Rept.Bk.No. 61/86
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DEPARTMENT OF MINES
SOUTH AUSTRALIA

GEOLOGICAL SURVEY

ENGINEERING DIVISION

RIVER MURRAY DRAINAGE INVESTIGATION

PROGRESS REPORT NO. 3

by

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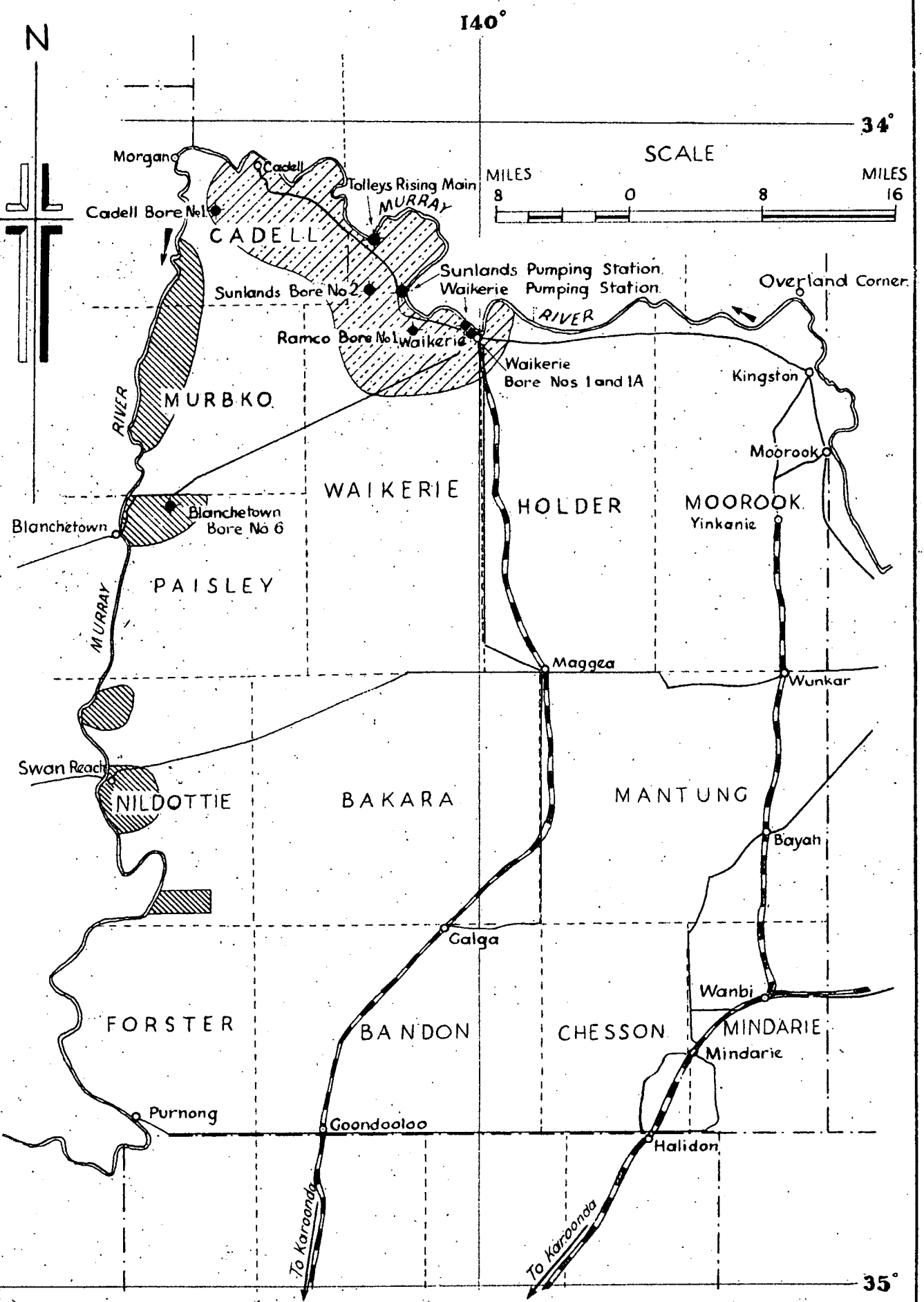
19th November, 1965.



LEGEND

Progress Report No. 1.

Progress Report No. 2. (Localities Referred to)

Progress Report No. 3.

S.A. DEPARTMENT OF MINES

Approved	Passed	Drn. MRL	RIVER MURRAY DRAINAGE INVESTIGATION	D.M.	Scale 1 inch = 8 Miles.
		Tcd. MRL	Locality Plan showing Areas Investigated	Req.	S-4307 Jab
Director		Ckd. J.B.A.			Date 26-8-65
		Exd.			

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PLANS AND SCHEDULES

	PLAN NO.
Locality Plan showing Areas Investigated	S.4307
Proclaimed Irrigation Areas	S.4635
Programme and Bore Location Plan	65-826
Plan of Sub-surface Edge and Upper Surface Contours of the Blanchetown Clay - Northern Area	65-862
- Southern Area	65-861
N.W. - S.E. Cross Section No's. 1 & 2	65-870
" " " No's. 3 & 4	65-871
Analysis of Drainage Potential - Bore Logs	S.4831
Water Levels - Plan	65-1255
Static Water Level Contours - Plan	S.4531
Bore Schedule - Cadell Programme	
Logs of Bore No's 1-15 Cadell Programme	
Bore Schedule - Sunlands Programme	
Logs of Bore No's 2 - 28 Sunlands Programme	
Bore Schedule - Ramco Programme	
Logs of Bore No's 1 - 25 - Ramco Programme	
Bore Schedule - Waikerie Programme	
Logs of Bore No's 1 - 15 Waikerie Programme	
Bore Schedule - Holden Programme	
Logs of Bore No's 1 - 8 Holden Programme	

CONTENTS

	Page
ABSTRACT	1
INTRODUCTION	1
HISTORICAL	1
Development	2
Drainage	3
METHODS OF INVESTIGATION	4
PHYSIOGRAPHY	7
GEOLOGY	8
Dune Sands	9
Kunkar	9
Bungunnia Limestone	9
Blanchetown Clay	10
Norwest Bend Formation	10
Loxton Sands	11
Pata Limestone	11
Morgan Limestone	12
Finnis Clay	12
Mannum Formation	12
HYDROGEOLOGY	13
(a) Causes of Drainage Problems	13
Areas underlain by Blanchetown Clay	13
The Ramco Heights-Golden Heights Area	14
Sunlands Area	15
Areas not underlain by Blanchetown Clay	17
(b) Underground Drainage Methods	18
Aquifer analysis	22
Waikerie	23
Ramco Heights	23
Sunlands	24
Riverine Flats	24
ESTIMATION OF DRAINAGE WATER VOLUMES	25
Waikerie Irrigation Area	26
Private Irrigation Areas	27
STATIC WATER LEVELS	28
WATER QUALITIES	30
CONCLUSIONS AND RECOMMENDATIONS	31

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DEPARTMENT OF MINES
SOUTH AUSTRALIA

RIVER MURRAY DRAINAGE INVESTIGATION

PROGRESS REPORT NO. 3

ABSTRACT

The geology of the district south of the Murray between Cadell and Holder is described, with particular reference to the affect on the irrigation areas in terms of both creation and solution of drainage problems.

The occurrence and nature of the "Blanchetown Clay" as the main shallow aquiclude is evaluated in some detail. Exploratory bores sunk to examine the main aquifer horizons in the Lower Miocene limestones are assessed in terms of suitability for drainage water disposal, and limited experimental work carried out to try and improve aquifer characteristics by chemical treatment is described.

The report reviews, in particular, the problems likely to arise in the recently established private irrigation areas and suggests, where possible, the most likely danger spots. Established drainage methods in the Waikerie Irrigation Area are noted, and a general analysis of likely future requirements is made for guidance in planning new bores.

Brief referenae is made to the regional pattern of groundwater as it affects drainage of excess irrigation water.

INTRODUCTION

The area covered by this report includes an important zone of irrigation development entirely dependent on underground methods of drainage for the disposal of excess irrigation water.

An established irrigation area of long standing, and administered by the Lands Department of the South Australian Government surrounds the township of Waikerie while, to the west, several large and important private irrigation areas have been lately set up. Together they form a major economic unit at the downstream end of the so called Upper Murray of South

Australia.

Drilling provided a basin for studying the geology of the area and, in addition to the established irrigation areas, zones of potential development were investigated to facilitate future planning. Since there is no coordinated plan for development, however, it was not considered practicable to test drill the whole area against any eventuality. This particularly applies to the northern bank of the Murray where no drilling was undertaken because of the fragmentary character of present irrigation development.

This report does not include details of aquifer tests carried out during and subsequent to the geological investigation. These will be the subject of a separate progress report as soon as the analysis of data is complete.

HISTORICAL

Development

Irrigation in the Waikerie district began in the last decade of the nineteenth century with the establishment of small Village Settlements on the first slopes of the river valley at Holder, Waikerie and Ramco.

The original 460 acres under irrigation was increased to 2050 acres in 1909 and the system was nationalised in the following year by the proclamation of the Waikerie Irrigation Area to include Waikerie and Holder. Ramco was added to the Area in 1912. During this period the present basic channel system in the Waikerie Irrigation Area was established and pumps installed capable of delivering 6-7 cusecs. These soon proved inadequate, however, and progressive increases were made in the next few years to a capacity of 45 cusecs by 1921.

The district expanded again after the Second World War and in 1957 the pumping capacity was raised to 59 cusecs, the full capacity of the main channel. This is now used to irrigate

approximately 3,800 acres comprised of 1,700 acres of vines, 1,400 acres of citrus and 700 acres of deciduous trees.

Furrow methods of irrigation have been used almost exclusively in the Waikerie Irrigation Area although several block holders have installed sprinkler systems in recent years.

No significant extension of irrigation took place outside the Waikerie Irrigation Area in the period up to 1959. In 1956 a very high flood on the River Murray resulted in loss of trees on a lowlying portion of the Waikerie Irrigation Area. Rehabilitation of the settlers concerned was investigated by a specially formed committee called the Waikerie Irrigation Extension Committee. At this time lack of pump capacity prevented an extension of the irrigated acreage within the Waikerie Irrigation Area and attention was turned to other suitable areas nearby to satisfy the land hunger.

A further stimulus may also be attributed to the introduction of sprinkler irrigation systems capable of watering deep sandy soils not suitable for conventional furrow type irrigation.

Since 1959 four areas have been developed (Golden Heights, 1959, Sunlands South, 1962, Sunlands North, 1963, and Ramco Heights 1965) under private co-operative systems of management bringing over 3,000 acres of citrus, vines and deciduous trees under irrigation.

Drainage

Water logging problems first became serious after the First World War and drainage bores were put down by the Mines Department at the request of the Waikerie Irrigation Commission in 1925/26 (14 holes), 1928 (11 holes) and 1931 (8 holes).

The first assessment of the drainage of the district was made by Tisdall in 1936. He reported on various irrigation areas along the River Murray and considered the effect of the shaft-well system already in wide use in Waikerie, comparing it

favourably with the tile drainage systems used elsewhere.

In 1941 the results of a soil survey of the Waikerie Irrigation Area by Herriott and Johnson were published by the C.S.I.R.O. The report comes to the conclusion that the 'position of bores in relation to soil type ..... is most important'. The authors noted that, at that time, about seventy deep sumps and bores were in use in the area.

Barnes' survey in 1951 was concerned with the underground water resources of counties Alfred and Albert and little attention was directed to drainage problems. The report however gives the first assessment of the geological section exposed in the cliffs at Waikerie.

By 1964 a total of at least 235 drainage bores had been drilled in the Waikerie Irrigation Area. With the exception of the original 33 5" diameter bores drilled by the Mines Department in the period 1928-31, all the bores appear to be 4" in diameter, and the procedure used in sinking and equipping drainage points seems to have been standard throughout. All the bores are located in sumps which vary in depth from less than 5' to a maximum of 48', the majority being between 10' and 20' deep.

METHODS OF INVESTIGATION

The first systematic work, after P.G. Miller's preliminary survey, was done during the sinking of a drainage Bore (Bore 2.S) for the Sunlands Irrigation Board in November, 1964. This bore was cored throughout to a depth of 110' and provided the first opportunity of examining the full range of strata away from the indifferent sections available along the banks of the River Murray. Several important aquiclude horizons were penetrated, including the Plio-Pleistocene clay noted by Miller at the top of the river section to the east of the bore. Below 110' the borehole intersected a satisfactory

aquifer in the Morgan-Mannum sequence, and tests carried out using slugs of 4-500 gallons of water confirmed the drainage potential of the strata.

A comparison of the log of Bore 2.S with the logs of bores drilled in the 1925-31 period revealed wide discrepancies and it was clear that several more cored holes would be necessary to establish a basic reference network across the area.

Before any further drilling was undertaken a thorough search was made of the drainage bores in existence. Approximately 235 bores were found but no logs were forthcoming due to the failure of the drilling company responsible for most of the holes to keep records. The survey did reveal, however, that, with few exceptions, the bores performed poorly. The reasons for this were not immediately obvious but part of the trouble was attributable to inadequate maintenance.

Two more cored holes (Bores 1.W and 1.R) were drilled early in 1965 and the initial programme was completed in July, 1965 with a fourth stratigraphical hole (Bore 2.W).

The results of Bores 1.W and 1.R confirmed that lateral changes in lithology were present across the area in both the Pliocene and Lower Miocene beds. Correlation of strata by lithology was therefore dangerous and a palaeontological study was made by J.M. Lindsay to establish the detailed stratigraphy of the bores and key river sections. The results of this study were of paramount importance, throwing considerable light on the reasons for the unsatisfactory performance of most of the drainage bores in the Waikerie Irrigation Area.

The other major geological problem was the delineation of the "Blanchetown Clay", the aquiclude lying immediately below the Recent dune sands over wide areas. Drilling carried out during the period covered by Progress Report No. 1 traced the clay northwards from Blanchetown to the south end of the Cadell Irrigation Area. The present programme explored the left bank of the Murray south eastwards to Waikerie over an area of

approximately 75 square miles.

A Failing W.W.1 air driven rotary drill was used for this stage of the investigation. The work was divided into five programme areas to assist in the subsequent location of specific boreholes, the holes being laid out on an approximate one mile grid except for one large area where it proved impossible to reach bore sites because of high shifting sand dunes and thick bush. The holes were drilled through the clay stratum or in clay free areas, to a sufficient depth to identify the rocks penetrated. Latterly some holes just penetrated the top of the clay where it was necessary to fill in details of the upper surface contours.

The programme areas and bore locations of all holes drilled to the end of July, 1965 are shown on Plan No. 65-826. All the bores were accurately levelled and referred to the Mean Sea Level datum used to produce the base contour maps compiled by the Lands Department. Four bores (13.W, 14.W, 15.W and 25.R) drilled since July 1965 are shown only on Plan No. 65-861.

During the final stages of the work a further attempt was made to apply geophysical techniques to the problems of the area. Several test traverses were made along section lines of drilling. Generally speaking the results were disappointing in that characteristics immediately below ground level masked the effects of lower horizons. This work will be described later in a further Progress Report. (No. 5)

Work is continuing in the area to examine the aquifer characteristics of the main drainage aquifers in the Morgan-Mannum sequence of the Lower Miocene. This involves pump-in and pump-out tests and data obtained from these tests will be recorded at a later date in Progress Report No. 6.

PHYSIOGRAPHY

The present phase of the investigation is concerned with a small portion of Murray Valley plain lying within the major loop of the river south east of Morgan.

In common with the major part of the Murray Basin in South Australia the area is devoid of significant topographic expression and completely lacks a defined drainage pattern. The base level of the plain is at about 125 feet above mean sea level, but depressions occur to a minimum level of about 85 feet, and minor isolated hills rise to a maximum altitude of just over 200 feet.

The major topographic feature is provided by the Murray on the north eastern edge of the area. There the plain terminates against sheer cliffs in places over 100 feet high, or gradually drops away across abandoned meander loops of the river which have been partially infilled with blown sand deposits.

Minor relief on the plain is the result of two main factors. In the first place thickness variations in the "Blanchetown Clay" have resulted in several gentle hills or mounds notably north and west of Sunlands Pumping Station, 7 miles south west of Waikerie and at Golden Heights. This relief has been preserved by the overlying tough kunkar horizon and subsequently modified by a veneer of Recent sand dunes varying in thickness from zero to at least 70 feet. Two dunes systems are evident; the earliest takes the form of elongated dunes running east-west across most of the area while a younger system of arcuate dunes is confined to an area of about 8 square miles south east of the Cadell Irrigation Area.

The area was originally covered with typical Mallee vegetation but much of this has now been cleared and, in addition to the extensive tracts of land under irrigation, considerable acreages of wheat are now grown.

GEOLOGY

The detailed stratigraphy of the Waikerie area from the upper levels of the Lower Miocene to the Upper Pliocene has already been described in detail by J.M. Lindsay from a study of bores and cliff sections. Bore 2.W penetrated strata down to the Upper Eocene and in view of the significance of this bore it will be the subject of a later Progress Report.

This account of the sequence is concerned with the geology as it affects underground drainage, and is summarised as follows:-

AGE	FORMATION	THICKNESS	LITHOLOGY
RECENT		0 - 70'+	Dune sands, limy dune sands.
Pleistocene	Kunkar	0 - 6'	Tough, massive or pebbly limestones overlying soft grey marls.
	"Bungunnia Lst."	0 - 5'	Flaggy, dense, greenish limestone.
	"Blanchetown Clay"	0 - 70'+	Blue-green and brown clay and silty clay. Underlain in places by 0-4' of greenish-yellow very clayey fine sand.
Upper Pliocene	Norwest Bend	8 - 22'	Calcareous sands, calcareous sandstone or oyster beds.
Lower Pliocene	Loxton Sands	0 - 20'	Cross bedded, calcareous sands.
Lower Miocene	Pata Limestone	0 - 44'	Variable interbedded limestones, marly limestones and sandy limestones.
	Morgan Limestone	125' approx.	30-70' marls and marly limestones over limestones and sandy limestones.
	Finniss Clay	0 - 12'	Marl
	Mannum	225' approx.	Mainly limestones with some marly horizons.

Dune Sands

The pattern of dunes has already been described in an earlier section. The thickness of sand varies widely across the area from practically zero over some low lying areas to thicknesses in excess of 70', notably near Bores 6.R and 7.R on the western side of the high ground at Golden Heights.

The sands vary widely and appear to be poorly graded. In the thicker sections three or four limy horizons may be distinguished in the profile, varying from very calcareous loose sands to semi-consolidated kunkar. The limy horizons are important hydrogeologically since they are of a low permeability and may contribute to perched water tables near the surface. The sands are often rather clayey in nature and this results in only a moderate permeability.

Herriott & Johnson studied the upper part of the sands in the Waikerie Irrigation area in their soil report. Five main soil types were distinguished on the basis of the physical constitution down to a depth of 5'. Whilst the soils have been studied for irrigation development on the new areas at Golden Heights, etc. no formal reports have as yet been published of this work, and no detailed comparison can be made with the Waikerie Irrigation Area.

Kunkar

The main kunkar horizon varies widely in its development across the area but it appears to be continuous. In sheet form it is almost a complete aquiclude and even in the pebbly areas underlying marly sands invariably form an effective barrier to the downward percolation of excess irrigation water.

"Bungunnia Limestone"

The "Bungunnia Limestone" is believed to occur over most of the area although it was not recognised in all the

boreholes. It consists of a thin bed of hard flaggy greenish limestone usually about 1-2' thick but rarely up to 5' in thickness. Often the bed is intimately associated with the calcareous crust of kunkar and is therefore difficult to recognise.

Little special hydrogeological significance is attached to the bed except insofar as it forms one of a series of aquicludes immediately at the base of the Recent dune sands.

"Blanchetown Clay"

This is an extremely important horizon occurring over wide areas although, surprisingly, no clay appears to be present under a major part of the Waikerie Irrigation Area.

The "Blanchetown Clay" consists of a practically impermeable series of dense clays and silty clays except for certain relatively small discontinuous areas where substantial thicknesses of gypsum are present. One such locality lies near the west end of Sunlands South (see Bores 15.S, 24.S, and 2.R). Further occurrences are at Bores 22.S and, of a minor nature, 4.C. Where gypsum is present to the exclusion of clay the horizon becomes quite pervious, as demonstrated by crystals of gypsum found over a range of many feet in the underlying sands or limestones.

A band of very clayey fine sand is recorded by many bores at the base of the clay. It is provisionally considered to be part of the "Blanchetown Clay" rather than the underlying Norwest Bend Formation.

Norwest Bend Formation

This formation occurs over the whole area and displays an extreme variability in lithology. Oyster beds are common in the northern part of the area while a tough recrystallised calcareous sandstone is developed near Ramco Lagoon and in the cliffs in Waikerie township. Borrow pits on the main road

5 miles southwest of Waikerie show a soft green and yellow sand and sandstone with oysters and this type of lithology was intersected in many bores.

Since the Norwest Bend Formation occurs close to the surface in areas where the Blanchetown Clay is absent it has some significance from a drainage point of view. Generally the drainage characteristics are poor and troublesome perched water tables may be formed close to the surface.

