeper water near the west boundary. There is a possibility, which has already been mentioned, of obtaining small supplies at a depth between 100 and 200 feet along the west boundary of Winning, but the supply is likely to be insufficient.

ARTESIAN AND SUB-ARTESIAN WATER POSSIBILITIES, WOODLEIGH STATION, MURCHISON DISTRICT.

(F. G. Forman, B.Sc.)

Woodleigh Station and the adjoining properties are, except for a narrow coastal strip which is covered by Tertiary and Post Tertiary rocks, entirely covered by rocks of Cretaceous age.

The Cretaceous rocks can be divided into two groups, an upper consisting of bright coloured shales, clays, and chalks or chalky clays; and a lower group of dark coloured (dark grey to black) shales and clays, with at or near the base thin beds of sands and sandstones. Occasional thin cherty beds are distributed through both the upper and lower groups.

Little of the Cretaceous rocks can be seen at the surface as the greater part of the country is covered by red sand and, in places, travertine, which effectively mask the underlying rocks. The upper group of the Cretaceous is, however, exposed fairly well in a group of low flat-topped hills on Yaringa and Yaringa South Stations, where it is seen to consist predominantly of white or greenish clays or chalky clays. The lower group can only be studied by the examination of the logs of numerous bores put down in the search of water.

Near Mt. Curious, at the mouth of the Murchison River, a fairly complete section of both the upper and lower Cretaceous is exposed. This section (which was examined by the writer on an earlier trip) is, however, somewhat different to the sections cut in the numerous bores in the Wooramel District and north to the Gascoyne. An approximate section of the Mt. Curious beds is given below, the main difference between this and the sections cut in bores further north being the increase in the proportion of sandy beds towards the south.

——	Thickness, in Feet.	Nature of Strata.	Remarks.
	100	Chalk	Fossiliferous; Inoceramus fragments; Ostrea sp; Spirulaea sp; Trigonosemus sp; spines and plates Cidaris; fish scales and teeth; Belemnite guards.
Upper Group ...	50	Current-bedded sandstones with pebble bands	
	10	Chalk	Fossiliferous; Inoceramus fragments.
	25	Greensand	
	25	White and ferruginous, current-bedded sandstone	
	10	Brown argillaceous sandstone with thin streaks of gypsum	
	10	White and ferruginous current-bedded sandstone	
	7	Greensand	
	15	White and ferruginous coarse and fine-grained sandstone	
	5	Gritty chalk	Fossiliferous; Inoceramus fragments.
	15	Greensand with brown sandy streaks	Fossiliferous; fish scales.
Lower Group ...	Uncertain—100–200	Dark grey and green shales	Fossiliferous; Belemnite guards.
		Coarse-grained current-bedded sandstone	Possibly Kennedy Stage of Permo-Carboniferous.

In bore cores or sludge from percussion plants, the Upper Cretaceous group is readily identified by the presence of chalk and chalky clays carrying numerous fragments of Inoceramus; the lower group is just as certainly identified by the preponderance of dark grey to black clays and shales.

The Cretaceous rocks in this area rest on a series of sandstones and shales, probably the Kennedy Stage of the Permo-Carboniferous. This group is not exposed anywhere in the area examined, but can be readily identified by studying the logs of the deeper bores between the Wooramel and Gascoyne Rivers, the break from the dark shales and clays of the Cretaceous into the predominating sandy beds of the Kennedy Stage being in most cases distinct. The coarse current-bedded sandstones below the Cretaceous near Mt. Curious are tentatively referred to the Kennedy Stage.

The principal water-bearing beds of the district are the sands and sandstones at or near the basal Cretaceous rocks and the sandstones of the Kennedy Stage, the latter, however, having only been exploited in this area by a few of the deepest bores.

The majority of the bores on Woodleigh Station and all those on Yaringa South Station which adjoins Woodleigh on the west, obtain their water from the basal Cretaceous sands. Only Woodleigh Nos. 4 and 9 Bores and possibly Woodleigh Nos. 1 and 2 Bores have penetrated to the Kennedy sandstone group, and none of them has been successful in obtaining useful water supplies below the base of the Cretaceous rocks. Several bores on Wahroonga Station, which lies north of Woodleigh, have, however, obtained flows in the Kennedy sandstones.