Loxton Sands

The Loxton Sands have been recognised at Sunlands Pumping Station and at Tolleys Pumping Station but have not, as yet, been positively identified by drilling. This is, no doubt, due to the close similarity between the facies developed by the Loxton Sands and the Norwest Bend Formation.

The sands of this formation have no great hydrogeological significance in the Waikerie area and can safely be ignored.

Pata Limestone

This formation appears to be developed only in a narrow belt through Sunlands Pumping Station and Bore I.R. In the former locality it consists of a hard sandy limestone about 18 feet thick, while in the bore it is 44 feet thick and consists of sandy limestones containing four significant marly layers.

The Pata Limestone is important in the Ramco area because of a superficial resemblance to the Morgan Limestone. In these circumstances uninformed drilling could lead to trouble if drainage holes were terminated in this horizon in the belief that the aquifer in the Morgan Limestone had been penetrated.

Morgan Limestone

The success of underground drainage in the Waikerie district depends largely on the aquifer characteristics of this formation, and in consequence, considerable attention has been paid to the examination of the rock in the key bores and, to a lesser extent, in the cliff sections.

The formation consists of a lower limestone sequence 70-80ft. overlain by a series of marls and marly limestones from 30-70ft. thick. The base has not been defined in every hole because there is often no lithological change down into the underlying Mannum Formation and accurate definition is possible only by microfaunal changes.

The strata sequence is well exposed in the river cliffs between Waikerie Pumping Station and Holder and is intersected with minor variations in Bore I.W. and 2.W. In this area the top marly series is between 30ft. and 50ft. thick but to the west and northwest in Bores I.R. and 2.S. 70ft. of marl and marly limestone overlie the aquifer limestones.

Finniss Clay

Insufficient bores have been drilled to establish the extent of this horizon. In any case it appears to have no characteristics to distinguish it from other marly horizons except by microfaunal changes.

Mannum Formation

This formation is characterised by the overall 'cleanliness' of the Limestones. Some marly horizons were intersected in Bore 2.W. but in general the formation has superior aquifer characteristics to the overlying Morgan Limestone.

HYDROGEOLOGY

Drainage, as it affects the irrigation areas, may be conveniently discussed under two separate headings.

a. Causes of drainage problems.

b. Underground drainage methods.

Causes of Drainage Problems

The River Murray Drainage Investigation, as originally conceived, was concerned mainly with the definition of the 'Blanchetown Clay' as an aquiclude already causing, or likely to cause, serious drainage difficulties in irrigation areas along the Murray. It is evident however, that this horizon is only partially responsible for poor drainage and other horizons are almost equally impermeable. Some of these horizons are definable geologically over wide areas whereas others are merely lithological variations of a semirandom nature within a specific layer. In this report it is proposed, firstly, to deal with the Blanchetown Clay and secondly, in less detail, to examine some of the other aquiclude conditions noted in the course of the investigation.

Areas underlain by Blanchetown Clay

The 'Blanchetown Clay' is a readily recognisable horizon lying close to the surface over much of the area investigated. The detailed geology of the clay is illustrated on Drawing Nos. 65-861 and 65-862 together with sections on Drawing Nos. 65-870 and 65-871. They indicate that the base of the clay is practically horizontal over most of the area while, in contrast, the upper surface shows considerable variations in level notably in the form of several 'hills' rising from a general elevation of 100 ft. above M.S.L. of the three main 'hills' proved by drilling, two lie below private irrigation areas (Ramco Heights-Golden Heights and Sunlands) and one is located on the S.W. margin

of the area across the Waikerie - Blanchetown road (See Bores 14R and 15R).

The Ramco Heights-Golden Heights Area

Under the Ramco Heights - Golden Heights area the 'hill' of Blanchetown Clay is dome shaped with a maximum elevation of 180 ft. above M.S.L. It is covered with a blanket of Recent sands which, above a ground elevation of 150 ft., is nowhere less than 20 ft. thick. These sands should provide an effective reservoir for irrigation seepage water allowing gradual lateral migration of water to lower levels down the slopes of the clay. However, high water applications may induce the formation of near-aquiclude conditions in the highly calcareous horizons present in the sands. In either event a repetition of the poor drainage conditions now prevelent in the Waikerie Irrigation area is unlikely.

At this stage it is not possible to forecast the ultimate underground drainage lines which will develop below Golden Heights. If the 'hill' of clay is as uniform as shown on the plans lateral drainage will be diffuse but it is more likely to concentrate along specific lines or zones governed by minor troughs and swells in the top of the clay.

Two obvious danger spots are located in the hollows lying below the 125 ft. contour at Bore I.R. and 250 yds. to the north. The log of I.R. proved that only 7 ft. of superficial sands and kunkar overlie the 'Blanchetown Clay" and similar conditions will obtain in the hollow to the north also. A short period of irrigation will probably produce seepage troubles round these hollows and the quantity of water to be drained may increase over the years as seepage from the upper blocks reaches the area.

More immediate concern has been expressed over the old irrigation areas lying to the north and east of Golden Heights with the suggestion that seepage water is already affecting lower areas. No evidence could be found to support this con-

tention; Bore 8R proved a perched water table at 10 ft., but this is unquestionably the result of long term irrigation on adjacent properties; Bore 17R was damp from 19 ft. but contained no standing water and Bore 18.R was also without any indication of seepage water. With considerable foresight the Golden Heights Irrigation Board have put a row of shallow holes along the eastern boundary of the property to check on seepage to the east. The value of these holes would be enhanced if half of them were deepened, to say, 30ft. At present there is a chance that seepage may pass undetected below the holes.

Sunlands Area

The other important 'hill' of clay lies under the eastern end of the Sunlands Irrigation Area. It also extends for about 2 miles on the N.E. side of the main Waikerie-Cadell road. Insufficient holes were drilled to obtain precise details of the configuration of the top of the clay but the low density pattern of holes employed delineated a long 'hill' running N.E. - S.W. connected by a shallow col to a second 'hill' to the S.E., the latter being truncated by the left bank of the Murray Valley. Both high points rise to an elevation in excess of 150ft. above M.S.L.

The interpretation of the Sunlands area presents more difficulties because of the complex configuration of the clay top and, whilst precision in forecasting danger spots for water logging is desirable, it is not possible at this stage.

An indication of the difficulties involved is given by the area around Bore 2.S. The bore was drilled in November, 1964 to provide drainage of a perched water table formed only two years after the start of irrigation. Considerable shallow exploration of the sand thickness and depth to kunkar was carried out prior to the drilling of Bore 2.S. (See Plan No 64-480 of Kinnaird, Hill, de Rohan & Young, Consulting Eng.). Later work in the main investigation showed that this gave a good indication of

the dip of the Blanchetown Clay top since the clay underlies the kunkar within 2 - 3 feet. The problem here, as in other areas, is complicated however, by changes in soil types and the eventual seepage area was determined to a large degree by progressive increase in clay content of the sand dunes downslope with corresponding decrease in lateral permeability, thus preventing water movement to the lowest topographical levels.

It will be clear from the foregoing that, without detailed soil surveys and a much more intimate knowledge of the kunkar and 'Blanchetown Clay' horizons, anomalous seepage problems are likely to be the rule rather than the exception. Despite this, sufficient work has been done to broadly delineate areas where conditions are likely to lead to early trouble.

It will be noted from Plan 65-861 that three areas on Sunlands Irrigation Area show relatively steep slopes on the top of the Blanchetown Clay, namely:-

a. west of Bore 7.S
b. south of Bore 6.S
c. adjacent to Bore 28.S

a. Conditions in this area suggest an immediate hazard. Bore 27.S penetrated 27ft. of sands but thinning occurs to the south west. Consequently little 'reservoir capacity' will be available and perched water tables may quickly develop towards Bore 14.S.

b. Provided that the contours of the clay top have been correctly interpolated drainage water may be expected to move north eastwards across the Waikerie-Cadell road and eventually seepages will appear along the cliff face downstream of Sunlands Pumping Station. The seepage already evident at the Pumping Station may be derived from an established irrigation block immediately west of Bore 7.S.

c. Contours of the clay top through Bore 28.S show a general dip to the north west. Kinnaird, Hill and Associates produced a soil survey plan for Sunlands North (Plan 698/M/1) showing areas of shallow soil and consideration of the composite picture suggests that seepage troubles may be expected in several areas but especially between the 100 and 100 ft. clay contours.

A general drainage hazard exists on the Sunlands Irrigation Area wherever the Recent sand veneer is thin. Much of the low lying land must be considered in this category but the most notable area lies between Bores 15.S and 16.S. Here less than 5ft. of total cover overlies the "Blanchetown Clay" and considerable care in the control of watering will be necessary if extensive perched water tables are to be avoided.

Areas not underlain by Blanchetown Clay

A systematic and exhaustive investigation of the drainage problems of areas where the Blanchetown Clay does not exist has not been made but any discussion of drainage would be imcomplete without due reference to the causes of seepage problems. This is particularly true in the Waikerie Irrigation Area where problems have existed for over 40 years.

Herriott and Johnson (1940) gave the first and, as far as the author is aware, only published account of drainage in relation to soil characteristics for this area. They distinguished four main soil types broadly defined for drainage potential on the basis of physical constitution to a depth of 5 - 6 ft.

The best soil for drainage is the Winkie sand which is characterised by a coarse sand content in excess of 60% and a fairly constant silt clay content of less than 10% to a depth of 70in. At the other end of the scale the Nookamka sandy loam averages around 35% coarse sand coupled with an increase of silt

clay content from over 20% at the surface to about 35% at a depth of 60 inches.

Unfortunately no comparable details are available for lower horizons. Holes drilled during the present investigation often could not be logged with sufficient accuracy when passing through saturated strata to define zones of low permeability. It is suspected however, that low permeability is present at horizons enriched with fine calcareous material. (So called kunkar). Two or three such layers are recorded in several bores penetrating thick sands and, in places where dunes have been excavated, soft highly calcareous layers are exposed containing semi-consolidated pipes rising into the sands above.

In areas of thin sand cover drainage problems develop over kunkar horizons which are invariably present in one form or another. Sheet kunkar is impermeable and near aquiclude conditions also obtain in areas where the development is in the form of kunkar pebbles because of the underlying soft marl.

Underground Drainage Methods

Efficient long term drainage is dependent upon the following conditions:-

(a) The largest possible borehole diameter

(b) Sufficient casing

(c) Adequate penetration of the aquifer

(d) Development of the aquifer

(e) Properly designed headworks.

A check of the drainage bores in the Waikerie district has shown that few are completely satisfactory owing to a failure to comply with one or all of the conditions set out above. It is realised however, that economic pressures have often been responsible for short comings in drainage design, and the notes below are intended as an explanatory guide to point out the long term advantages of bores which have been expertly drilled and

equipped. As is so often the case, a poorly planned and executed project will prove to be expensive in the long run and, for little extra care and cost, a much more satisfactory end product will result.

(a) Larger diameter bores have a number of advantages over the standard 4" diameter bores which form the majority in the Waikerie district. These may be summarised as:-

(1) Speedier and more efficient drilling

(2) Easier rehabilitation in the event of failure

(3) Better drainage characteristics

(4) Comparable drilling costs.

Six inch diameter bores are recommended for drainage. As an example of comparative costs with a 4" diameter hole to, say, 200 feet with casing to 100ft the following approximate figures are instructive:-

Diameter of Bore	4 ins	6 ins	Difference
Time to drill	8 days	6 days	
Cost to drill	£320	£240	-£80
Cost of casing	£75	£95	+£20
Saving on 6" diameter hole			£60

In addition to the cost factor 6" diameter holes are easier to maintain over a long period. Very little can be done to rehabilitate a small diameter bore if the casing is in a poor state of repair but a larger hole can be more easily cleaned and smaller casing inserted inside the old casing, if necessary.

(b) Adequate casing is essential to control the erosion and eventual collapse of softer strata overlying the drainage aquifer. Detailed discussion later will show that it is sometimes necessary to case to a considerable depth to seal off marly bands in the top levels of the Morgan Limestone.

(c) Hitherto, because of drilling costs and a failure to understand the processes involved in underground drainage many bores inadequately penetrated the main aquifer. Limited drainage was achieved but the over a long period the drainage capacity of many bores has fallen away, sometimes to zero.

Simply stated, a bore is more effective as more of the aquifer is penetrated. In the Morgan-Mannum Limestone sequence drilling conditions are extremely good in the main aquifer. An extra day's drilling adds little to the total cost of the bore while it may easily increase the drainage capacity by 25%.

A further advantage of a deep hole lies in the provision of sump capacity at the base of the bore which can store debris accidentally discharged with drainage water without seriously reducing the effective aquifer thickness.

(d) Aquifer development is not yet widely understood and practised although unreliable methods such as 'blowing' the holes with explosives have been used in past attempts to increase drainage capacity and to rehabilitate failing bores.

Modern techniques have lately demonstrated that aquifers can be successfully 'washed' with chemicals to give significant improvements in drainage characteristics.

Experiments have been carried out with the chemical detergent calcium hexametaphosphate, under the trade name of 'Calgon'. This chemical is eminently suited to washing the clay element from limestones thus increasing the permeability in the vicinity of the borehole. The detergent acts as a sequestering agent breaking the clay/marl down to a fluid form which can then be pumped from the borehole.

Calcium hexametaphosphate occurs in solid form and must be disolved before use. It is most conveniently dissolved by suspending a sack containing the chemical in water. This

avoids the formation of a glassy sludge in the bottom of the container. A concentrated solution is desirable and 160 lbs. may be dissolved in 20 gallons of water. The efficiency of a 'Calgon' treatment depends on dispersion, and vigorous surging of the solution in the well is essential to the operation. The present technique consists of surging with a plunger every 2-3 hours over a 24 hour period, alternately driving the solution out into the strata and drawing back any sludge to the borehole.

Investigations are in hand to establish the most effective and economical quantities of Calgon to use in drainage bores in the Waikerie district. Until such investigations are completed it is recommended that at least 160 pounds (2 bags) of Calgon should be used in a 6" bore penetrating 100 feet into the aquifer. This will ensure that clayey material is cleaned from the strata in the immediate vicinity of the hole.

Strata cleaning with 'Calgon' may also be successfully used for borehole rehabilitation. Much of the dirt entering a borehole is in a finely disseminated form as silt or clay which penetrates the walls of the bore with the drainage water. Exactly the same procedure is followed as with a new bore.

Development with explosives is not recommended. Usually the method results in no improvement plus damage to the string of casing. This merely results in the necessity to drill a new hole.

(e) It is clear from inspections of existing drainage bores that a casual attitude is generally adopted by owners to drainage bore maintenance. Twigs and leaves have been observed clogging the top of the casing and only sporadic efforts are made to clean out sump shafts to prevent silt from entering the bores. This is unsatisfactory and it is not surprising that some bores have failed very quickly.

The present drainage trend is towards tile drain systems conveying larger quantities of water to a single disposal

point. This is in contrast to the original bore and shaft system which achieved limited drainage by inducing a cone of drainage around the bore. Tisdall examined this system in 1937 and concluded that a bore may be expected to lower the water table to a safe depth below the root zone over a radius of about 6 chains.

The modern system is more hazardous with the chance of large quantities of silt entering the bores from drain fractures. A two sump system is recommended to safeguard against this possibility. In addition the bore casing top should be fitted with a 'goose-neck' to prevent floating trash from entering the bore.

Aquifer Analysis

Recent drilling was designed to try and provide the basic information necessary to give advice on the depths at which adequate drainage may be achieved. The lithological succession has now been fairly well established from Waikerie township to Sunlands Irrigation Area but the five bores illustrated on Plan No. S4831 show that results are sufficiently diverse to preclude the formulation of hard and fast rules. Further bores, carefully logged, will throw more light on the problem and it may be possible eventually to advise on bore construction and depth with much more precision than is possible now.

The bore logs have been simplified as far as possible On Plan S4831 and, in addition, an arbitrary grading system of permeabilities has been introduced to highlight aquifer and aquiclude horizons. The depositional sequence may be simplified to a basic form of:

Aquiclude - marl (C)

Partial aquifer - marl and marly limestone (B)

Aquifer - limestone (A)

but there is considerable variation in thickness of each of the horizons. In two of the bores the marly element in the overall 'B' horizon is sufficiently strong to warrant the insertion of a definite aquiclude.

Waikerie

The best conditions for drainage appear to exist in the immediate area of Waikerie township. Bore 15.W drilled for the S.A. Housing Trust intersected good aquifer conditions in very fossiliferous limestones below approximately 112 feet (R.L.20ft). Adequate drainage for irrigation purposes is available in the strata from 112 to 205 ft. (R.L. -73ft) and increases in drainage potential are available in strata intersected below 225 ft. (R.L.-93ft).

Conditions for drainage deteriorate in a westerly direction from Waikerie as indicated by Bore 25R on the property of A.H. Leak Esq. (section 112B). Limited drainage is available immediately below the top marly layer at about 95ft. (R.L. 20 ft) and all the previous bores in the neighbourhood were completed in this upper A horizon. Bore 25.R was carried through to the second limestone horizon at 155 ft. (R.L. minus 30ft.) in an attempt to provide better drainage but, at the time of writing, the abnormally high district static water level confirmed by the bore has not been explained. It seems likely that the lateral permeability is generally low and a high 'mound' of water has resulted from underground drainage over a prolonged period.

Bore 2.W lies on the southern edge of the Waikerie Irrigation Area. Although limestones with aquifer properties occur at around 100 ft. (R.L. 32 ft.) significant drainage is unlikely until a depth of 150 ft (R.L. minus 18ft.) is reached and a bore to at least 200 ft. (R.L. minus 68 ft.) is advisable for irrigation drainage purposes.

Ramco Heights

Conditions are unique along a narrow belt through Bore 1.R and Sunlands Pumping Station. In both localities the Pata

Limestone is present above the Morgan Limestone with a consequent deepening of the level of the Morgan Limestone aquifer.

The limits of the Pata Limestone 'trough' have not been established but the available evidence suggests that it is probably developed along a N-S line with a maximum width not in excess of two miles. Unfortunately the deepest zone appears to coincide with the likeliest problem area on the western edge of Ramco Heights Irrigation Area.

In Bore 1.R poor drainage conditions persist to a depth of 180 ft. (R.L. minus 64 ft.) and adequate drainage in the area will necessitate bores to a depth of about 250 ft. (R.L. minus 34 ft.).

Sunlands

Good drainage conditions are restored on the west side of the Pata Limestone 'trough' with a satisfactory aquifer at about 110 ft. (R.L. minus 10ft.) in Bore 2.S.

Until more information is available it would be unwise to extrapolate too far from Bore 2.S but it is probable that adequate drainage will be accomplished with bores to a depth of about 200ft.

Riverine Flats

The success of drainage bores on the main irrigation areas is attributable to the available head or difference between the land and static water levels. A head in excess of 70 feet is usually available and this results in adequate drainage rates for excess water on irrigation blocks.

These conditions do not apply on the limited portions of the Waikerie Irrigation Area which lie on the first terrace levels of the river along the Waikerie-Cadell road. These areas lie some 60-70 feet below the lowest areas of the main irrigation area and consequently the static water level of the main aquifer, is much closer to the surface. A recent bore (13W) in Waikerie township was completed with the static level 13 ft. below surface, and tests revealed a limited drainage rate suitable for household effluent but quite inadequate for orchard drainage unless extra head is produced by pumping the water underground.

Contrary to popular belief amongst local people, there is no simple relationship between the natural static water level and the summer river level. Bore 13.W is situated within 500 yds. of the river and shows a static water level approximately 10 ft. above the summer pool level upstream of Lock 2.

Readings are now being made to see if a more complex relationship exists between the ground water levels and the river at all stages but results are unlikely to be conclusive for several years.

ESTIMATION OF DRAINAGE WATER VOLUMES

Despite the importance of drainage no attempt has yet been made to measure the quantities of water involved, and any estimation made at this stage must be subject to gross potential errors owing to the following variables:-

a. Variation in soil types and, therefore, permeabilities.

b. Variation in water usage of different crops.

c. Use of two irrigation systems - furrow and sprinkler.

d. Knowledge and efficiency of individual block owners.

(a) Herriott & Johnson (1940) showed on the Waikerie Irrigation Area that the Winkie soils with a high surface permeability occur at the highest topographic levels. Downslope, increasing clay content results in a decreasing permeability until, in the hollows, very poor drainage conditions are encountered in the Nookamka Sandy Loam. The pattern of water movement at deeper levels in the soils is not understood in detail but downward percolation probably takes place on the sandier soils to less permeable horizons at depth, followed by lateral

movement which produces seepage difficulties in zones around the sides of the lower topographic areas.

(b) Water usages of various orchard crops have not yet been fully evaluated. In addition to the main problem, complications exist concerning factors such as crop spacing and intercropping.

For the present, the suggested annual water use figures given by the Department of Agriculture are

Citrus - 35 inches
Stonefruit - 30 inches
Vines - 24 - 30 inches

(c) A detailed discussion of the differences between furrow and spinkler systems of irrigation is not called for. Briefly, sprinkler systems result in a more even spread of water, whereas furrow systems often overwater part of the crop at the expense of the rest.

(d) This variable is probably as important as the combined effect of the first three, There is ample evidence that mismanagement is responsible for serious seepage problems. At present little can be done to control wilful mis-use of water which, in addition, is often to the detriment of neighbouring holdings.

Waikerie Irrigation Area

An average of approximately 40 inches of water was delivered to 3,925 acres under irrigation during the period

July, 1964/ June, 1965. Employing the water usage figures given above, it seems reasonable to assume that 25% of the volume delivered drained through the soil profile, a total of 9×10^8 gallons. A significant percentage of this may be dissipated by natural downward percolation and lateral movement but assuming the whole volume must be drained this could be accomplished by 40 bores draining at a moderate rate of 2,500 gallons per hour. In practice, 80 bores draining at 2,500 gallons per hour for 50% of the year would be more realistic assessment.

The total number of drainage bores is in excess of 230. Many are justifiable on economic grounds to avoid the necessity for long tile drain systems but the inference remains that many of the existing bores would be redundant under a more rational drainage system.

Private Irrigation Areas

A total of 3,060 acres are developed for irrigation on the three private irrigation areas at Golden Heights, Ramco Heights and Sunlands. It is estimated that a total of 36 inches of water is delivered to the orchards over a period of 12 months.

Geological conditions under the Golden Heights and Ramco Heights areas preclude a realistic forecast of the number of bores which are likely to be required in the long term future. Probable early trouble spots have already been indicated, and it is anticipated that 3 or 4 bores will be necessary at an early date on the west side of the main road through Ramco Heights.

For reasons already explained in an earlier section the situation at Sunlands is likely to lead to drainage problems at an early date. Increased quantities of seepage water are likely in the early stages of orchard establishment because of the lower water usage of young trees, and it is probable

that at least 50% of the water applied in the first 2 - 3 years drains through the soil profile. Later the percentage may fall back to 25% resulting in a total volume of ~~1.84~~ 3.25 x 10^8 gallons per year to be drained.

Taking into consideration the geological conditions at Sunlands it is estimated that an early need will arise for a minimum of 5 bores. Ultimately 10 or more bores may be necessary in order to avoid long subsurface drains to central disposal points.

STATIC WATER LEVELS

Two plans have been prepared to illustrate present static water levels in the aquifer of the Morgan-Mannum Limestone series.

Plan S.4531 shows the general pattern in the Morgan - Blanchetown - Waikerie triangle south and east of the River Murray. Indications are that the levels decline in a northwest or westerly direction from Waikerie, but the situation could be much more complicated near the Murray between Morgan and Blanchetown because of the unknown influence of freshwater 'tongues' in the otherwise very saline aquifer. Bores, F, G, H, J and K penetrated freshwater, whereas Bores A, B, C, D and E proved the normal saline water of this area. It remains to be proved whether the freshwater 'tongues' are recharged from the Murray. A comparison of the static water levels in the bores with the summer river level between Locks 1 and 2 suggests this possibility, although previous work by O'Driscoll (1960) has noted a clear topographical correlation of the freshwater zones, suggesting that recharge takes place from the surface.

Plan No. 65-1255 illustrates the local problem arising from underground drainage in the Waikerie district. Unfortunately no records are available of static water levels existing when the first drainage bores were sunk in the period 1925-1931

but, assuming that recently drilled bores (Nos. 2W, 15W and 1R) on the periphery of the area record levels close to the original, a considerable 'mound' or series of 'mounds' of water has been built up over the years by the discharge of large volumes of water underground.

The bores shown on Plan No. 65-1255 have been selected on the basis of efficiency of operation at the present time. Efficiency was arbitrarily judged from an assessment of the water level compared with other nearby bores plus a judgement of drainage capacity made in the field or by consultation with the block owner. The shortcomings of the method will be obvious but the consistency of the results provides some confirmation that a generally high water table has developed. The plan presents the 'best' picture and the position in some areas is much more serious with many bores recording a water level varying little from 100 feet M.S.L. The water levels given on Plan 65-1255 were made at the beginning of the summer irrigation programme for 1965/66 and checks will be made at intervals to see if a marked seasonal rise takes place.

The implications of this preliminary study are obvious. Continual rise of the static water level will eventually result in a breakdown of underground methods for the disposal of drainage water. Already there may be sufficient head in the central part of the Waikerie Irrigation Area to be the direct cause of serious seepage problems on some of the lower lying blocks along the edge of the Murray Valley. However, there is sufficient doubt concerning the true static water level pattern to warrant expenditure of further funds on a series of observation holes in various key positions across the Waikerie Irrigation Area. These holes have been sited at locations as free from the local influence of drainage bores as possible. At least two of the holes should be fitted with water level recorders.

Tentative positions for eight observation holes to 250 feet are shown on Plan No. 65-1255.

WATER QUALITIES

The practicability of underground methods of drainage in the Waikerie district is dependent upon two factors:-

1. Availability of suitable aquifers.
2. The naturally high salinity of water in the aquifers.

The sinking of Bore 2W has markedly increased the basic knowledge of both factors, and recent results in other bores have confirmed that the saline water conditions in the Morgan - Mannum Limestone series are universal in the Waikerie district. Thus there appears to be no doubt that discharge of drainage water underground will serve only to improve the quality of the groundwater over the limited area below the irrigated orchards. A random check of irrigation drainage water qualities was made at six bores across the area on 8th September, 1965; four of the samples had analyses in the range 1200 - 1700 ppm, one, in an area with all abnormally high water table, gave a low salinity of 675 p.p.m. and the final sample, taken from a bore used only intermittently for drainage, gave a high salinity of 2500 p.p.m.

CONCLUSIONS AND RECOMMENDATIONS

The present investigation has explored the subsurface geology of the area between Waikerie and Cadell on the left bank of the River Murray, with particular reference to the development and maintenance of extensive areas under irrigation. The area around and immediately north-west of Waikerie is important because of the contrast offered between old established irrigation blocks over 50 years old and new areas developed in the past 10 years.

The investigation has examined the complementary problems associated with the formation of perched water tables near the surface and the drainage of water by underground methods.

Extensive shallow drilling defined the thickness and lateral extent of the main aquicludes occurring near the surface. Particular attention was paid to the "Blanchetown clay" as the most intractable aquiclude, and the upper surface levels of the clay were contoured to try and forecast the likeliest areas where perched water tables may be expected to develop under the new private irrigation areas. Sunlands Irrigation Area is noteworthy in this respect because of the relatively thin soil cover over the highest aquiclude horizon.

The shallow drilling programme was sufficiently extensive to cover all the main areas of development and such areas as may be proposed for development in the near future. The position of each bore was accurately plotted and the reduced ground level related to the Lands Department Mean Sea Level datum.

A light pattern of deeper bores examined strata down into the Morgan-Mannum Limestone series in the lower Miocene to delineate suitable aquifer horizons for future drainage needs. In addition, a realistic assessment could be made of the 235 bores in the Waikerie district which are used for drainage at present. Most of the bores have no logs and hitherto the relative

success or failure of particular bores could not be related to the geology. One bore was carried down to 770 ft. to penetrate the full aquifer thickness of the Morgan-Mannum Limestone series and to examine aquifer conditions down to the Knight Group in the Upper Eocene.

Aquiclude and/or aquitard conditions were found to depths of 180 feet or more across the area and it is obvious that the rule of thumb methods used to judge bore depths hitherto were unable to allow for the varying lithological characteristics in the top of the Morgan Limestone.

The paucity of properly logged bores, coupled with the lateral strata changes already noted, precludes a clear definition of drainage potential by district or depth in the main aquifer horizon.

The best zone appears to be around the township of Waikerie where good aquifer limestones are encountered from about 110 feet. Conditions appear to deteriorate westwards and south-westwards and on the edges of the Waikerie Irrigation Area, although limited drainage potential is present at about 100 feet, "clean" limestones with a satisfactory potential are not intersected until a depth of at least 150 feet is reached.

Unusual conditions are present on the western side of the Ramco Heights Irrigation Area. Pata Limestone is developed here over the Morgan Limestone and this results in the depression of the aquifers a further 30-40 feet. Little or no drainage is available above 180 feet.

Under the Sunland Irrigation Area satisfactory drainage conditions were encountered below 110 feet in the only bore drilled to date. Further bores may reveal a more complex situation particularly in a north-westerly direction.

A careful review has been made of the main factors involved in the proper construction and utilisation of drainage bores. It is believed that the present system used in the majority of bores in the Waikerie district is unsatisfactory and

has contributed to a dangerously high water level under many orchards. If this situation is allowed to continue considerable areas of orchard may go out of production as bores become progressively less efficient. At present there is little realisation of the imminence of widespread trouble and shallow bores are still being constructed. Under the present system each block holder is responsible for his own drainage. However, conditions have deteriorated in some areas to the extent that one man's effort may be completely nullified by the poor conditions on adjoining properties which are themselves often the results of ignorance rather than neglect.

It is recommended that no further bores of a diameter of less than 6 inches should be sunk for drainage purposes. Further, shallow bores should be discontinued and pending further drilling results the following broad standards be used for the areas as indicated:-

AREA	MINIMUM BORE DEPTH	CASING DEPTH
1. In and around Waikerie Township	200'	120'
2. South of the Blanchetown Waikerie road	250'	150'
3. West of a N-S line through Bore 4W as far as the western boundary of the Waikerie Irrigation Area.	250'	150'
4. Ramco Heights Irrigation Area	300'	180'
5. Sunlands Irrigation Area	250'	120'
6. Riverine Flats	Bores not recommended.	-

The importance of accurate information cannot be overemphasised. As further bores are properly drilled and logged it should be possible to give more accurate advice on the optimum bore depth and casing length to ensure long term success.

Apart from geological considerations, success is also dependent on headworks construction and adequate maintenance of

the complete drainage installation. The deleterious effects of dirty drainage water are enormous. One serious inflow of silt will reduce drainage capacity to almost zero in a few hours. This can only be prevented by a more sophisticated headworks system with two sumps, both of which are regularly cleaned. A goose neck on the bore head is considered essential to prevent the entry of large trash. As far as is known not a single irrigation bore is so fitted at the moment.

The science of aquifer development for drainage bores has not yet advanced to the stage where types and quantities of chemicals can be advised for every situation. Calgon has been used with some success to 'clean' the limestones of marly material. Provisionally, it is recommended that at least 160 lbs. of Calgon are used in a concentrated solution to develop 100 ft. of aquifer in a six inch bore.

Further experiments are planned using acids to develop the aquifer by increasing the effective diameter of bores. The results of these tests will be given in a later progress report.

Examination of water levels under the Waikerie Irrigation Area has given rise to concern at the high level of the main water table under several zones. Expenditure on eight observation bores to 250 ft. is recommended for a study of the regional static water level pattern. This will ascertain whether there has been a general rise of static levels in the Morgan Limestone aquifer as a result of drainage increment over a long period. If this is so the necessity may arise for a radical change in the methods of water disposal. Otherwise the continuing rise of water table will eventually lead to the loss of extensive acreages of orchards and vineyards.

GTR:DLH:AWK:AVR
19.11.65

G.T. ROBERTS
GEOLOGIST
HYDROGEOLOGY SECTION.

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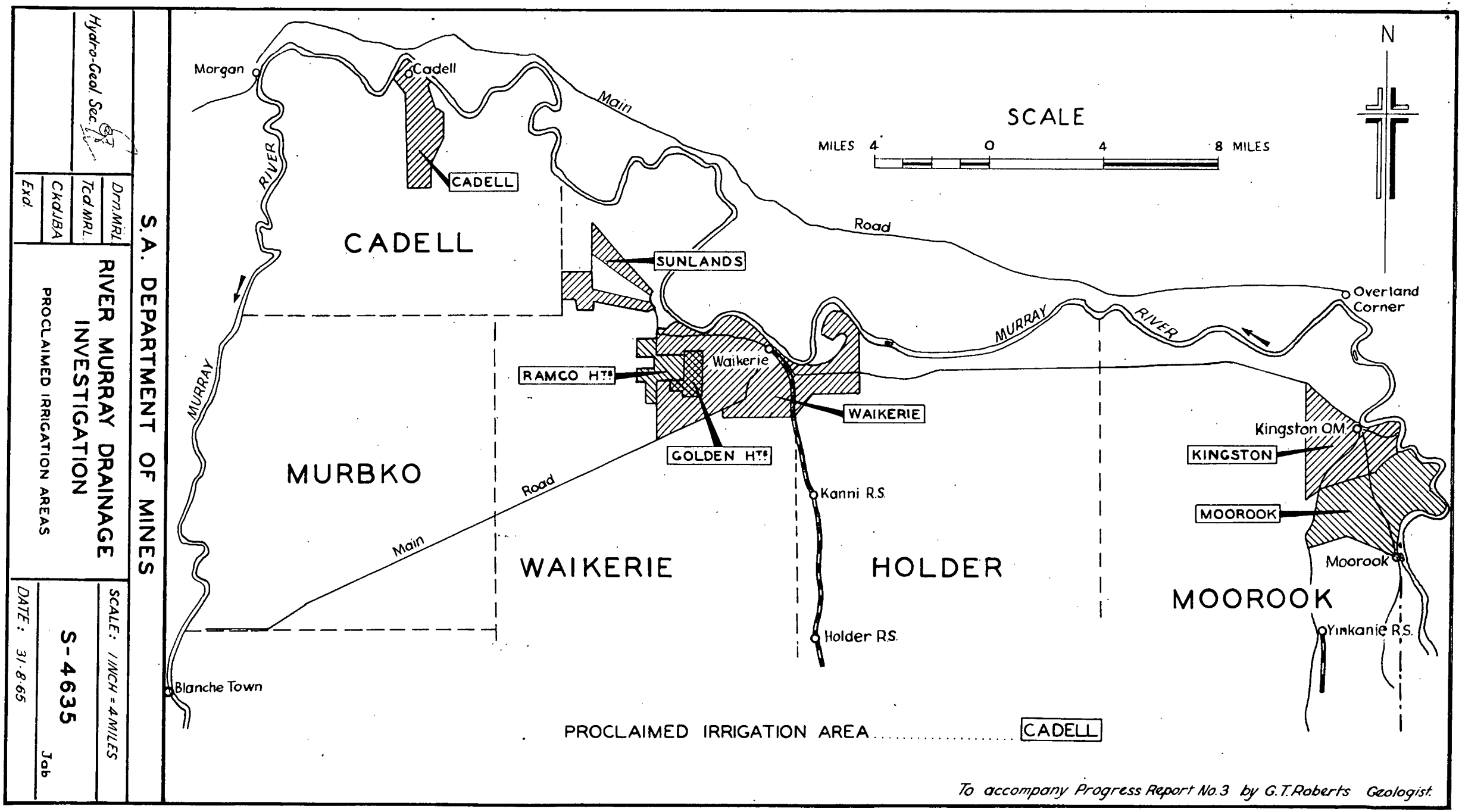
Morgan
Cadell
Main
RIVER
CADELL
CADELL
SUNLANDS
Road
Overland Corner
MURRAY
RIVER
Waikerie
RAMCO Hts
WAIKERIE
GOLDEN Hts
MURRAY
MURBKO
Road
Main
Kanni R.S.
Kingston OM
KINGSTON
MOOROOK
Moorook
WAIKERIE
HOLDER
MOOROOK
Yinkanie R.S.
Holder R.S.
Blanche Town
SCALE
MILES 4 0 4 8 MILES
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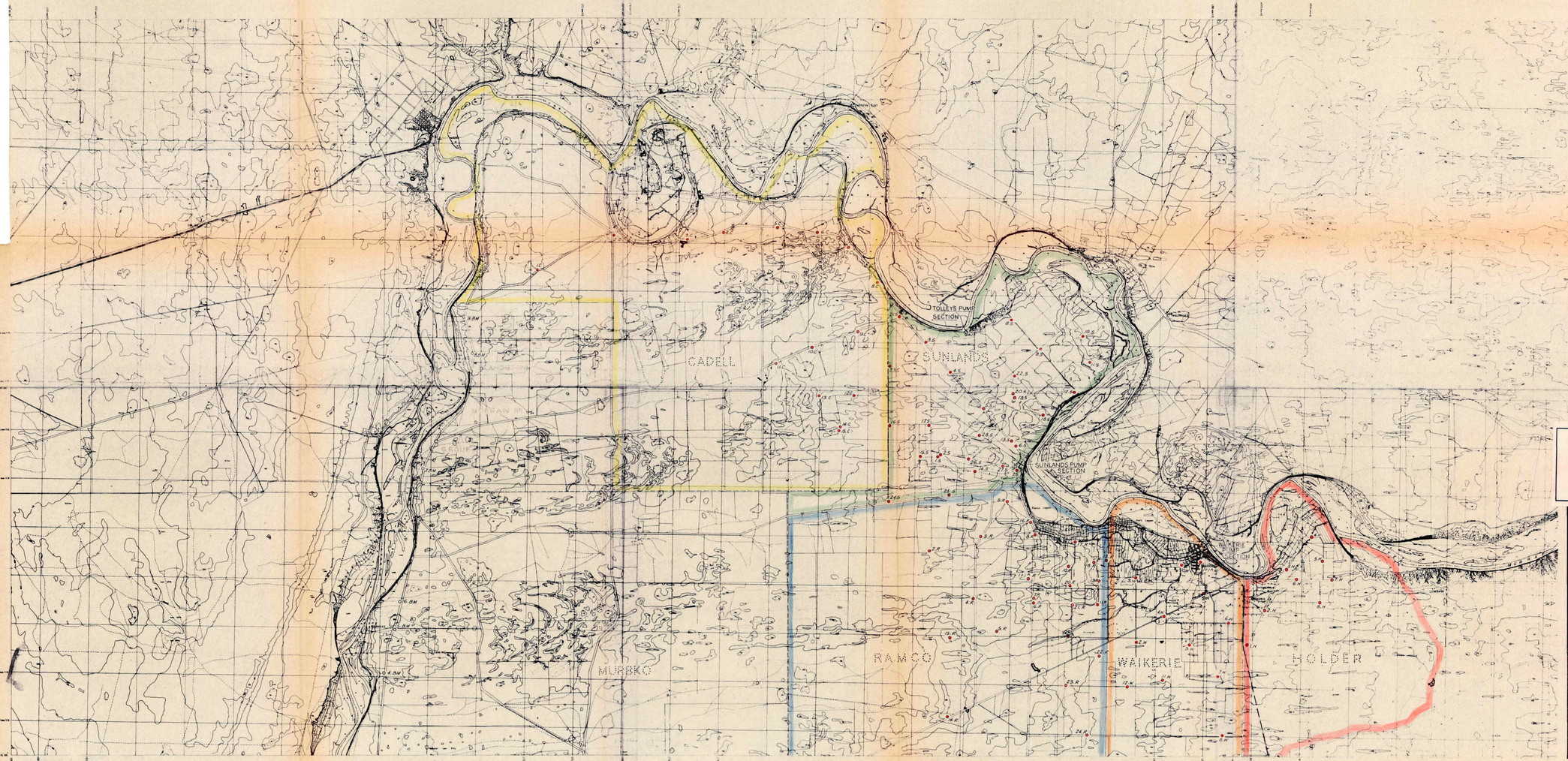
PROCLAIMED IRRIGATION AREA ..... CADELL
Hydro-Geol. Sec.
Drn.MRL
Tcd MRL
CKd JBA
Exd
S.A. DEPARTMENT OF MINES
RIVER MURRAY DRAINAGE INVESTIGATION
PROCLAIMED IRRIGATION AREAS
SCALE: 1 INCH = 4 MILES
S-4635
DATE: 31.8.65
Jab
To accompany Progress Report No.3 by G.T.Roberts Geologist.



Subsequent to the preparation of this plan, four additional bores (Ref. Nos. 13W, 14W, 15W and 25R) have been completed and their positions are shown on plan 65-861

DEPARTMENT OF MINES — SOUTH AUSTRALIA

RIVER MURRAY DRAINAGE INVESTIGATION

PROGRESS REPORT NO. 3

PROGRAMME, AND BORE LOCATION PLAN ——

PROGRAMMES	NO. OF BORES
CADELL	15
SUNLANDS	28
RAMCO	24
WAIKERIE	12
HOLDER	8

HYDRO-GEOLOGY SECTION	G.T. Roberts	DRN. AC TCD. A.C	SCALE: ONE INCH TO ONE MILE
DIRECTOR OF MINES		CKD. J.B.A EXD	65-826 Jab DATE: 4 - 8 - 65

To accompany report by G.T. Roberts, Hydro geologist

MORGAN D

DEPARTMENT OF MINES — SOUTH AUSTRALIA

RIVER MURRAY DRAINAGE INVESTIGATION

PROGRESS REPORT NO. 3.

PLAN OF THE SUBSURFACE EDGE AND UPPER SURFACE CONTOURS OF THE BLANCHETOWN CLAY.

LEGEND

Line of Section..... 2W ——— 11W (3)

Clay Edge.....

Contours..... 90

HYDRO-GEOLOGY SECTION	G.T. Roberts	DRN. T.P.S.	SCALE: ONE INCH TO FORTY CHAINS
		TCD. T.P.S.	65-861 Jab
DIRECTOR OF MINES		CKD. J.B.A.	
		EXD.	DATE 28 – 10 – 65.

135° 45' 00" E — 276 000 Y.E. — 278 000 Y.E. — 296 000 Y.E. — 298 000 Y.E. — 140° 00' 00" E

34° 07' 30" S — 780 000 Y.N. — 782 000 Y.N. — 772 000 Y.N. — 770 000 Y.N. — 34° 15' 00" S

SUNLANDS PUMP SECTION

RIVER MURRAY

Ramco Lagoon

Hart Lagoon

WAIKERIE PUMP SECTION

No Clay

Outcrop ?