The accompanying cross sections from west to east through the principal bores on Yaringa South and Woodleigh Stations illustrate the water conditions which exist in this area. The upper dotted line in the sections represents the potential head of water in the basal Cretaceous aquifer, *i.e.*, the height to which water would rise in a bore cutting this horizon. Where the potential head line rises above the surface, artesian conditions exist, *i.e.*, water will flow at the surface from the bore at such a position. Where the line passes beneath the ground surface only subartesian water will be obtained, and where it cuts the line marking the base of the Cretaceous rocks or passes below that line, no water would be obtained.

A study of the sections will make it clear that no water is likely to be obtained from the basal Cretaceous aquifer, at any site on Woodleigh Station east of the line joining the sites of Nos. 3 and 4 bores, as the potential head line passes below the base

PLATE Nº II

PLAN OF
WOODLEIGH STATION

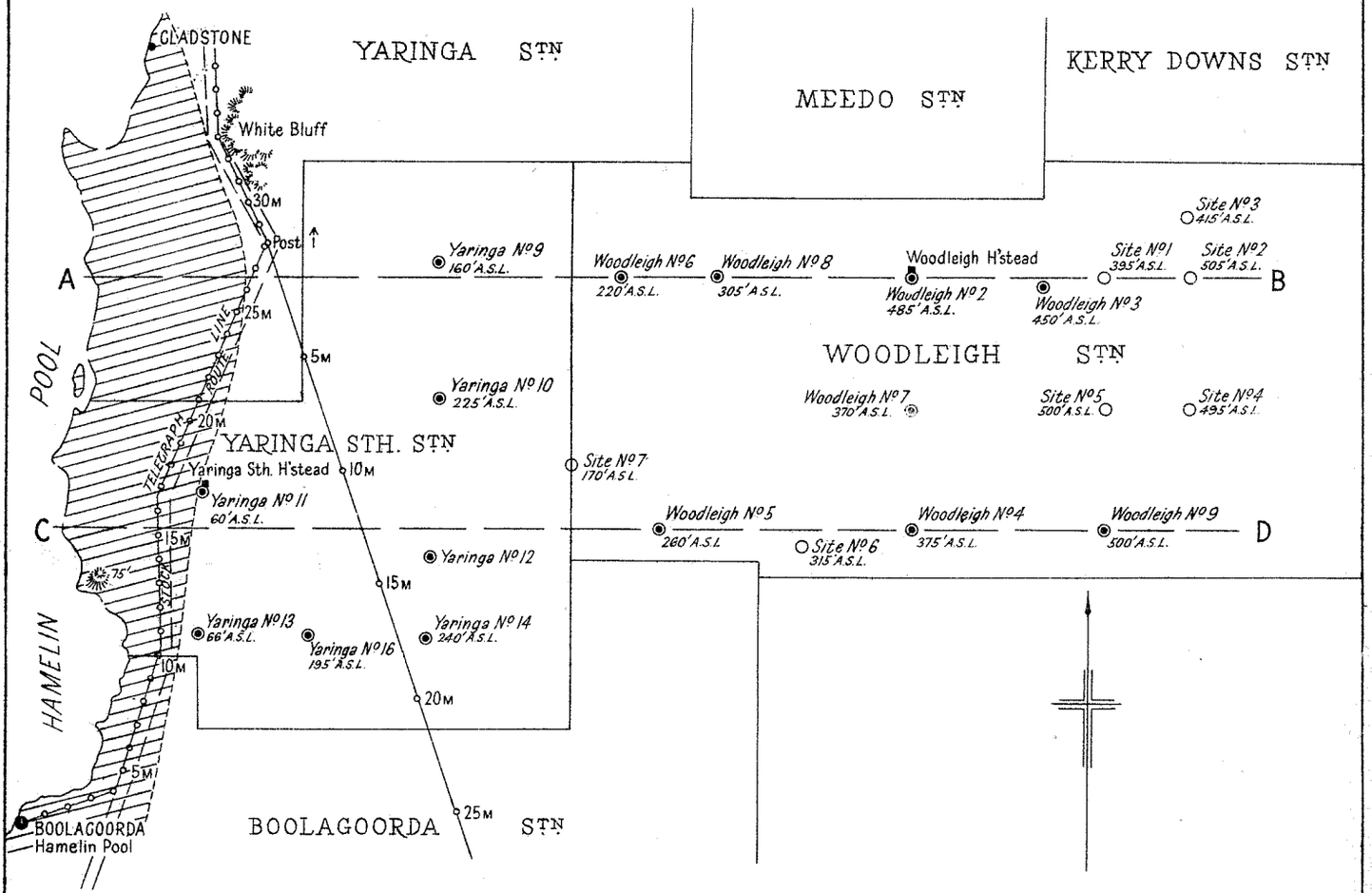
Showing Distribution of Bores and Bore Sites