Subsurface ?

SCALE OF CHAINS AND YARDS

CHAINS 0 10 20 30 40 50 60 70 80 90 100 CHAINS

YARDS 0 200 400 600 800 1000 1200 1400 1600 1800 2000 YARDS

To accompany report by G.T. Roberts, Geologist.

65-861 Jab

MORGAN B

DEPARTMENT OF MINES — SOUTH AUSTRALIA

RIVER MURRAY DRAINAGE INVESTIGATION

PROGRESS REPORT NO. 3.

PLAN OF THE SUBSURFACE EDGE AND UPPER SURFACE CONTOURS OF THE BLANCHETOWN CLAY.

LEGEND

Line of Section..... 3.5 — 7.5 (3)

Clay Edge.....

Contours..... 90

HYDRO GEOLOGY SECTION	G.T. Roberts	DRN. T.P.S.	SCALE: ONE INCH TO FORTY CHAINS.
		TCD.T.P.S.	65-862 Jab
DIRECTOR OF MINES		CKD.J.B.A.	
		EXD.	DATE: 12 – 8 – 65

N

SCALE OF CHAINS AND YARDS

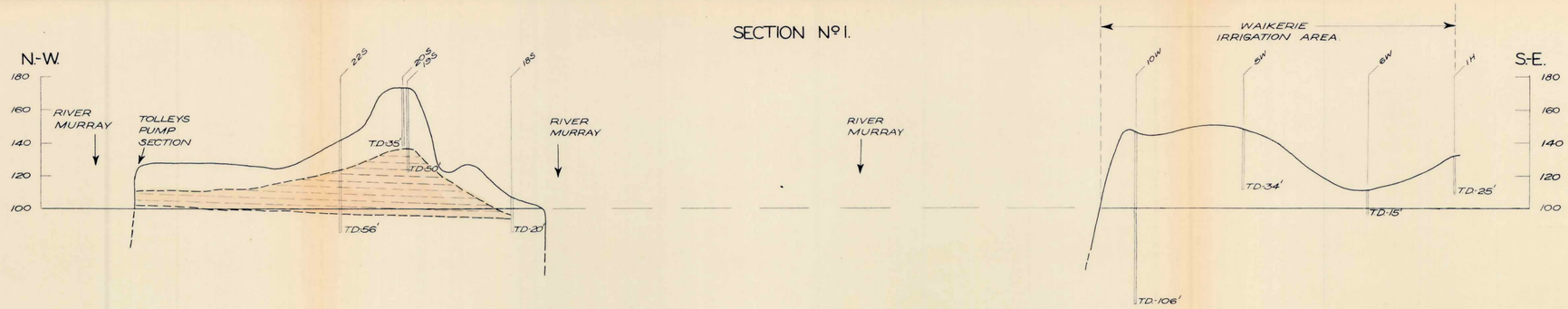
CHAINS 0 10 20 30 40 50 60 70 80 90 100 CHAINS

YARDS 0 200 400 600 800 1000 1200 1400 1600 1800 2000 YARDS

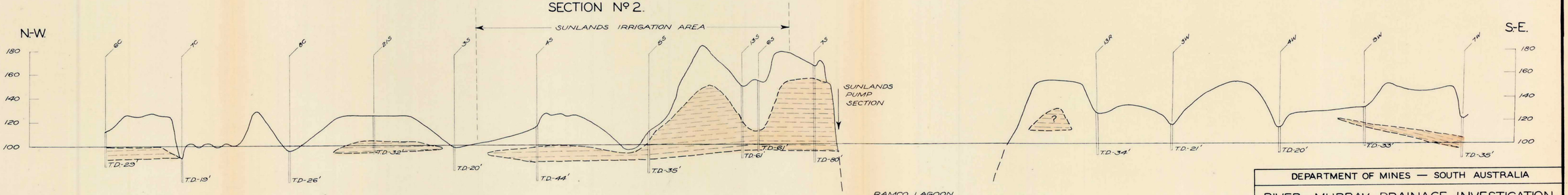
To accompany report by G.T. Roberts, Geologist.

65-862 Jab

SECTION Nº 1.



SECTION Nº 2.



SCALES

Horizontal.....1 inch = 40 chains.

Vertical.....1 inch = 40 feet.

LEGEND

Blanchetown Clay.....

Bore Hole Nº & Programme.....3W (WAIKERIE)

Total Depth of Bore Hole.....T.D-21'

To accompany report by G.T. Roberts, Geologist.

DEPARTMENT OF MINES — SOUTH AUSTRALIA

RIVER MURRAY DRAINAGE INVESTIGATION

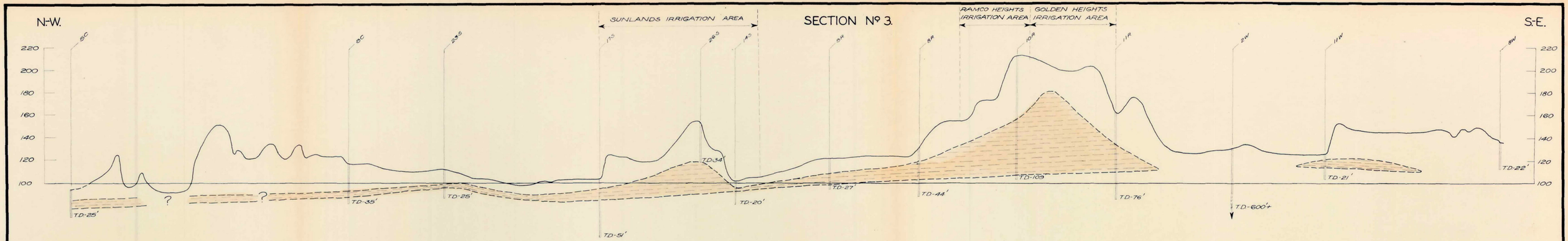
PROGRESS REPORT NO. 3

N.W.— S.E. CROSS SECTIONS.

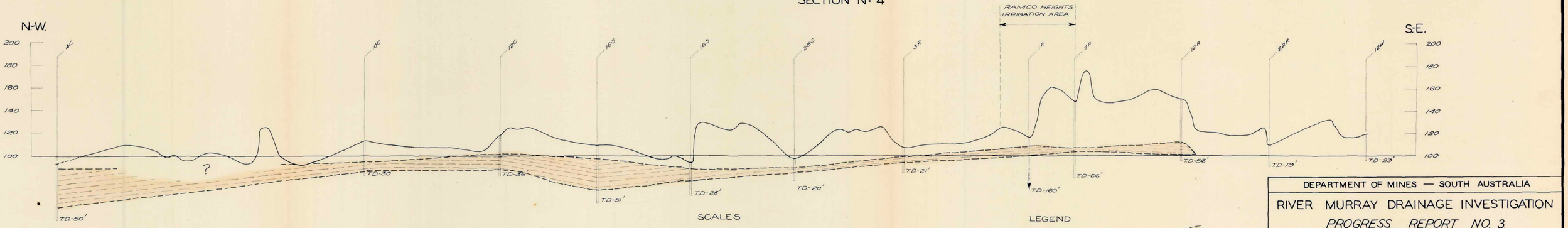
(Reference Drawing Nos. 65-861 & 65-862)

HYDRO GEOLOGY SECTION	G.T. Roberts	DRN. T.P.S	SCALE : AS SHOWN.
		TCD. T.P.S	65-870 Jab
DIRECTOR OF MINES		CKD. J.B.A	
		EXD.	DATE : 12 - 8 - 65.

SECTION Nº 3.



SECTION Nº 4



SCALES

Horizontal..... 1 inch = 40 chains

Vertical..... 1 inch = 40 feet

LEGEND

Blanchetown Clay.....

Bore Hole Nº & Programme..... 22R(RAMCO)

Total Depth of Bore Hole..... T.D-19'

To accompany report by G.T. Roberts, Geologist.

DEPARTMENT OF MINES — SOUTH AUSTRALIA

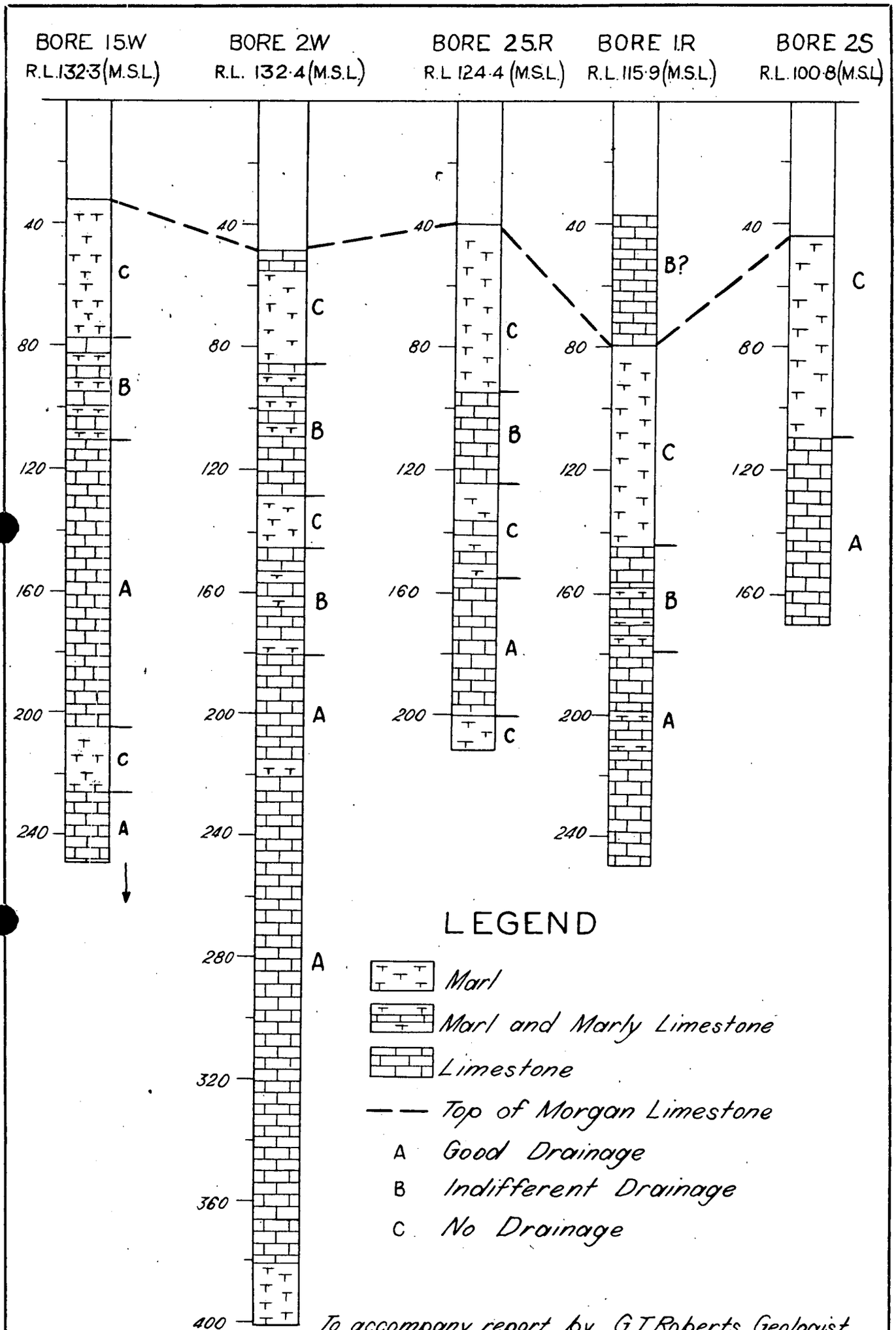
RIVER MURRAY DRAINAGE INVESTIGATION

PROGRESS REPORT NO. 3.

N.W.— S.E. CROSS SECTIONS.

(Reference Drawing Nos. 65-861 & 65-862)

HYDRO GEOLOGY SECTION	G.T. Roberts	DRN. T.P.S.	SCALE: AS SHOWN.
		TCD. T.P.S.	65-871 Jab
DIRECTOR OF MINES		CKD. J.B.A.	
		EXD.	DATE: 12 - 8 - 65

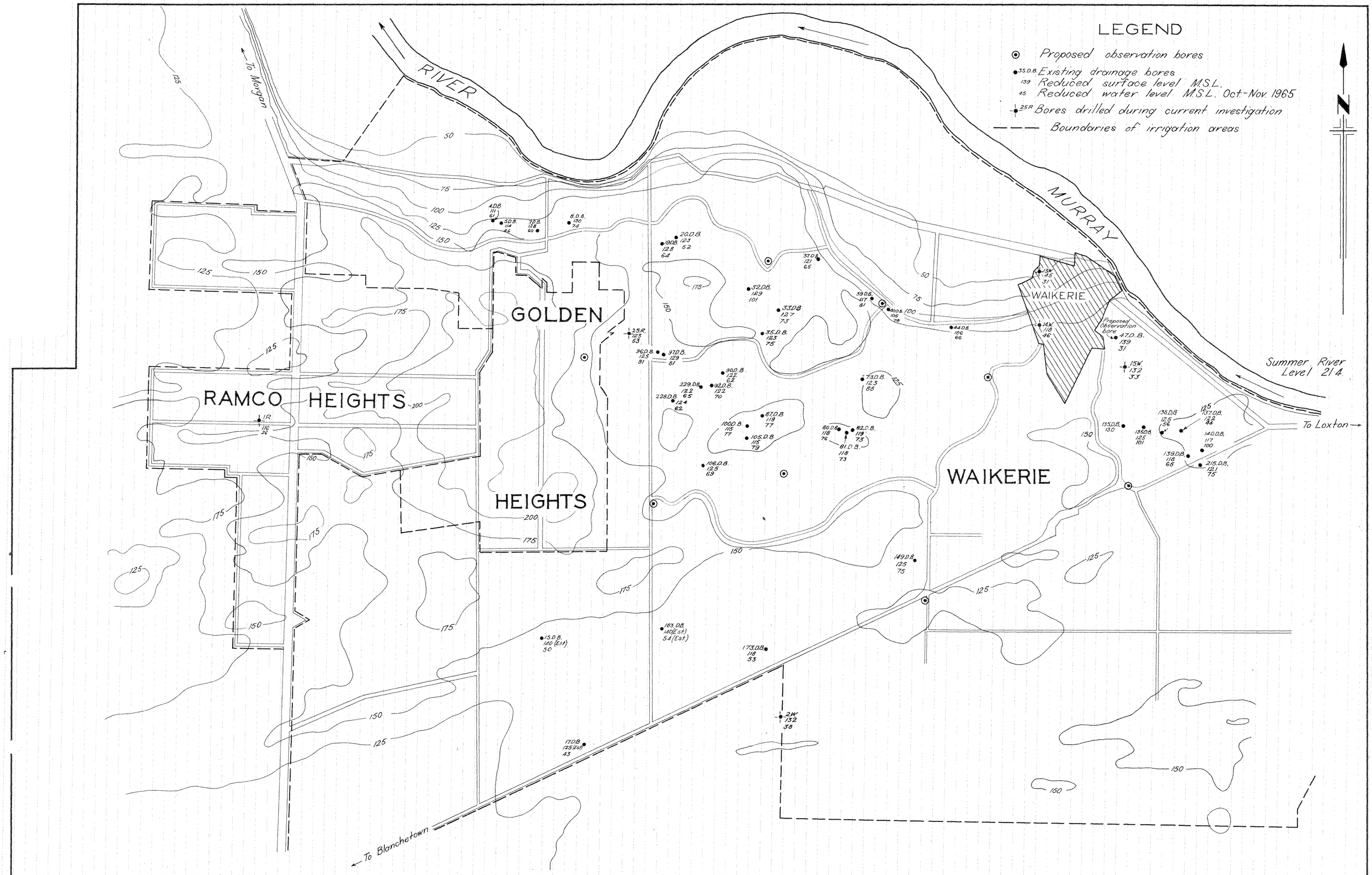


To accompany report by G.T.Roberts, Geologist

S.A. DEPARTMENT OF MINES

Approved	Passed	Drn. G.T.R.	RIVER MURRAY DRAINAGE INVESTIGATION	D.M.	Scale 1" = 40 feet
		Tcd. R.H.	PROGRESS REPORT No 3	Req.	S4831
		Ckd. L.V.W.	ANALYSIS OF DRAINAGE POTENTIAL		Jab
Director		Exd.			Date 29-10-65

400— 6.63 1423



To accompany report by G.T. Roberts, Geologist

200—2.61 3805

S.A. DEPT. OF MINES

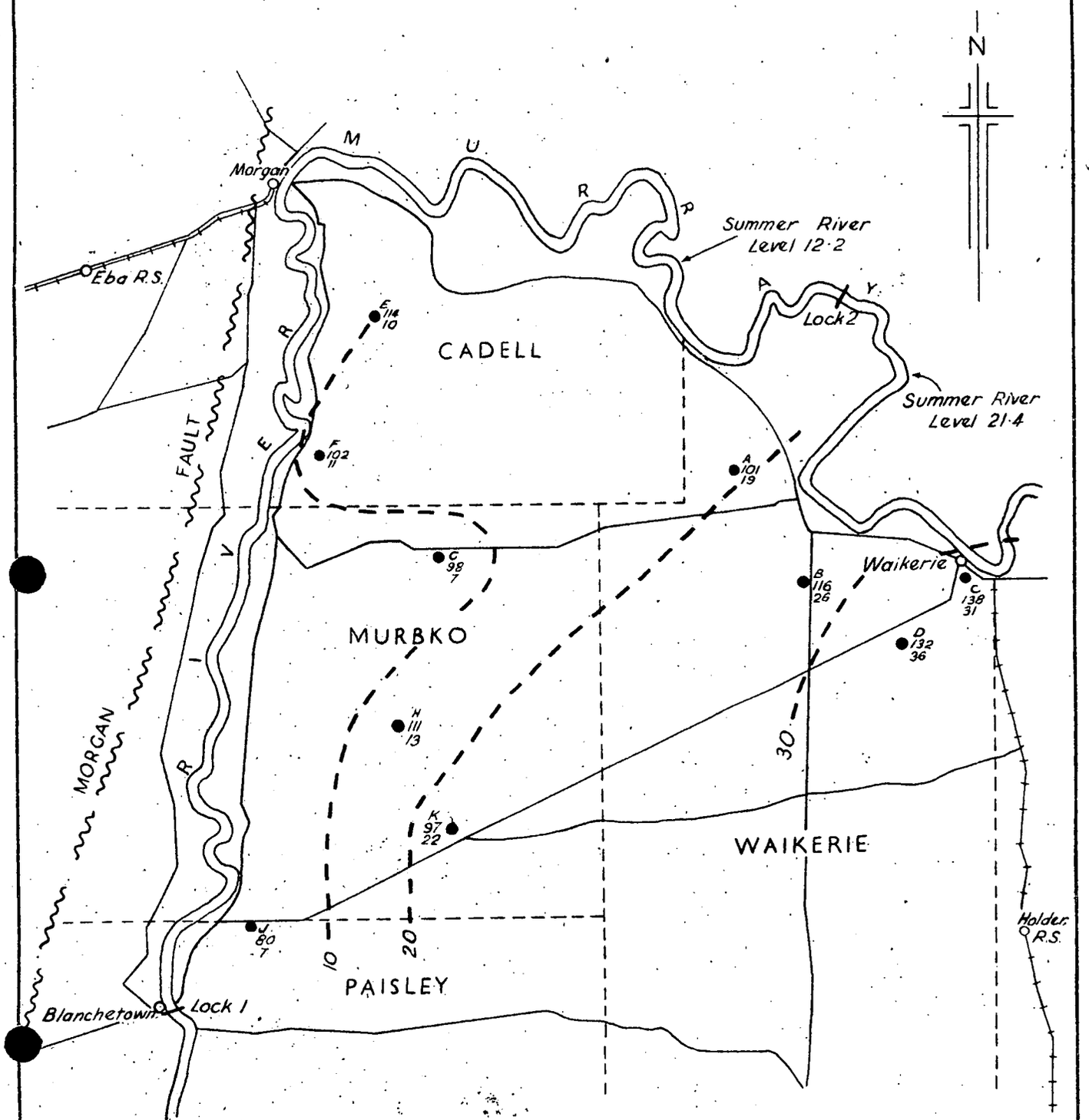
RIVER MURRAY DRAINAGE INVESTIGATION
PROGRESS REPORT Nº 3
WATER LEVELS

Associated Drawing	No.	No.	Amendment	Exd.	Date

Req. No.
D.M.
Compiled from

Approved	Passed	
		Drn.
		Tcd. R.H.
		Ckd.
Director of Mines		Exd.

Scale: 1 inch = 20 chains
65—1255
Jab
Date 9-11-65



Legend

Bore and Details..... ● A Bore Reference. 101 Ground R.L. (M.S.L.) 19 S.W.L. R.L. (M.S.L.)

Static Water Level. ---20

SCALE

MILES 4 0 4 8 MILES

S.A. DEPARTMENT OF MINES

Approved	Passed	Drn. M.R.L.	RIVER MURRAY DRAINAGE INVESTIGATIONS Progress Report No.3 Static Water Level Contours	D.M.	Scale 1 Inch = 4 Miles.
		Tcd. M.R.L.		Reg.	S-4531 Jab
		Ckd. J.B.A.			
Director		Exd.			Date 18·8·65

400— 8.63 1423

DEPARTMENT OF MINES
SOUTH AUSTRALIA

RIVER MURRAY - DRAINAGE INVESTIGATION

PROGRESS REPORT NO. 3

PROGRAMME - CADELL

Bore Number	Hundred	Section	Reduced level (M.S.L.)	Drilling Method
1	Cadell	G	114.21	Rotary
2	"	F S.W.	99.05	"
3	"	258	103.08	"
4	"	E^S	93.54	"
5	"	C^3	94.48	"
6	"	237	111.28	"
7	"	260	89.35	"
8	"	12	95.21	"
9	"	255	116.33	"
10	"	10	113.50	"
11	"	10	109.41	"
12	"	9	117.97	"
13	"	9	115.39	"
14	"	9	134.44	"
15	"	9	121.27	"

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Cadell
Section: 6
Commenced: 25.2.1965
Completed: 25.2.1965
Driller: T. Jarvis
Logged: W. Preiss Date: 25.2.1965

Bore No. 1
Programme Cadell
Bore Serial No. 623/65
Drilling Method Rotary
Total Depth 135'
Reduced Level 114.21 (MSL)
Salinity (p.p.m.) 18570 at 123'
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
					0		0 - 4' Hard pink to pale grey sandy kunkar.	
					4		4 - 5 Hard pale green fresh water limestone.	
					5		5 - 9 Poor partly recrystallized limestone, with external moulds of gastropods. Oyster fragments at 8-9'.	
					9		9 - 13 Bright yellow and dark brown marly clay.	
		1			13		13 - 16 Soft buff clay calcareous sandstone.	
					16		16 - 21 Yellow brown clay and buff sandy limestone.	
					21		21 - 24 Hard white recrystallized limestone.	
		1			24			
					43		24 - 55 Mainly yellow-brown marly clay with some hard white limestone at 27-28', also 43-44', 47-48', 52-55'. Blue-grey clay at 40'.	
					52		55 - 58 White marly limestone.	
							58 - 60 Blue-grey and yellow-brown soft marly clay.	
					60			
		2 or 3					60 - 80 White to pale buff marly limestone with bryozoa and/or ditrupa.	
					80		80 - 93 Blue-greenish-buff moist clay friable limestone with bryozoa.	
					93		93 - 96 Buff moist, silty and clay bryozoal limestone.	
				101'	96		96 -123 Buff and green calcareous silty clay and marly limestone fragments, a few bryozoa and/or ditrupa and thin shell fragments.	
		1	123				123 -127 Pale greenish-buff marly clay and limestone fragments.	
					127		127 -134 Pale greenish-buff marly limestone.	
		3					134 -135 Blue-grey and greenish grey calcareous clay.	
					135			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary Dry ▨ Sludge ⊠

No S-4611 Job
Date: 27.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report No. 3
Location: Hundred: Cadell
Section: F S.W
Commenced: 25.2.1965
Completed: 25.2.1965
Driller: T. Jarvis
Logged: W. Preiss Date: 25.2.1965

Bore No. 2
Programme Cadell
Bore Serial No 623/65
Drilling Method Rotary
Total Depth 50'
Reduced Level 99.05 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft.)	Graphic Log	LOG	Remarks
		1			0		0 - 5' White to pink sandy kunkar. Red brown sandy clay.	
					5		5 - 8 Red-brown and slightly brown mottled clay with shell fragments at 7'.	
		1 or 2			8		8 - 15 White to pale greenish fossiliferous sandy limestone with oysters.	
					15		15 - 16 Buff to yellow sandy clay limestone.	
							16 - 17 Yellow-brown marly clay.	
							17 - 20 Pale cream sandy limestone.	
					20		20 - 23 Greenish yellow and yellow-brown sandy calcareous clay.	
		1			23		23 - 34 Pale greenish buff marly clay and marl with bryozoa fragments? Thin hard white limestone interbedded at 32'.	
					34		34 - 35 Yellow silty limestone with white limestone fragments.	
							35 - 40 Pale buff to greenish grey bryozoa marl.	
					40		40 - 41 Pale yellowish green marly sandy clay.	
		2 or 3					41 - 43 Pale buff marly limestone.	
							44 - 50 Pale cream slightly bryozoa limestone.	
					50			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. -15- Rotary. Dry. Sludge.

No S-4612 Job
Date: 27.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Cadell
Section: 258
Commenced: 25.2.1965
Completed: 25.2.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 4.3.1965

Bore No. 3
Programme Cadell
Bore Serial No. 623/65
Drilling Method Rotary
Total Depth 41'
Reduced Level 103.08 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
		1			5		0 - 5' Kunkar, greenish fresh water limestone and mottled clay.	
							5 - 12 Brown and grey-blue mottled slightly calcareous clay.	
		1 or 2			12		12 - 18 Cream, soft silty limestone with shell fragments and recognisable oysters at 16'.	
		2					19 - 25 Fawn limestone with oyster fragments - marly 21' - 23'.	
							25 - 27 Cream limestone with oyster fragments.	
					27		27 - 30 Strata are composed of near 100% oysters.	
					30		30 - 36 Fawn limestone with oysters.	
					36		36 - 38 Oyster bed.	
					38		38 - 41 Cream limestone with oyster fragments.	
					41			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No S-4613 Job
Date: 27.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No.3
Location: Hundred: Cadell
Section: E[8]
Commenced: 25.2.1965
Completed: 25.2.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 2.3.1965

Bore No. 4
Programme: Cadell
Bore Serial No: 623/65
Drilling Method: Rotary
Total Depth: 50'
Reduced Level: 93.54 (MSL)
Salinity (p.p.m.): — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth(Ft)	Graphic Log	LOG	Remarks
					0			
					4		0 - 4' Kunkar and mottled clay.	
							4 - 20 Mottled grey and reddish brown calcareous clays.	
		1			20		20 - 31 Brown and yellow calcareous clay.	
					31		31 - 39 Brown and yellow gypsiferous clays.	
					39		39 - 41 Oyster bed.	
		2			41		41 - 42 Hard fawn limestone.	
							42 - 50 Mainly fawn limestone. Bryozoal from 44'.	
					50			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

-13-

No S-4614 Jab
Date: 27.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Cadell
Section: C3
Commenced: 12.5.1965
Completed: 12.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 19.5.1965

Bore No. 5
Programme Cadell
Bore Serial No. 623/65
Drilling Method Rotary
Total Depth 25'
Reduced Level 94.48 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
					0		0 - 1' Soil and kunkar.	
		1			1		1 - 8 Massive and pebbly pink kunkar.	
					8		8 - 16 Variegated blue-green-yellow clay, slightly silty towards base. Oysters in basal 1'.	
		2			16		16 - 17 Yellow-green fine grain micaceous sand and oysters.	
		1			17		17 - 23 Buff and yellow poorly sorted fine to coarse sands becoming clayey from 21 - 23'.	
					25		23 - 25 Marly buff calcareous sandstone or sandy limestone.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No S-4615 Job

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 5
Location: Hundred: Cadell
Section: 237
Commenced: 12.5.1965
Completed: 12.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 20.5.1965

Bore No. 6
Programme Cadell
Bore Serial No. 623/65
Drilling Method Rotary
Total Depth 29'
Reduced Level 111.28 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Out	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		1 or 2			0		0 - 6' Pink and light brown fine to medium grain dune sands with soft kunkar.	
					6		6 - 12 Hard pink kunkar passing down into soft marly kunkar.	
		1			12		12 - 16 Variegated blue-green clay.	
							16 - 20 White marly (?) clay.	
					20		20 - 23 Blue-green clay becoming silty at base.	
		2			23		23 - 29 White or light yellow fine sand with scattered grains up to fine gravel.	
					29			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Rotary. Dry ▨ Sludge [-15-] Sludge ⊠

No S-4616 Job

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Cadell
Section: 260
Commenced: 13.5.1965
Completed: 13.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 20.5.1965

Bore No. 7
Programme Cadell
Bore Serial No. 623/65
Drilling Method Rotary
Total Depth 19'
Reduced Level 89.35 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		2			4		0 - 4' Dark brown fine to medium grain dune sand.	
		1			8		4 - 8 Hard pink passing down into soft pink marly kunkar.	
							8 - 9 Brown fine - medium grain sand.	
					12		9 - 10 Hard pink kunkar.	
							10 - 11 Brown fine - medium grain sand.	
		2					11 - 12 Pink kunkar.	
							12 - 17 Orange brown fine to medium grain sands with some hard bands. Some coarse grains.	
		1			17		17 - 19 Very hard buff sandy limestone.	
					19			

Permeability estimates 1. Low, 2. Fair, 3 High.

Sample type: Percussion. Core. Sludge. -15- Rotary. Dry. Sludge.

No S-4617 Job
Date: 27.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Cadell
Section: 12
Commenced: 13.5.1965
Completed: 13.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 19.5.1965

Bore No. 8
Programme Cadell
Bore Serial No. 623/65
Drilling Method Rotary
Total Depth 26'
Reduced Level 95.21 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft.)	Graphic Log	LOG	Remarks
		2			0		0 - 2' Dark brown sandy soil.	
					2		2 - 6 Red-brown fine-medium grain dune sands.	
					6		6 - 11 Fawn fine-medium grain slightly micaceous sand.	
		1			11		11 - 13 Red sands, clayey. Kunkar.	
					13		13 - 18 Pink pebbly kunkar passing down into soft pink marly kunkar.	
		2			18		18 - 20 Light brown clayey sand with marly kunkar.	
					20		20 - 26 Mainly greenish yellow fine grain micaceous sand.	
					26			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary. Dry ▨ Sludge ⊠

No. S-4618 Jab
Date: 27.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report No. 3
Location: Hundred: Cadell
Section: 255
Commenced: 17.5.1965
Completed: 17.5.1965
Driller: T. Jarvis.
Logged: G.T. Roberts Date: 19.5.1965

Bore No. 9
Programme Cadell
Bore Serial No. 623/65
Drilling Method Rotary
Total Depth 35'
Reduced Level 116.33 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		2 or 3			0		0 - 1' Brown sand.	
					1		1 - 3 Soft pink kunkar and sand.	
		3			3		3 - 6 Mainly coarse grain pinkish sands.	
		2 or 3			6		6 - 14 Buff, fine to medium grain slightly calcareous, micaceous sand.	
		1			14		14 - 17 Soft white kunkar in buff sands.	
		1 or 2			17		17 - 24 Buff passing down into light brown fine-medium grain sand.	
		1			24		24 - 29(?) Blue-green clays with calcareous material at 25'.	
		2			29		29(?)- 35' Light greenish-yellow fine to coarse sands. Slightly micaceous.	
					35			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary Dry ▨ Sludge ⊠

No S-4619 Job
dte 27.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Cadell
Section: 10
Commenced: 17.5.1965
Completed: 17.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 19.5.1965

Bore No. 10
Programme Cadell
Bore Serial No. 623/65
Drilling Method Rotary
Total Depth 30'
Reduced Level 113.50 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
					0		0 - 2' Dark brown sandy soil.	
					2		2 - 4 Buff sand and kunkar.	
					4			
		- or 2					4 - 16 Buff fine grain slightly micaceous sand.	
					16		16 - 18 Buff sand and soft kunkar.	
					18		18 -26(?) Blue-green clay.	
		1			26			
		2					26(?) -30 Yellow-green slightly micaceous mainly fine grain sand. Some coarse grains.	
					30			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. -13- Rotary. Dry. Sludge.

No S-4620 Ja
Date: 27.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Cadell
Section: 10
Commenced: 17.5.1965
Completed: 17.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 17.5.1965

Bore No. 11
Programme: Cadell
Bore Serial No. 623/65
Drilling Method: Rotary
Total Depth: 35'
Reduced Level: 109.41 (MSL)
Salinity (p.p.m.): — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
					0		0 - 4' Mainly hard pink massive and pebbly kunkar.	
					4		4 - 8 Brown and yellow silty clay.	
		1					8 - 13 Greenish clay.	
							13 - 14 Greenish clay but silty and micaceous.	
							14 - 21 Greenish-yellow silty clay passing down into orange-brown clay.	
							21 - 29 Blue-green silty clay becoming micaceous and siltier downwards. Becoming yellow in colour.	
					29		29 - 35 Oyster bed in yellowish-grey fine grained sand.	
		2			35			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge.

No S-4621

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report No. 3
Location: Hundred: Cadell
Section: 9
Commenced: 24.5.1965
Completed: 24.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 26.5.1965

Bore No. 12
Programme Cadell
Bore Serial No. 623/65
Drilling Method Rotary
Total Depth 36'
Reduced Level 117.97 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth(ft)	Graphic Log	LOG	Remarks
		2 or 3			0		0 - 8' Fine to coarse brown dune sand.	
					8		8 - 11 As above with fairly soft kunkar.	
					11		11 - 12 Pink hard pebbly kunkar.	
					12		12 - 15 Kunkar and green fresh water limestone.	
		1			15		15 - 29 Variegated blue-green clay.	
					29		29 - 32 Yellow-green fine clayey sand.	
		2			32		32 - 36 Mainly fawn-yellow fine sand and sandstone with oyster fragments.	
					36			

Permeability estimates 1. Low, 2. Fair, 3. High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No. S-4622 Jo
Date: 27.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Cadell
Section: 9
Commenced: 24.5.1965
Completed: 24.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 26.5.1965

Bore No. 13
Programme Cadell
Bore Serial No 623/65
Drilling Method Rotary
Total Depth 36'
Reduced Level 115.39 (MSL)
Salinity (p.p.m) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth(ft)	Graphic Log	LOG	Remarks
					1		0 - 1' Brown fine to coarse sand.	
					4		1 - 2 Fairly hard grey-pink kunkar.	
					6		2 - 4 Light brown limy sand.	
					8		4 - 6 Pink pebbly kunkar.	
					10		6 - 8 Hard green limestone.	
							8 - 10 Grey-green marly limestone.	
		1					10 - 24 Variegated blue-green clay.	
					24		24 - 28 Yellow-green clayey sand.	
		2			28		28 - 36 Grey and light fawn fine sands. Shelly at top. Oysters plentiful from 31' down.	
					38			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

-15-

Nº S-4623
Date: 27·8·65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Cadell
Section: 9
Commenced: 24.5.1965
Completed: 24.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 25.5.1965

Bore No. 14
Programme Cadell
Bore Serial No. 623/65
Drilling Method Rotary
Total Depth 47'
Reduced Level 134.44 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		2 & 3			0		0 - 21' Brown fine-medium grain dune sand.	
		1			21		21 - 22 Hard grey and pink kunkar.	
					22		22 - 26 Fawn fine passing down to fine-coarse fawn sand.	
					27		26 - 27 Sand and kunkar.	
					29		27 - 29 Pink pebbly kunkar.	
					32		29 - 32 Green fresh water limestone kunkarised at top.	
		1					32 - 47 Variegated blue-green clays - bore abandoned with loss of air.	
					47			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. -15- Rotary. Dry. Sludge.

No. S-4624 Job
Date: 27.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Cadell
Section: 9
Commenced: 25.5.1965
Completed: 25.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 25.5.1965

Bore No. 15
Programme Cadell
Bore Serial No. 623/65
Drilling Method Rotary
Total Depth 42'
Reduced Level 121.27 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		2					1 - 3' Brown fine-medium grain dune sand.	
		1			3		3 - 5 Hard grey and pink kunkar.	
		2			5		5 - 8 Fawn fine-coarse grain sand.	
							8 - 14 Orange-brown, fine to coarse slightly clayey sand.	
					14		14 - 16 Pink pebbly kunkar.	
					17		16 - 17 Fawn kunkar and sand.	
							17 - 18 Kunkarised green fresh water limestone.	
					20		18 - 20 Green limestone and marl.	
		1					20 - 35 Variegated blue-green clay.	
					35			
		2					35 - 36 Yellow-green fine micaceous clayey sand.	
					40		36 - 40 Yellow-brown and greenish fine grain clayey sand.	
					42		40 - 42 Oysters in marly fine-medium grey-yellowish sand.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion: Core ■ Sludge [13] Rotary: Dry ▨ Sludge ⊠

No S-4625 Job
Date: 27.8.65

DEPARTMENT OF MINES
SOUTH AUSTRALIA

RIVER MURRAY - DRAINAGE INVESTIGATION

PROGRESS REPORT NO. 3

PROGRAMME - SUIT[illegible]

Bore Number	Hundred	Section	Reduced level (M.S.L.)	Drilling Method
1	Waikerie	607	95.79	Percussion
2	"	607	100.76	Percussion
3	"	557	97.63	Rotary
4	"	563	114.49	"
5	"	12D	111.43	"
6	"	12D	154.43	"
7	"	606	165.37	"
8	"	616	117.94	"
9	"	455	126.43	"
10	"	455	44.75	"
11	"	456	61.43	"
12	"	660	110.56	"
13	"	12D	149.97	"
14	"	607	101.11	"
15	"	610	93.04	"
16	"	610	109.76	"
17	"	610	102.06	"
18	"	12D	106.19	"
19	"	12D	172.37	"
20	"	12D	172.38	"
21	"	594	124.17	"
22	"	12D	141.22	"
23	"	574	112.92	"
24	"	549	102.32	"
25	"	11G	96.75	"
26	"	Blk.14	153.69	"
27	"	Blk.3 607	137.31	"
28	"	662	138.53	"

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section 607 Blk. 22
Commenced: 4.11.1964
Completed: 4.11.1964
Driller: A. Van Rens
Logged: G.T. Roberts Date: 16.11.1964

Bore No. 2.
Programme Sunlands.
Bore Serial No 649/65
Drilling Method Percussion
Total Depth 174'6"
Reduced Level 100.76. (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth(ft)	Graphic Log	LOG	Remarks
							0 - 2' Sand, mainly medium grained quarts particles. Brown.	
			4'6"		2		2 - 3'6" As above but containing clay.	
		1					3'6"- 7 Clay with sand and kunkar fragments light brown.	
					8		7 - 8 Stiff clay and sand. Kunkar fragments. Stringers of blue-green and yellow clay. Calcareous.	
					13		8 - 13 Limy clay, stiff, blue-green. Stringers of yellow-brown sand throughout. Sand increasing in basal 6".	
					17		13 - 17 Sand, clayey, fine to medium grained. Yellow and green variegated.	
					20		17 - 19 Sand fine & medium grained. Fossil fragments.	
					23		19 - 20 Sandy limestone, fawn. Many oyster fragments.	
		2 or 1					20 - 22 Clayey sand with some sandy patches, containing large rounded quartz grains. Fossil fragments. Grey and brown.	
					28		22 - 23 As above but with large oyster fragments.	
					30		23 - 24'6" Sand, slightly, clayey. Shell fragments, mica flakes. Yellow and brown.	
					33		24'6" -28 Very clayey sand with fossil fragments, and casts in top foot (26-28', sludge only).	
					35		28 - 30 Calcareous sandstone and sand, medium grained rounded quarts fragments becoming coarser below 29'. Shell fragments and fossil casts.	
					37		30 - 33 As above but sandstone with poorly sorted grains with ferruginous staining.	
					39		33 - 35 Calcareous grit, hard, shelly, with medium and coarse rounded quarts. Crowded with fossils. Some ferruginous staining.	
					44		35 - 37 Sand with poorly sorted fine to coarse grains of rounded quarts. Slightly calcareous with a few cemented lumps. Patches of clay in lower foot. A few poorly preserved fossil casts.	
					48		37 - 39 Calcareous clay with siliceous nodules and fragments. Grey. Clay element contains many grains of fine to coarse rounded quarts. Fossil fragments poorly preserved.	
					51		39 - 40 Clay, stiff plastic, grey and brown.	
					54		40 - 44 Clay, stiff, yellow to fawn and medium to coarse grain quarts.	
		1					44 - 48 Clay silty fawn and light grey. Thin sandy layer at 45'. Ferruginous streaks 47-48'.	
					61		48 - 51 Clay mainly stiff dark grey with stringers and patches of lime.	
					74		51 - 54 Clay grey and yellow-brown, still silty, in places, white pinheads of lime.	
					76		54 - 61 As above but with increased limy material in vertical tubing. Fossil shells and casts. Harder fossiliferous band at 59'.	
				81'6"			61 - 74 Clay, silty, grey and brown. Specks of carbonaceous material to 69'. Fossil horizon at 69-70'.	
			90'				74 - 76 Clay mainly silty. Some hard limestone bands and many fossils.	
					94		76 - 94 Clay, silty, grey and fawn.	
							94 - 95 Clayey limestone with shell fragments and bryozoa.	
					100		95 - 108 Clays with some bands of limestone con-	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge [15] Rotary. Dry ▨ Sludge ⊠

No S-4645 Jab
Date: 3.9.65

S. A. DEPARTMENT OF MINES

Sheet No. 2 of 2

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 607 Blk. 22
Commenced: 4.11.1964
Completed: 4.11.1964
Driller: A. Van Rens
Logged: G.T. Roberts Date: 16.11.1964

Bore No. 2
Programme Sunlands
Bore Serial No. 649/65
Drilling Method Percussion
Total Depth 174'6"
Reduced Level 100.76 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		1	104'		100		taining macrofossils. Bryozoa throughout.	
					108		108 - 109'6" Dark grey plastic clay.	
			110'6				109'6"- 170' Grey and fawn limestone.	
		3						
					170			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotar. Dry. Cuttings.