To accompany report by F.G. Forman Govt. Geologist

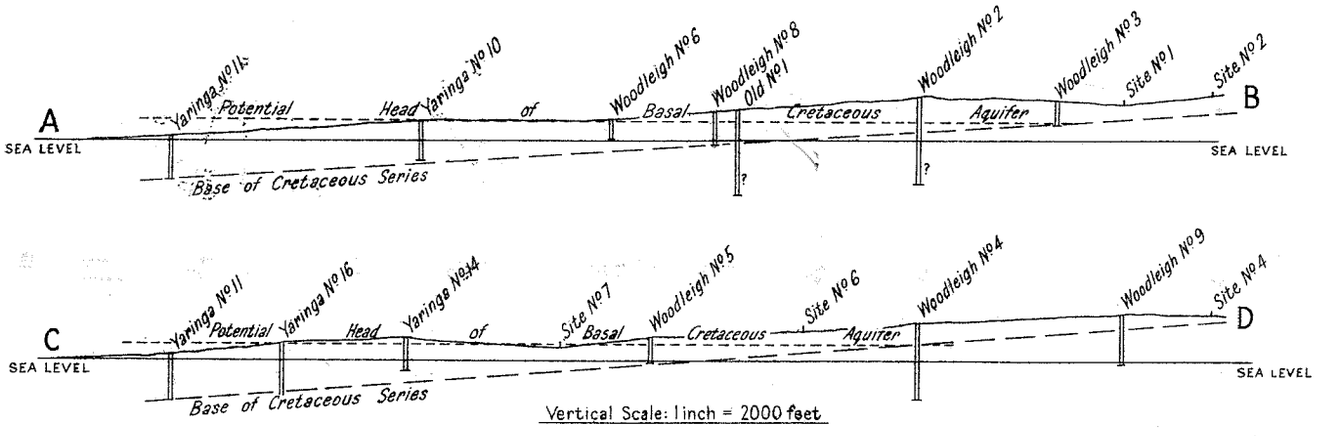
Scale 600 Chains to an Inch

600 0 600 1200 CHAINS

MILES 8 0 8 16



CROSS SECTIONS ON LINES A-B AND C-D



Vertical Scale: 1 inch = 2000 feet

LEGEND

TERTIARY & SUB-RECENT

CRETACEOUS

J.McL. del. 25/1/37

of the aquifer just east of these points. Sites 1, 2, 3, 4 and 5 are therefore clearly unsuitable places in which to bore for shallow water.

Sub-artesian conditions exist on Woodleigh Station west of the line joining the Nos. 3 and 4 bores, as may be seen from the sections. It should be noted, however, that a bore at site 7 would probably obtain artesian water at a depth of about 280 feet; the potential head line passing above the surface at this point. The water obtained would probably be of fair quality.

Bore No. 6 is one of the shallowest on the Station, and the supply from it could be improved by deepening to the basal Cretaceous aquifer. The water at this point should be of a fair quality. Owing to the fact that the elevations used in the preparation of the cross sections are only approximate (aneroid barometer elevations) it is uncertain if the No. 6 bore site is actually above or below the potential head line, but it is certain that if the bore were deepened, the water would rise at least very close to the surface.

Site No. 6 should yield a sub-artesian supply from a depth of 230 feet; the quality would probably be poor stock water* similar to that obtained from No. 7 bore.

That portion of Woodleigh Station west of the line joining Nos. 3 and 4 bores can be adequately watered by bores put down to the base of the Cretaceous, with depths varying with the elevation of the ground. At any site with a surface elevation of less than 180 feet, artesian water should be obtainable. Unfortunately such sites are rare on the property as the general elevation is 300 feet to 400 feet above sea-level. Site No. 7 has already been mentioned as a favourable location for a flowing bore.