No S-4645-a Job

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section 557
Commenced: 14.5.1965
Completed: 14.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 19.5.1965

Bore No. 3
Programme Sunlands
Bore Serial No. 675/65
Drilling Method Rotary
Total Depth 20'
Reduced Level 97.63 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth(ft.)	Graphic Log	LOG	Remarks
		2			4		0 - 4' Red mainly fine grain, dune sands, slightly clayey at base.	
		1					4 - 6 Hard pink kunkar and red sand.	
							6 - 8 Soft pink marl and kunkar.	
					9		8 - 9 ? Greenish limestone.	
		2					9 - 14 Oysters in poorly sorted fine-coarse, yellow-green sands. Recrystallised from 11-14'.	
					20		14 - 20 Buff and yellow poorly sorted fine to coarse sands with shell fragments, slightly micaceous.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No S - 4646 Job
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 563
Commenced: 14.5.1965
Completed: 14.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 18.5.1965

Bore No: 4
Programme: Sunlands
Bore Serial No: 675/65
Drilling Method: Rotary
Total Depth: 44'
Reduced Level: 114.49 (MSL)
Salinity (p.p.m.): — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft.)	Graphic Log	LOG	Remarks
		2			0		0 - 11' Fine grained red dune sands.	
					11		11 - 15 Marly kunkar and/or green fresh water limestone.	
					15		15 - 22 Brown and green variegated silty clays.	
							22 - 23 White marls in clay.	
		1					23 - 28 Mainly greenish/blue and yellow silty clays.	
					29		28 - 29 Red and grey-green sandy clay.	
							29 - 39 Yellow and buff fine to coarse grain clayey sands.	
		2					39 - 43 Mainly fine slightly micaceous light yellow sands with some coarse grains. Shelly.	
					44		43 - 44 Fine white slightly micaceous sand with some coarse grains. Shelly.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge. Sludge.

No S-4647 Jab

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 5
Location: Hundred: Waikerie
Section: 12D
Commenced: 14.5.1965
Completed: 14.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 17.5.1965

Bore No. 5
Programme Sunlands
Bore Serial No. 675/65
Drilling Method Rotary
Total Depth 35'
Reduced Level 111.13 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
					0		0 - 1' Brown sand.	
					1		1 - 3 Brownsand and soft white kunkar.	
					3		3 - 6 Hard pink kunkar.	
					6		6 - 7 Greenish fresh water limestone.	
		1			7		7 - 11 Brown and green silty clay.	
					11		11 - 23 Grey-green/blue variegated clay.	
		2			23		23 - 24 Medium grain grey-brown sand. 24 - 26 Yellowish-brown mainly fine grain sand with some coarse grain. 26 - 28 Yellow brown clayey sand with occasional ferruginous pieces and some coarse quarts grains. 28 - 29 As above but greenish colour. 29 - 30 Grey and fawn mainly medium grain sand clayey. 30 - 31 As above but calcareous. 31 - 33 Yellow-brown fine clayey sand, with coarse grains, fossiliferous. 33 - 35 Many oysters in yellow-brown medium grain sand.	
					35			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Rotary. Dry ▨
Sludge -15- Sludge ⊠

No S-4648 Jab
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: *Hundred:* Waikerie
Section: 12D
Commenced: 14.5.1965
Completed: 14.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts *Date:* 18.5.1965

Bore Nº 6
Programme Sunlands
Bore Serial Nº 675/65
Drilling Method Rotary
Total Depth 61'
Reduced Level 54.43 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
		2 or 1					0 - 27' Reddish fine grain dune sands. Calcareous at 5 - 8' and 17 - 22'.	
		1			27		27 - 31 Soft pink kunkar.	
					31		31 - 35 Fine light brown limy sand.	
					35		35 - 41 Greenish marls and limestones, and white marly limestones.	
					41		41 - 56 Mainly greenish and brown variegated clays and silty clays. Calcareous layer at 56'.	
					55		56 - 58 Brown clayey sand? Poor samples.	
					58	?	58 - 61 No samples.	
					61			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

Nº S-4649 Job
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 606
Commenced: 14.5.1965
Completed: 14.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 18.5.1965

Bore No. 7
Programme: Sunlands
Bore Serial No: 675/65
Drilling Method: Rotary
Total Depth: 80'
Reduced Level: 165.37 (MSL)
Salinity (p.p.m.): — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth(ft)	Graphic Log	LOG	Remarks
					0		0 - 1' Brown fine dune sand.	
					1		1 - 2 Fawn fine limy sand with kunkar pebbles.	
					2		2 - 3 Light brown fine and medium limy sand.	
					3		3 - 6 Mainly kunkar pebbles.	
					6		6 - 11 Greenish fresh water limestone becoming soft and marly downwards.	
					11		11 - 15 Greenish and brown silty clay.	
		1			15		15 - 44 Mainly brown and brick-red silty clays with some green and yellow mottling.	
					44		44 - 59 Light brown passing down into green-yellow-brown mottled silty clays.	
					59		59 - 63 Greenish-yellow silty clays with calcareous white granules.	
					63		63 - 70 Blue-green clays.	
					70		70 - 76 Very clayey yellow-green and mottled brown fine sands with occasional coarse grains. Slightly micaceous.	
					76		76 - 77 Fine green micaceous sand with some coarse grains.	
		2			77		77 - 80 Fine yellow micaceous sand, slightly clayey. Coarse grains up to fine gravel size at 78'.	
					80			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge. Sludge.

No S-4650 Jab

Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 616
Commenced: 17.5.1965
Completed: 17.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 17.5.1965

Bore No. 8
Programme Sunlands
Bore Serial No 675/65
Drilling Method Rotary
Total Depth 31'
Reduced Level 117.9± (MSL)
Salinity (p.p.m.) = at =
= at =

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
					1		0 - 1' Red medium grain sands.	
							1 - 4 Fawn limy sand and soft kunkar.	
							4 - 8 Fawn limy sand and pebbly kunkar.	
					8		8 - 11 Fawn limy and clayey sand with kunkar.	
					11		11 - 13 Mainly greenish fresh water limestone.	
		1			13		13 - 16 Yellow and green rotten silty clay.	
							16 - 21 Variegated green-yellow clay.	
							21 - 25 Yellow silty clay.	
		2			25		25 - 31 Oyster bed.	
					31			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Rotary. Dry ▨ Sludge [-13-] Sludge ⊠

No S-4651
Date 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 455
Commenced: 17.5.1965
Completed: 17.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 18.5.1965

Bore No: 9
Programme: Sunlands
Bore Serial No: 675/65
Drilling Method: Rotary
Total Depth: 38'
Reduced Level: 126.43 (MSL)
Salinity (p.p.m.): — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		1 or 2					0 - 1' Dark brown sandy soil.	
							1 - 10 Cream fine limy sands with soft kunkar at 3', 5 and 7'.	
					10		10 - 12 Greenish limestone with limy sands.	
					12		12 - 24 Variegated green and yellow brown clays.	
		1					24 - 26 As above but with calcareous material and white hard clay.	
							26 - 30 Variegated green and yellow silty clay.	
					30		30 - 33 Variegated green and yellow clayey sands.	
							33 - 35 Oysters in fine grain buff sands.	
		2					35 - 38 Light fawn poorly sorted fine to very coarse quartz sands - calcareous.	
					38			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No S-4652 Job

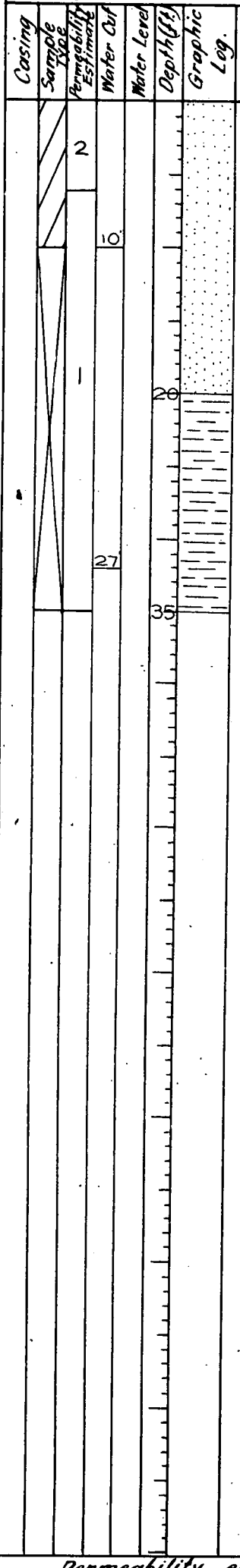
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 455
Commenced: 18.5.1965
Completed: 18.5.1965
Driller: T. Jarvis
Logged: G.T.Roberts Date 18.5.1965

Bore No. 10
Programme Sunlands
Bore Serial No. 675/65
Drilling Method Rotary
Total Depth 35'
Reduced Level 44.75 (MSL)
Salinity (p.p.m.) = at =
= at =



LOG

0 - 6' Red mainly fine grained sands.

6 - 20 Variegated greenish-grey and brown clayey sand.

20 - 29 Mainly light grey clay.

29 - 31 Mixture of brown sand and light grey clay.

31 - 32 Grey clay.

32 - 35 Gypsum.

Remarks

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge -15- Rotary. Dry. Sludge

No S-4653 Job

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 456
Commenced: 18.5.1965
Completed: 18.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 19.5.1965

Bore No. 11
Programme Sunlands
Bore Serial No. 675/65
Drilling Method Rotary
Total Depth 50
Reduced Level 61.43 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft.)	Graphic Log	LOG	Remarks
		2			0		0 - 6' Red fine and medium sands.	
		1			6		6 - 33 Mainly very clayey red sands.	
					33		33 - 50 Increasing quantities of grey clays in brown silts and sands.	
					50			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -15- Rotary. Dry ▨ Sludge ☒

No S-4654 Jab
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 660
Commenced: 18.5.1965
Completed: 18.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 18.5.1965

Bore No. 12
Programme Sunlands
Bore Serial No. 675/65
Drilling Method Rotary
Total Depth 32'
Reduced Level 110.56 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
					1		0 - 1' Brown sandy soil.	
							1 - 2 Brown sandy soil and kunkar.	
							2 - 6 Pink pebbly kunkar.	
							6 - 8 Soft and hard greenish limestone, some marly.	
					8		8 - 17 Brown and green variegated clay becoming brown in basal.	
		1					17 - 18 Grey-greenmarl.	
							18 - 25 Green and yellow clay and silty clay.	
							25 - 26 Green and yellow sandy clay.	
					26		26 - 32 Oysters in coarse sandy matrix.	
		2			32			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge [-13-] Rotary. Dry ▨ Sludge ⊠

No. S-4655 Lab
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 12D
Commenced: 18.5.1965
Completed: 18.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 18.5.1965

Bore No. 13
Programme Sunlands
Bore Serial No 675/65
Drilling Method Rotary
Total Depth 61'
Reduced Level 149.97 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth(ft)	Graphic Log	LOG	Remarks
		2			0		0 - 20' Fine grain brown dune sands.	
					20		20 - 30 As above with kunkar, and possibly fresh water limestone at base.	
		1			30		30 - 33 Yellow clayey sand passing down into yellow silty clay.	
					33		33 - 53 Blue-green and yellow-brown variegated clays. Marly layers from 42-45' and 49-52'.	
		2			53		53 - 61 Yellow-green silty and clayey sands with oyster fragments 55-57'.	
					61			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge -13-

Nº S-4656 Jab

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 607
Commenced: 19.5.1965
Completed: 19.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date 19.5.1965

Bore No. 14
Programme Sunlands
Bore Serial No 675/65
Drilling Method Rotary
Total Depth 20'
Reduced Level 101.11 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
		2			0		0' - 4' Mainly red, fine to medium grained sands, slightly clayey at base.	
		1			4		4 - 6 Pink kunkar and sand.	
					8		6 - 8 Mixture of kunkar, clayey sand and green clay (?).	
		2			10		8 - 10 Oyster bed.	
							10 - 14 Fine yellow micaceous sand with oyster fragments.	
							14 - 15 Oysters in fine white sand.	
					20		15 - 20 Dirty yellow fine micaceous sand with hard bands. Some coarse grains.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary. Dry ▨ Sludge ☒

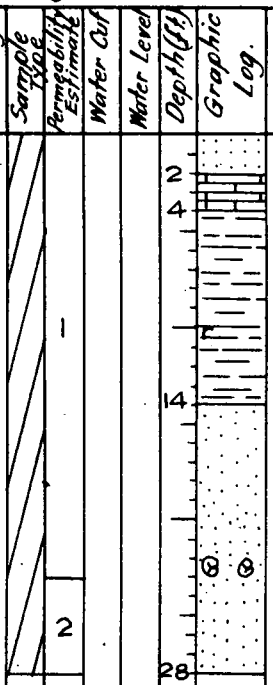
No S-4657 Jab
Date: 3·9·65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 610
Commenced: 19.5.1965
Completed: 19.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 19.5.1965

Bore No. 15
Programme Sunlands
Bore Serial No 675/65
Drilling Method Rotary
Total Depth 28'
Reduced Level 93.04 (MSL)
Salinity (p.p.m.) -- at --
-- at --



LOG			Remarks
0	- 1'	Brown sand.	
1	- 2	Brown sand and kunkar.	
2	- 4	Massive pink kunkar becoming pebbly.	
4	- 10	Grey and brown clay with gypsum.	
10	- 13	Hard brown silty clay.	
13	- 14	Brown clay and gypsum.	
14	- 18	Bands of hard recrystallised sandstone in light cream sands. Gypsum.	
18	- 23	Mainly fine-medium grain cream clayey sands.	
23	- 25	Oysters in light cream sands.	
25	- 28	Yellow fine- coarse sands with some hard bands.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -TS- Rotary. Dry ▨ Sludge ⊠

No S-4658 Jab
Date: 3.9.65

S. A. DEPA TMENT OF MIN S

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 610
Commenced: 19.5.1965
Completed: 19.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 19.5.1965

Bore Nº 16
Programme Sunlands
Bore Serial Nº 675/65
Drilling Method Rotary
Total Depth 51'
Reduced Level 109.76 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
		2 or 1					0 - 2' Brown fine-medium grain sands.	
							2 - 10 Light pinkish calcareous fine to medium grainsands with soft kunkar.	
					10		10 - 11 Hard green fresh water limestone.	
		1					11 - 39 Variegated blue-green clays with brown and red patches.	
							39 - 40 Light fine grain slightly micaceous sands. Clayey.	
					39		40 - 49 Cream fine-medium grain clayey sands with some coarse grains.	
		2			51		49 - 51 Light fine grain sands with some coarse grains.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

Nº S-4659 Jab
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 610
Commenced: 19.5.1965
Completed: 19.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 19.5.1965

Bore No. 17
Programme Sunlands
Bore Serial No 675/65
Drilling Method Rotary
Total Depth 35'
Reduced Level 102.06 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		2			0		0 - 2' Brown fine to medium grain sand.	
					3		2 - 3 Light brown sand and kunkar.	
							3 - 4 Hard pink kunkar.	
					8		4 - 8 Pink pebbly and marly kunkar.	
					10		8 - 12 Mainly brown silty clay.	
							12 - 18 Variegated blue-green silty clay.	
		1			18		18 - 26 Light brown and grey mixed clayey fine grain sands.	
							26 - 31 Cream to coffee-brown clayey sands. Fine grain but with some coarse grains.	
		2					31 - 34 Light brown fine clayey sand with some coarse grains and a few shell fragments.	
					35		34 - 35 Fine to coarse light brown sands with oyster fragments.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -15- Rotary. Dry ▨ Sludge ⊠

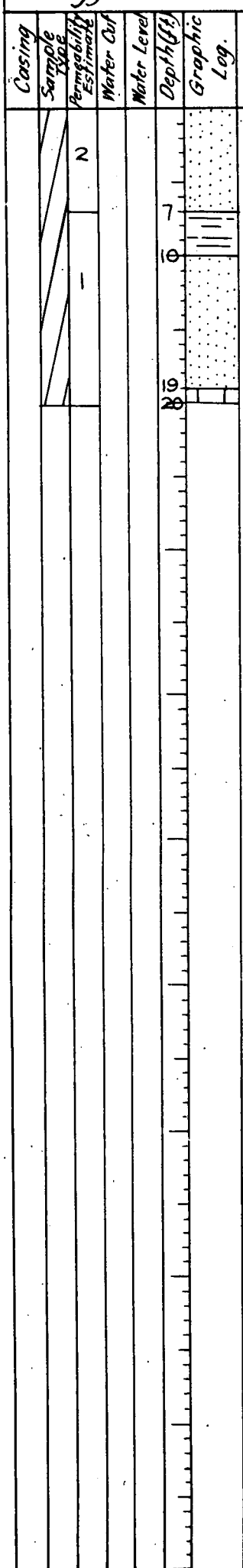
No S-4660 Jab
Date: 3·9·65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 12D
Commenced: 19.5.1965
Completed: 19.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 19.5.1965

Bore No. 18
Programme Sunlands
Bore Serial No. 675/65
Drilling Method Rotary
Total Depth 20'
Reduced Level 106.19 (MSL)
Salinity (p.p.m.) -- at --
-- at --



			LOG	Remarks
0	-	2'	Dark brown clayey sands.	
2	-	7	Brick-red clayey sand.	
7	-	10	Mixture of brown clayey sand and greenish marly clay.	
10	-	12	Brown and greenish-grey very clayey sand.	
12	-	16	Light brown and orange-yellow clayey sands.	
16	-	19	Cream fine grain micaceous sands.	
19	-	20	Grey-fawn very hard recrystallised limestone.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Rotary. Dry ▨ Sludge -15- Sludge ☒

No S-4661 Job

Date: 3·9·65

S. A. DEPA TMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 12D
Commenced: 20.5.1965
Completed: 20.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 20.5.1965

Bore No. 19
Programme: Sunlands
Bore Serial No: 675/65
Drilling Method: Rotary
Total Depth: 50'
Reduced Level: 172.37 (MSL)
Salinity (p.p.m.): — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft)	Graphic Log	LOG	Remarks
		2 or 3					0 - 2' Brown fine and medium grain sand.	
							2 - 14 Mainly fawn fine-medium grain sand.	
							14 - 22 Fawn sand and kunkar.	
					22		22 - 28 Hard pink kunkar.	
		1			28		28 - 35 Greenish limestone and pale grey-green marl.	
					35		35 - 50 Blue-green clay.	
							Bore abandoned without reaching base of clay.	
					50			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge [15-]

No S-4662 Jab

DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section 594
Commenced: 13.5.1965
Completed: 13.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 19.5.1965

Bore No. 21
Programme Sunlands
Bore Serial No. 675/65
Drilling Method Rotary
Total Depth 32'
Reduced Level 124.17 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG			Remarks
					0		0	-	1'	Brown sand.
					2		1	-	2	Hard kunkar in brown sand.
							2	-	4	Light brown calcareous sand.
							4	-	6	Very calcareous fawn sand.
		1			7		6	-	7	Light brown calcareous sand.
		or			9		7	-	9	Soft pink kunkar in sand.
		2					9	-	13	Brown, slightly clayey sand.
							13	-	15	Hard pink pebbly kunkar.
							15	-	17	Soft pink kunkar and sand.
					17		17	-	20	Brown sands mainly medium grains but coarse at base.
					20		20	-	22	Brown and green clay.
							22	-	23	Greenish clays with hard limestone.
		1					23	-	25	Variegated green and yellow clays.
							25	-	26	As above but with hard limestone.
							26	-	29	Greenish clay with oysters.
					29		29	-	32	Oyster bed.
		2			32					

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No. S-4663 Ja
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section 12D
Commenced: 21.5.1965
Completed: 21.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 26.5.1965

Bore No. 22
Programme Sunlands
Bore Serial No. 675/65
Drilling Method Rotary
Total Depth 56'
Reduced Level 141.22 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Depth (ft)	LOG	Remarks
1	1 - 2' Brown and fawn fine-medium grain clayey sand.	
3	2 - 3 Fairly soft pink kunkar.	
5	3 - 5 Fawn fine and medium grain limy sand.	
8	5 - 8 Fairly soft pink kunkar and sand.	
9	8 - 9 Fawn limy sand.	
11	9 - 11 Fairly soft pink kunkar.	
13	11 - 13 Fawn and brown fine-medium grain sand.	
17	13 - 16 Hard pebbly kunkar.	
	16 - 17 Kunkar and hard green fresh water limestone.	
	17 - 18 Greyish soft marl.	
21	18 - 21 Greyish clay passing down into fine brown sand and silt.	
	21 - 22 Kunkar and fresh water limestone.	
	22 - 24 Yellowish-brown gypsum.	
	24 - 25 Fine brown silt and gypsum.	
	25 - 30 Brownish gypsum.	
	30 - 31 Fine brown silt or gypsum.	
	31 - 36 White and pinkish floury gypsum.	
	36 - 39 Red clay and gypsum.	
	39 - 42 Greenish and red gypsum and clay.	
	42 - 44 Mainly red clay and gypsum.	
44	44 - 48 Yellow and greenish clayey sand or gypsum.	
	48 - 50 Fine yellow shelly sand.	
	50 - 52 Oysters in mainly fine yellow-brown sand.	
56	52 - 56 Yellow and light grey fine slightly micaceous and with oysters.	

Casing | Sample Type | Permeability Estimate: 1 | 2 or 1 | 2 | Water Cut | Water Level

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No. S-4664 Jab
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report No. 3
Location: Hundred: Waikerie
Section: 574
Commenced: 24.5.1965
Completed: 24.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 25.5.1965

Bore No. 23
Programme Sunlands
Bore Serial No. 675/65
Drilling Method Rotary
Total Depth 25'
Reduced Level 112.92 (MSL)
Salinity (p.p.m.) — at —
at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft.)	Graphic Log	LOG	Remarks
		2			0		0 - 2' Light brown fine to coarse dune sand.	
					2		2 - 3 Fawn fine-medium limy sand.	
					3		3 - 4 Medium hard kunkar in light brown sand.	
					4		4 - 9 Yellow-brown fine-coarse limy sand.	
					9		9 - 13 Kunkar underlain by fresh water limestone.	
		1			11			
					13		13 - 16 Blue-green and yellow clay.	
					16		16 - 18 Orange mainly fine grain sand.	
					18		18 - 22 Oyster bed.	
		2			22		22 - 25 Mainly fine yellow micaceous sand and oysters.	
					25			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge -13- Rotary. Dry. Sludge

No S-4665 Jab
Date: 3.9.65

S. A. DEPA TMENT OF IN

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 549
Commenced: 25.5.1965
Completed: 25.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 25.5.1965

Bore No: 24
Programme: Sunlands
Bore Serial No: 675/65
Drilling Method: Rotary
Total Depth: 36'
Reduced Level: 103.32 (MSL)
Salinity (p.p.m.): -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		1			3		0 - 3' Pink massive and pebbly kunkar.	
					5		3 - 5 Green fresh water limestone passing down into greyish marl.	
							5 - 8 Gypseous clay.	
		2					8 - 18 Gypsum.	
					18		18 - 19 Fine grain brown sand.	
					19		19 - 24 Mainly gypsum.	
		1			24		24 - 28 Greenish-yellow fine clayey sand impregnated with gypsum.	
							28 - 31 Greyish fine to coarse sand and gypsum. ? oyster fragments.	
		2					31 - 35 Yellow-brown fine slightly micaceous sand.	
					36		35 - 36 White fine micaceous sand.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge. Sludge.

No S-4666 Jab

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 11G
Commenced: 27.5.1965
Completed: 27.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 1.6.1965

Bore No. 25
Programme Sunlands
Bore Serial No 675/65
Drilling Method Rotary
Total Depth 20'
Reduced Level 96.75 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Out	Water Level	Depth(ft.)	Graphic Log	LOG	Remarks
		1			1 4 6 10 14 20		0 - 1' Brown fine sand. 1 - 4 Pink pebbly and hard marly kunkar. 4 - 6 Green fresh water limestone. 6 - 10 Grey-green and brown clay. 10 - 14 Yellow and greenish clayey sand with some coarse grains. 14 - 20 Buff and grey hard sandy limestone.	
		1 or 2						

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary. Dry ▨ Sludge ⊠

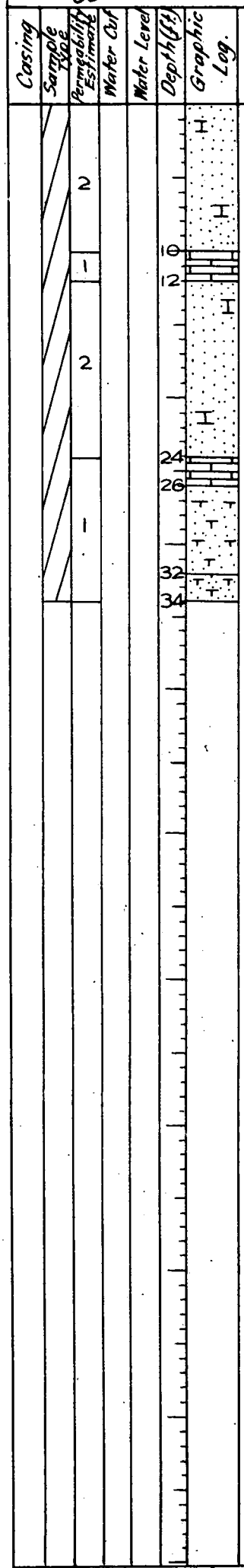
No S-4667 Job
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 607 Blk. 14
Commenced: 21.6.1965
Completed: 21.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 7.7.1965

Bore No. 26
Programme Sunlands
Bore Serial No. 675/65
Drilling Method Rotary
Total Depth 34'
Reduced Level 153.69 (MSL)
Salinity (p.p.m.) — at —
— at —



LOG

0 - 24' Brown and light brown fine and medium sands, limy throughout. Kunkar bands at 10-12'. (Soft).

24 - 26 Hard pebbly kunkar.

26 - 32 Grey and brown marl and fine sand.

32 - 34 Grey sandy marl and patches of green sandy clay.

Remarks

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary. Dry ▨ Sludge ⊠

No S-4668 Job

Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 607 Blk. 3
Commenced: 21.6.1965
Completed: 21.6.1965
Driller: T. Jarvis.
Logged: G.T. Roberts Date: 7.7.1965

Bore No. 27
Programme Sunlands
Bore Serial No. 675/65
Drilling Method Rotary
Total Depth 37'
Reduced Level 137.31 (MSL)
Salinity (p.p.m.) — at —.
— at —.

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
		2			0		0 - 18' Brown limy sand, fine-medium grain.	
		1			18		18 - 27 Soft kunkar and sand becoming marly at base.	
					22			
					27		27 - 37 Variegated blue-green clay - marly. Damp from 18' ?.	
					37			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge -13- Sludge

No S-4669 Job
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report No. 3
Location: Hundred: Waikerie
Section: 662
Commenced: 22.6.1965
Completed: 22.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 7.7.1965

Bore No. 28
Programme Sunlands
Bore Serial No. 675/65
Drilling Method Rotary
Total Depth 37'
Reduced Level 138.53 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		3 or 2			0		0 - 12' Brown fine to coarse limy sand.	
					12		12 - 20 Light brown and grey marl and fine sand.	
		1			20		20 - 28 Mainly brown clay.	
							28 - 37 Grey-green passing down into blue-green clay.	
					37			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge. Sludge.

No S-4670

DEPARTMENT OF MINES
SOUTH AUSTRALIA

RIVER MURRAY - DRAINAGE INVESTIGATION

PROGRESS REPORT NO. 3

PROGRAMME - RAMCO

Bore Number	Hundred	Section	Reduced level (M.S.L.)	Drilling Method
1 & 1A	Waikerie	695	115.92	Percussion
2	"	54B	109.25	Rotary
3	"	485	107.14	"
4	"	220	109.60	"
5	"	450	107.79	"
6	"	116	172.51	"
7	"	116	147.85	"
8	"	293	132.52	"
9	"	450	121.08	"
10	"	694	212.77	"
11	"	119	161.22	"
12	"	125	151.15	"
13	"	112B	125.94	"
14	"	401	161.35	"
15	"	50	184.10	"
16	"	324	124.41	"
17	"	108	149.43	"
18	"	269	170.73	"
19	"	112C	144.27	"
20	"	577	216.38	"
21	"	117	177.97	"
22	"	369	110.38	"
23	"	365	106.74	"
24	"	365	119.17	"
25	"	112B	124.36	Percussion

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 695
Commenced: 21.1.1965
Completed: 5.2.1965
Driller: R. Hubbert
Logged: G.T. Roberts Date 16.2.1965

Bore No 1
Programme Ramco
Bore Serial No 730/65
Drilling Method Percussion
Total Depth 160ft.
Reduced Level 115.92(M.S.L.)
Salinity (p.p.m.) at at

Depth (ft)	LOG	Remarks
0' - 1'	Brown clayey soil with rounded quartz grains and mica.	
1 - 2	Brown clayey iron rich soil, calcareous.	
2 - 3	Very tough, massive pink kunkar containing rounded quartz grains.	
3 - 7	Hard and soft bands of kunkarised sands.	
7 - 16	Mainly green-grey clays with fissues containing soft and pebbly kunkar to 10' and limy patches below. Oysters in basal 6 inches.	
16 - 18	Oyster beds in soft green and yellow slightly clayey sand.	
18 - 24	As above but oysters decreasing downwards. Sands fine grain, calcareous, micaceous.	
24 - 26	Soft and hard bands of fine clayey, calcareous, micaceous greenish yellow sandstone.	
26 - 30	Poorly sorted soft fine to coarse clayey calcareous sand and fine grit. Slightly micaceous.	
30 - 35	Soft fine to medium clayey calcareous sand with oysters. Occasional rounded coarse quartz grains. Slightly micaceous.	
35 - 36	Soft calcareous sand with thin hard cemented layers and patches of brown clay.	
36 - 80	Mainly fawn and brown sandy limestone, very fossiliferous. Soft marly bands at 53 - 56, 57 - 58, 67 - 71, 77 - 80. Very soft dark brown silty layer from 45 - 46.	
80 - 86	Grey and brown stained plastic marly clays.	
86 - 97	Soft fawn and grey silty marls.	
97 - 104	Light grey-fawn silty marls - fairly soft.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No S-4582 Lab

Date: 25.8.65

. A. DE RTMENT OF T E

BORE LOG

Project: River Murray Drainage Investigation
Report: No.3
Location: Hundred: Waikerie
Section: 695
Commenced: ? 21.1.1965
Completed: ? 5.2.1965
Driller: R. Hubbert
Logged: G.T. Roberts Date 16.2.1965

Bore No. 1
Programme Ramco
Bore Serial No. 730/65
Drilling Method Percussion
Total Depth 160ft.
Reduced Level 115.92 (M.S.L.)
Salinity (p.p.m.) at
at

Casing	Sample Type	Permeability Estimate	Water Out	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		1			100			
					104		104' - 145' Dark grey silty marls with occasional thin harder bands	Core from 104 - 145' Not continu
		1						
		1						
		1						
		1						
		1						
		1			145			
5	3						145 - 158 Hard fawn sandy limestone - sludge samples.	
5								
		1			158			
5					160		158 - 160 Fawn and grey marly clay - sludge samples.	
5	3						160 - 182 Limestone and marls, banded, grey limestone bands - hard.	
5								
					182			
5							182 - 195 Limestone, mainly grey-fawn, fossiliferous.	
5	3							
					195			
5							195 - 250 Limestone, marly at top becoming silty grey becoming fawn - yellowish	
5	3							
5								
					250			
5								

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge ▭ Rotary. Dry ▨ Sludge ▩

No S-4582-a Jal
Date 25.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 54B
Commenced: 27.5.65
Completed: 27.5.65
Driller: T. Jarvis
Logged: G.T. Roberts Date: 1.6.1965

Bore No. 2
Programme Ramco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 61'
Reduced Level 109.25 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth(ft.)	Graphic Log	LOG	Remarks
		2			0		0 - 7 Mainly brown and fawn fine - medium sands.	
					7		7 - 13 Very hard pebbly Kunkar passing down into Kunkarised green limestone.	
					11			
					13		13 - 16 Sandy and silty grey green and red clay.	
							16 - 27 Greenish gypsum clays with thin marly bands.	
					27		27 - 28 Fine grain greenish-yellow calcareous sand.	
							28 - 35 As for 16-27'.	
		1					35 - 37 Soft yellow green gypsum clay.	
							37 - 41 Grey, green-brown clay with gypsum.	
							41 - 42 Soft greenish gypsum clay.	
							42 - 49 Greenish passing down into brown gypsum clay.	
					49		49 - 52 Green and yellow clayey sand.	
					52		52 - 57 Mainly fawn fine sands with some coarse grains - gypsum.	
		2					57 - 61 Hard and soft sand with gypsum. Some coarse grains.	
					61			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -15- Rotary Dry ▨ Sludge ⊠

No S-4583

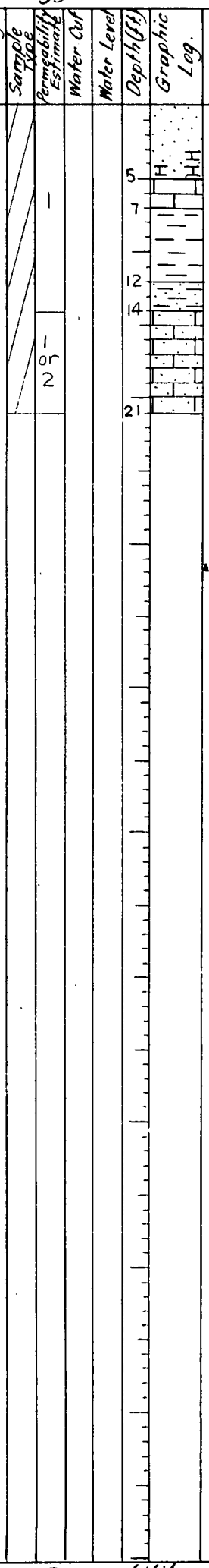
Date 25.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 485
Commenced: 28.5.1965
Completed: 28.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 1.6.1965

Bore No. 3
Programme Ramco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 21'
Reduced Level 107.14 (MSL)
Salinity (p.p.m.) -- at --
-- at --



LOG			Remarks
0	- 1	Brown mainly fine sand.	
1	- 5	Mixture of fawn fine sand and soft pink kunkar.	
5	- 7	Green fresh water limestone.	
7	- 12	Variegated blue-green clay.	
12	- 14	Green and yellow very clayey fine sand.	
14	- 21	Fawn sandy limestone passing down into hard white sandy limestone.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -15- Rotary. Dry ▨ Sludge ⊠

No S-4584 Jab
Date: 25.4.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 220
Commenced: 28.5.1965
Completed: 28.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 2.6.1965

Bore No. 4
Programme Ramco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 33'
Reduced Level 109.60 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
		2			0		0 - 9 Brown slightly clayey fine to coarse sand becoming coarse at base.	
		1			9		9 - 11 Light brown fine to coarse calcareous sand.	
					11		11 - 12 Pink fairly soft sandy kunkar.	
					12		12 - 17 Light brown calcareous sand and soft light brown kunkar.	
					17		17 - 20 Hard grey and fawn sandy limestone.	
		2			20		20 - 25 Mixture of hard sandy limestone and fine sand to fine gravel sized sands slightly calcareous.	
					25		25 - 26 Orange brown mainly fine clayey sand.	
		1			26		26 - 28 As for 20-25' but with shell fragments.	
					28		28 - 33 Yellowish marly limestone with hard bands near top.	
					33			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge. Sludge.

No S-4585 Jab

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 450
Commenced: 28.5.1965
Completed: 28.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 1.6.1965

Bore No. 5
Programme Ramco
Bore Serial No 668/65
Drilling Method Rotary
Total Depth 28'
Reduced Level 107.79 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft)	Graphic Log	LOG	Remarks
					0		0 - 2' Pink hard kunkar.	
					2		2 - 4 Brownish hard sandy kunkar.	
					4		4 - 6 Fine and medium brown sand.	
					6		6 - 9 Green and brown fresh water limestone passing down into grey marl.	
		1			9		9 - 16 Variegated blue-green clay.	
					16		16 - 20 Yellowish green sandy clay with fine shell fragments at 17-18'.	
		2			20		20 - 28 Fawn and light fine sands and sandy limestone with oyster fragments at 26-27'.	
					28			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge [15] Rotary Dry ▨ Sludge ☒

No S-4586 Job
Date: 25.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 116
Commenced: 1.6.1965
Completed: 1.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 1.6.1965

Bore No. 6.
Programme Ramco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 66'
Reduced Level 172.51 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		3			0		0 - 66' Dune sands with kunkar horizons at	
					21		21 - 24 - soft.	
		1			24			
					27		27 - 29 - gritty, pebbles.	
		3			29			
					40		40 - 49 - white, hard, sandy.	
		1			49			
		2					Sand becomes cream in colour below 54' and becomes progressively finer to base.	
		2			66		Hole abandoned in loose sands.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge. F15-

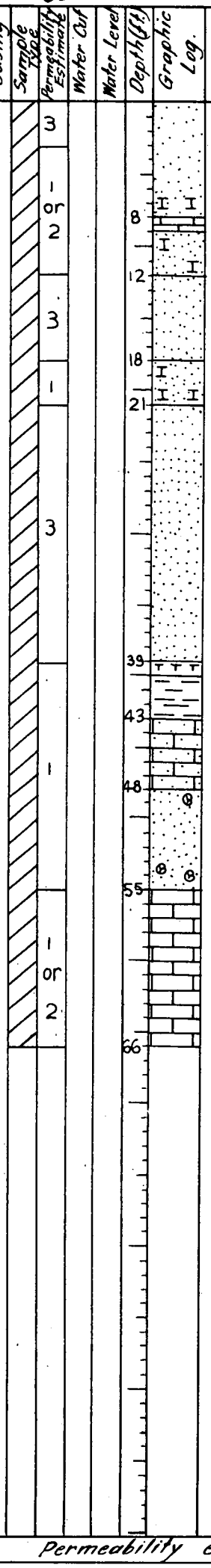
No S-4587 Jab

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 116
Commenced: 31.5.1965
Completed: 31.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 2.6.1965

Bore No. 7
Programme Ramco
Bore Serial No 668/65
Drilling Method Rotary
Total Depth 66'
Reduced Level 147.85 (MSL)
Salinity (p.p.m.) -- at --
-- at --



LOG			Remarks
0	- 3'	Fawn brown fine to coarse sand.	
3	- 7	Fawn fine to medium clayey sand with soft fawn kunkar at base.	
7	- 8	Red fine - medium clayey sand.	
8	- 9	Fairly hard fawn gritty kunkar.	
9	- 12	Fawn clayey calcareous sand.	
12	- 18	Reddish brown fine to coarse slightly clayey sand.	
18	- 21	Fawn sand with fairly soft grey gritty kunkar.	
21	- 27	Reddish brown fine to coarse sand.	
27	- 36	Reddish brown mainly fine sand, but with some coarse grains.	
36	- 39	Reddish brown fine to coarse sand.	
39	- 40	Pink grey soft kunkar and marl.	
40	- 41	Red very sandy clay.	
41	- 43	Green clay and sand.	
43	- 48	Very hard sandy limestone with fine - coarse sand grains.	
48	- 55	Greenish yellow mainly fine clayey sand with occasional oyster shells.	
55	- 59	Hard white sandy limestone with some softer bands.	
59	- 62	Yellow brown sandy limestone.	
62	- 66	Fawn marly limestone.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Rotary. Dry ▨ Sludge ☒

Nº S-4588

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 293
Commenced: 28.5.1965
Completed: 28.5.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 1.6.1965

Bore No. 8
Programme: Ramco
Bore Serial No: 668/65
Drilling Method: Rotary
Total Depth: 44'
Reduced Level: 132.52 (MSL)
Salinity (p.p.m.): -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		3			0		0 - 3' Brown fine - medium sand.	
		2			3		3 - 6 Fawn fine - medium sand.	
			10	10	6		6 - 9 Mainly coarse red clayey sand.	
					9		9 - 14 Pink rubbly and marly kunkar.	
					14		14 - 28 Green-blue variegated clay.	
		1			28		28 - 32 Yellow and greenish sandy clay.	
		1 or 2			32		32 - 44 Hard buff limestone becoming marly in basal 2ft.	
					44			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge [-15-] Rotary. Dry ▨ Sludge ☒

No. S-4589 Job
Date: 25.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 450
Commenced: 1.6.1965
Completed: 1.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 1.6.1965

Bore No. 9
Programme Ramco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 27'
Reduced Level 121.08 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		2			0		0 - 1' Brown sandy soil.	
					1		1 - 4 Light brown fine - medium sand with soft kunkar.	
					4		4 - 6 Rubbly pink kunkar.	
					6		6 - 10 Soft kunkar and limy sand.	
		1			10		10 - 12 Pebbly kunkar and kunkarised green limestone.	
					12		12 - 22 Yellow-green and brown silty clay.	
					22		22 - 27 Very hard sandy limestone.	
		2			27			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry.