The eastern portion of Woodleigh Station must depend for its water supplies on bores drilled to possible aquifers in the Kennedy sandstones, below the base of the Cretaceous rocks. The nearest points to Woodleigh Station on which the Kennedy sandstones have been exploited are the Nos. 1, 3 and 5 bore sites on Wahroonga Station to the north. Wahroonga No. 1 bore obtained flows from sandstones at depths of 144 feet and 343 feet below the base of the Cretaceous. No 3 bore obtained flows at depths of 125 feet and 460 feet below the Cretaceous, and No. 5 bore obtained a flow from a depth of 136 feet below the Cretaceous.

Woodleigh No. 4 Bore was sunk to a depth of 800 feet below the surface, and beneath the basal Cretaceous beds penetrated chocolate and grey shales similar to those in Wahroonga No. 3 Bore. These shales are regarded as a lateral variation in the Kennedy sandstone. A water horizon was cut between 752 feet and 758 feet. Salt water was obtained at the base of the Cretaceous in this bore, the water level standing at 228 feet below the surface. The standing level of the water after cutting the deeper aquifer at 752 feet was 240 feet, which makes it clear that the deeper aquifer has a lower potential head than the shallower one. These two waters were not separated during drilling operations and consequently it is almost certain that the upper salt water is mixing with the lower water, and this bore cannot be considered a fair test of the quality of the water in the deeper aquifer. At present it is unfit for stock, but it is pointed out that it is almost certainly contaminated by the upper salt water.

Woodleigh No. 9 Bore penetrated 343 feet below the base of the Cretaceous, which is not deep enough to reach the 752 ft. aquifer in No. 4 Bore, which is about 500 feet below the base of the Cretaceous.

The logs of Woodleigh Nos. 1 and 2 Bores are unreliable owing to the confusion of records, and it is now difficult to state the depths of either bore or the water conditions found at the lower levels.

The only useful evidence therefore of the presence of water below the base of the Cretaceous rocks on Woodleigh Station is afforded by No. 4 Bore, which, as previously pointed out, does not supply a conclusive test. Owing to the lack of knowledge of the surface elevations or the static heads of the flowing bores on Wahroonga Station, it is difficult to form an opinion of the probable potential head of waters in the lower beds on Woodleigh, but Woodleigh No. 4 Bore does afford some evidence that useful water supplies might be present with a potential head of about 130 feet above sea level.

The only method of proving the presence or absence of useful deep water supplies on the eastern portion of Woodleigh Station and the surrounding country is by boring in search for aquifers below the base of the Cretaceous rocks. A position should be chosen east of the line joining Woodleigh Nos. 3 and 4 Bores at as low an elevation as possible, and a bore put down to at least 1,000 feet and preferably to 1,500 feet. The 756 ft. aquifer of Woodleigh No. 4 Bore should be expected between the depths of 700 and 800 feet, and a 1,500 ft. hole would provide for exploration for a depth of 700 feet below this.

BORING FOR "DEEP LEADS," GREENBUSHES TINFIELD, SOUTH-WEST DIVISION.

(F. G. Forman, B.Sc.)

An inspection of the alluvial ground of the Greenbushes Tinfield† by the writer in 1933, led to the conclusion that deep leads likely to carry payable tin might exist below the shallow alluvial ground worked in the past, particularly in the vicinity of the Phoenix East and Battler's Hope leases.

During April of this year, a further inspection was made and bore sites located by Mr. H. A. Ellis, of this Branch. Boring with a percussion power plant commenced in August on the first line of bores located by Mr. Ellis on the Battler's Hope leases. Information gained in the first few holes caused the abandonment of the original programme, the bore sites as finally selected being shown on the accompanying locality plan.

Six holes on the Battler's Hope leases and three holes immediately to the west of the Phoenix East lease proved the existence of deep alluvial ground below the level to which the leases and claims had been worked previously, but failed entirely to locate payable tin deposits in this deep ground.

Assays of the material from the upper part of the holes indicated extensions of the previously worked shallow ground, but the distribution of the bores and their number was insufficient to indicate the full extent of shallow alluvial tin or its average grade.

* Since writing this report I have been informed by Mr. A. Thomson, of Woodleigh Station, that there is a probable leakage of an upper salt water into the No. 7 bore. If this leakage were stopped, the quality of the water in No. 7 bore would probably be improved.

† G.S.W.A. Ann. Prog. Rept. 1933, pp. 13-15.