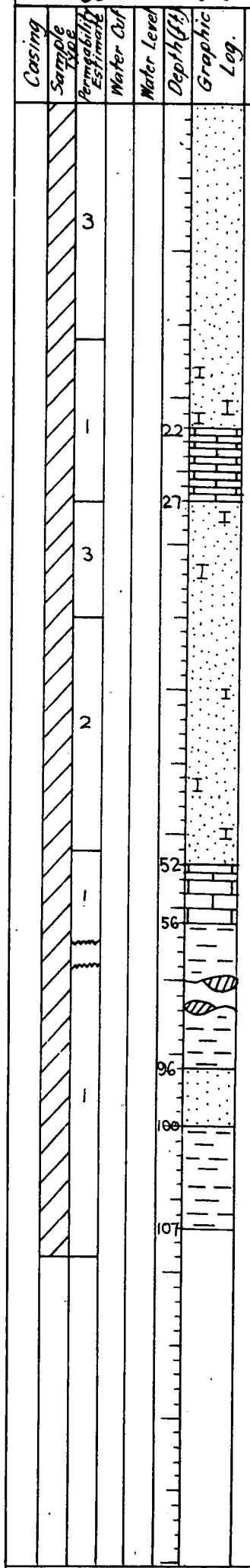
No S-4590

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 694
Commenced: 2.6.1965
Completed: 3.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 3.6.1965

Bore No. 10
Programme Ramco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 109'
Reduced Level 212.77 (MSL)
Salinity (p.p.m.) -- at --
-- at --



LOG			Remarks
0	- 2'	Brown fine-medium sand.	
2	- 7	Fawn fine-medium sand.	
7	- 16	Light brown and brown mainly fine sand.	
16	- 22	Brown and fawn rather clayey fine-medium sand with soft kunkar.	
22	- 27	Mainly hard pebbly sandy kunkar and limy sand.	
27	- 35	Mainly medium-coarse grain fawn sand with kunkar.	
35	- 52	Fine fawn sand with sandy white kunkar.	
52	- 53	Hard pink kunkar.	
53	- 56	Green limestone passing down into light marl with bands of reddish sandy limestone.	
56	- 59	Grey and greenish silty clay.	
59	- 96	Red silty clay with scattered limy patches throughout.	
96	-100	Red brown clayey sand.	
100	-107	Blue green variegated clay.	
107	-109	No samples - ? base of clay.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -15- Rotary. Dry ▨ Sludge ▩

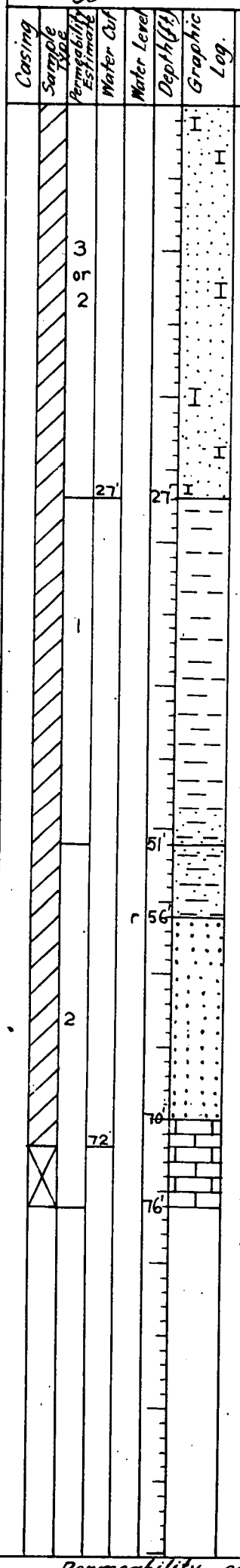
No S-4591 Jab
Date: 25.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 119
Commenced: 4.6.1965
Completed: 4.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date 8.6.1965

Bore No. 11
Programme Ramco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 76'
Reduced Level 161.22 (MSL)
Salinity (p.p.m.) at at



LOG			Remarks
0	- 1'	Red fine and medium sand.	
1	- 14	Fawn and light brown very limy fine and medium sand with soft kunkar horizons.	
14	- 18	Red and brown slightly limy fine and medium sand.	
18	- 27	As for 1-14' but somewhat less limy.	
27	- 32	Brown-yellow-green silty clay.	
32	- 38	Red, brown clay.	
38	- 50	Red-yellow-green variegated clay. Red colour decreasing downwards. Becoming silty and sandy at base.	
50	- 51	Mainly red clay with yellow-green clayey sand.	
51	- 56	Yellow-grey-green clayey sand.	
56	- 70	Very clayey fien to very coarse brown and yellow-grey sands.	
70	- 76	Dirty yellow sandy limestone and marl.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

-15-

No. S-4592 Jab
Date 2.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 125
Commenced: 7.6.1965
Completed: 7.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 8.6.1965

Bore No. 12
Programme Ramco
Bore Serial No 668/65
Drilling Method Rotary
Total Depth 56'
Reduced Level 151.15 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		3			2		0 - 2' Brown fine to coarse sand.	
		1					2 - 7 Light grey and pinkish massive and pebbly kunkar.	Strata damp throughout
		2			7		7 - 17 Mainly pink-grey fairly soft kunkar in sand. Sand increasing downwards.	
		3			17		17 - 28 Varying brown fine to coarse sands.	
					28		28 - 30 Pink tough kunkar, sandy at base.	
					30		30 - 32 Red clayey sand and kunkar.	
		1			32		32 - 37 Greenish limestone and hard grey-green marl.	
					37		37 - 48 Blue-green and yellow-brown clay.	
		2 or 1			48		48 - 56 Yellow hard sandstone (2-3') underlain by hard and soft bands (? sandy limestone and marl).	
					56			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge. F15-

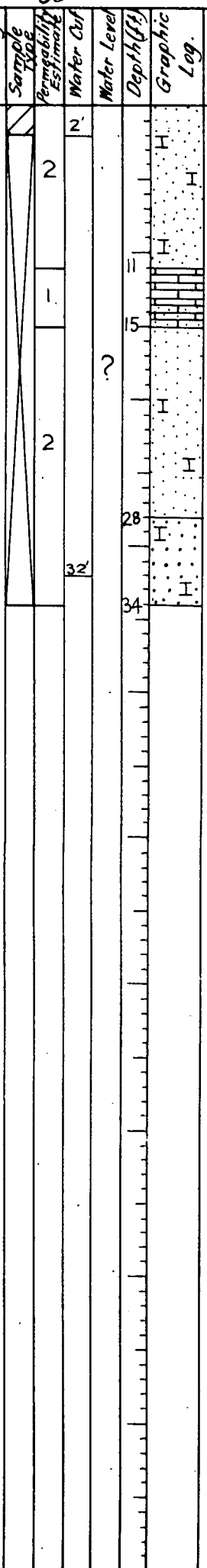
No S-4593 Job

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 112B
Commenced: 7.6.1965
Completed: 7.6.1965
Driller: T. Jarvis
Logged: C.T. Roberts Date: 9.6.1965

Bore No: 13
Programme: Ramco
Bore Serial No: 668/65
Drilling Method: Rotary
Total Depth: 34'
Reduced Level: 125.94 (MSL)
Salinity (p.p.m.): — at —
— at —



LOG		Remarks
0 - 2'	Brown fine-medium sand.	
2 - 11	Red-brown slightly limy fine-medium sands.	
11 - 13	Fairly soft grey kunkar in sand.	
13 - 15	Harder reddish sandy kunkar.	
15 - 18	Reddish limy fine-medium sand.	
18 - 28	Yellow-green clayey calcareous sand and sandstone with brown sand.	
28 - 34	Reddish very clayey sand with coarse rounded quartz grains and with hard bands. Slightly calcareous.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary. Dry ▨ Sludge ⊠

No S-4594 Jab
Date: 25.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report No. 3
Location: Hundred: Waikerie
Section: 401
Commenced: 16.6.1965
Completed: 16.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 16.6.1965

Bore No. 14
Programme Ramco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 80'
Reduced Level 161.35 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft.)	Graphic Log	LOG	Remarks
		1			2		0 - 2' Fawn fine limy sand	
							2 - 4 Pink nodular kunkar - hard.	
							4 - 9 Fine fawn kunkar (Hard) and fine sand.	
					11		9 - 11 Pink hard rubbly kunkar.	
							11 - 15 Variegated blue-green-brown clay with limy nodules.	
							15 - 33 Mainly brown clays.	
							33 - 37 Brown clay with grey marly layers.	
							37 - 48 Brown and grey-green clays.	
							48 - 64 Grey-green clays with light grey layers.	
		2			64		64 - 67 Mainly fawn fine sands.	
					67		67 - 74 Very clayey fawn and light brown sands with shell fragments.	
					74		74 - 80 Limy sands somewhat less clayey - shell fragments.	
					80			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge.

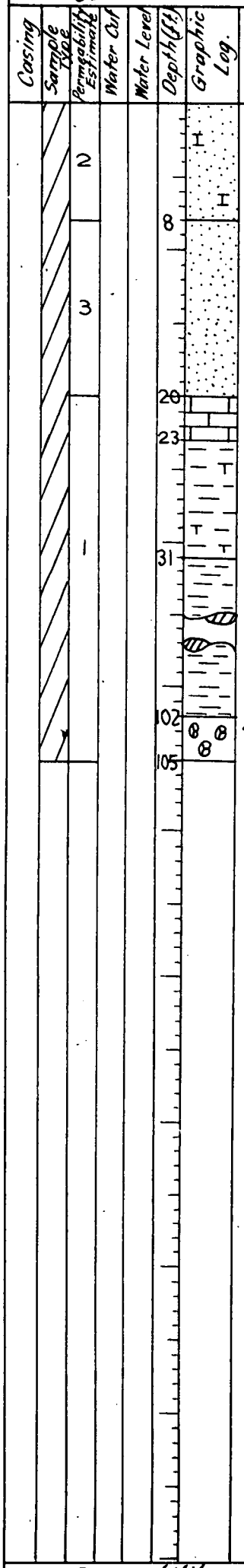
No S-4595 Jak

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 50
Commenced: 17.6.1965
Completed: 17.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 17.6.1965

Bore No: 15
Programme: Ramco
Bore Serial No: 668/65
Drilling Method: Rotary
Total Depth: 105'
Reduced Level: 184.10 (MSL)
Salinity (p.p.m.): -- at --
-- at --



LOG			Remarks
0	- 8'	Fawn soft kunkar and sand.	
8	- 20	Brown fine to coarse sand becoming finer downwards.	
20	- 23	Pink kunkar and greenish kunkarsied fresh water limestone.	
23	- 31	Marly clay - light greenish grey.	
31	- 73	Brown clay.	
73	- 90	Yellow-green clay.	
90	-102	Blue-green clay.	
102	-105	Oyster bed.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. -15- Rotary. Dry. Sludge.

No S-4596 Jab
Date: 25.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 324
Commenced: 17.6.1965
Completed: 17.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 18.6.1965

Bore No. 16
Programme Ramco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 25'
Reduced Level 124.41 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		2			0		0 - 1' Brown sandy soil.	
					1		1 - 7 Soft limy sand.	
					7		7 - 9 Pink sandy kunkar.	
		1			9		9 - 11 Green limestone.	
					11		11 - 15 Brown and green variegated clay.	
		2			15		15 - 20 Very clayey green and brown sand.	
					20		20 - 25 Fawn and yellowish green fine to coarse clayey sand.	
					25			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -15- Rotary. Dry ▨ Sludge ⊠

No S-4597 Jab
Date: 25.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 108
Commenced: 18.6.1965
Completed: 18.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 18.6.1965

Bore No. 17
Programme Ramco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 35'
Reduced Level 149.43 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		2					0 - 1' Brown limy soil.	
							1 - 4 Pebbly kunkar and limy fine sand.	
							4 - 20 Fawn, passing down into light brown limy fine - medium sand with white kunkar patches.	
		1					20 - 25 Brown sand with sandy kunkar.	
					25		25 - 30 White pebbly kunkar passing down into grey marl.	
					30		30 - 35 Green clay.	
					35			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -15- Rotary Dry ▨ Sludge ⊠

No. S-4598 Job
Date: 25.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 269
Commenced: 18.6.1965
Completed: 18.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 6.7.1965

Bore No: 18
Programme: Ramco
Bore Serial No: 668/65
Drilling Method: Rotary
Total Depth: 65'
Reduced Level: 170.73 (MSL)
Salinity (p.p.m.): -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		3			7		0 - 56' Brown and red brown fine to medium sands with distinct kunkar band at 10-11' and 17-18'. Marly at 7-8'. Limy throughout to 40'.	
		3			10			
		3						
		3			56		56 - 59 Soft grey marl.	
		1			59		59 - 65 Grey and greenish grey clay.	
					65			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -15- Rotary. Dry ▨ Sludge ⊠

No S-4599 Job

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: ° Waikerie
Section: 112°
Commenced: 23.6.1965
Completed: 23.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 6.7.1965

Bore No. 19
Programme Remco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 80'
Reduced Level 144.27 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth(Ft.)	Graphic Log	LOG	Remarks
		3					0 - 65' Brown and fawn fine - medium sands, limy generally throughout but less so in basal 20'. Kunkar horizons developed 3-4', 6-11', 14-17', scattered to 22'.	
		-						
		3						
		1						
		3						
		-						
		2						
		3						
					65			
		1					65 - 73 Grey and greenish marls and fine sand.	
					73		73 - 80 Grey and red clay, slightly limy.	
		-			80			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Rotary. Dry ▨ Sludge ☒

No S-4600 Jab

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 577
Commenced: 24.6.1965
Completed: 24.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 7.7.1965

Bore No. 20
Programme Ramco
Bore Serial No 668/65
Drilling Method Rotary
Total Depth 36'
Reduced Level 216.38 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		3					0 - 23' Brown fine - medium sands calcareous throughout. Soft kunkar horizons at 3', 13-16'.	
		1						
		3						
		1						
		3						
					23		23 - 24 Light brown very calcareous fine sand.	
							24 - 29 Thin layer of green limestone overlying greenish-grey marl.	
		1			29		29 - 30 Grey and greenish grey clay.	
							30 - 36 Red clays with white clay patches.	
					36			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -15- Rotary. Dry ▨ Sludge ▩

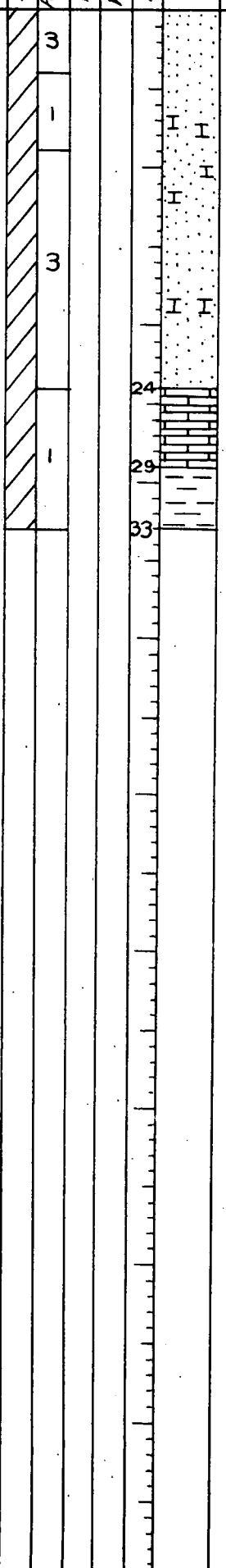
No S-4601 Jab
Date: 25.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 117
Commenced: 24.6.1965
Completed: 24.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 7.7.1965

Bore No. 21
Programme Ramco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 33'
Reduced Level 177.97 (MSL)
Salinity (p.p.m.) — at —
— at —



LOG		Remarks
0 - 24'	Brown fine - medium passing down into fine to coarse sands. Generally limy to 17' and with soft kunkar layers 4-9'.	
24 - 29	Pink pebbly kunkar passing down into pink and grey marl.	
29 - 30	Grey and light brown marly clay.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -15- Rotary. Dry ▨ Sludge ⊠

No S-4602 Jab
Date: 25.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 369
Commenced: 25.6.1965
Completed: 25.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 6.7.1965

Bore No. 22
Programme Ramco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 19'
Reduced Level 110.38 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		2			0		0 - 2' Brick red fine sand.	
		1			2		2 - 6 Pink tough kunkar.	
		2			6		6 - 10 Fine greenish-fawn limy sand with oyster fragments.	
		2			10		10 - 17 Grey very sandy limestone or very limy recrystallised sands.	
					17		17 - 19 Yellowish fawn fine - coarse clayey sand.	
					19			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge. Sludge.

No S-4603 Job
Date: 25.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 365
Commenced: 25.6.1965
Completed: 25.6.1965
Driller: T. Jervis
Logged: G.T. Roberts Date: 6.7.1965

Bore No. 23
Programme Ramco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 16'
Reduced Level 106.74 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
		1			0 - 2		Dark brown fine soil and kunkar.	
					2 - 6		Pink kunkar and fine limy sand.	
		2			6 - 10		Greenish and fawn clayey fine sand with oyster fragments.	
					10 - 14		Greenish and fawn limy fine sand with some rounded coarse grains.	
					14 - 16		Fine light brown limy clayey sand.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge. Sludge.

No S-4604

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report No. 3
Location: Hundred: Waikerie
Section 365
Commenced: 28.6.1965
Completed: 28.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 6.7.1965

Bore No. 24
Programme Remco
Bore Serial No. 668/65
Drilling Method Rotary
Total Depth 14'
Reduced Level 119.17. (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		1			2		0 - 2' Dark brown fine soil. 2 - 3 Pink kunkar and fine brown sand.	
					8		3 - 8 Greenish grey very limy sand and limestone bands - recrystallised.	
					13		8 - 13 Recrystallised limestone with oysters.	
					14		13 - 14' Very limy fine - coarse sand.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -15- Rotary Dry ▨ Sludge ☒

No S-4605 Jab
Date: 25.8.65

S. A. DEPARTMENT OF MINES

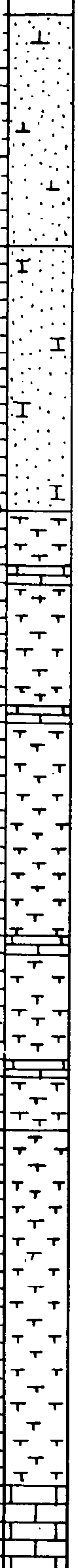
BORE LOG

Project: River Murray Drainage Investigations
Report: Progress Report No. 3
Location: *Hundred*: Waikerie
Section: 112B
Commenced: 29.9.1965
Completed: 14.10.1965
Driller: D.R. Phillips
Logged: G.T. Roberts *Date*: 14.10.1965

Bore No. 25
Programme Ramco
Bore Serial No. 408/66
Drilling Method Percussion
Total Depth 212ft.
Reduced Level 124.36
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	LOG	Remarks
152' of 6" Casing						0' - 12' Sump - No samples.	
					12	12 - 25 Sand, fine, marly, light fawn-red.	
		2	28	27'	25	25 - 40 Sandstone, very hard, rounded quartz grains to coarse size, very calcareous fawn.	
					40	40 - 55 Marls with thin hard limestone bands, yellow.	
						55 - 75 Marls, thin hard limestone bands, mixture of fawn and grey.	
		1		74'	75	75 - 95 Marl mainly but with thin limestone bands, fawn yellow.	
		3			95		

Graphic Log:



Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No. S-4847 Jab
Date 8.11.65

BORE LOG

Project: River Murray Drainage Investigations
Report: Progress Report No. 3
Location: Hundred: Waikerie
Section 112[B]
Commenced: 29.9.1965
Completed: 14.10.1965
Driller: D.R. Phillips
Logged: G.T. Roberts Date: 14.10.1965

Bore No. 25
Programme Ramco
Bore Serial No. 408/66
Drilling Method Percussion
Total Depth 212ft.
Reduced Level 124.36
Salinity (p.p.m.) = at = = at =

Casing: 152' of 6" Casing
Sample Type
Permeability Estimate
Water Cut
Water Level
Depth(Ft)
Graphic Log

LOG	Remarks
95' - 125' Limestone mainly, very fossiliferous. Some silty bands towards base. Grey and fawn.	
125 - 155 Marl and marly limestone fossiliferous fawn passing down into grey.	
155 - 200 Limestone, very fossiliferous grey.	
200 - 206 Limestone and marl yellow-fawn.	
206 - 212 Marl, silty, fossiliferous fawn, grey.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge -15- Rotary. Dry. Sludge

No S-4847a Jab

DEPARTMENT OF MINES
SOUTH AUSTRALIA

RIVER MURRAY - DRAINAGE INVESTIGATION

PROGRESS REPORT NO. 3

PROGRAMME - WAIKERIE

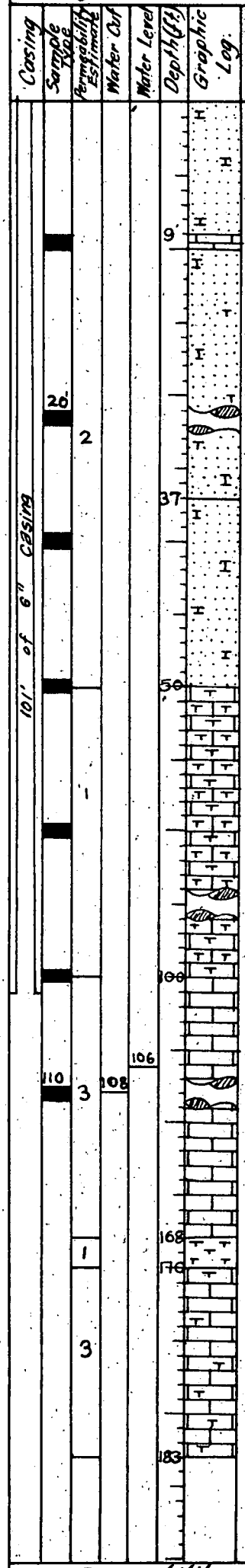
Bore Number	Hundred	Section	Reduced level (M.S.L.)	Drilling Method
1 & 1A	Waikerie	339	147.43	Percussion
2	"	692	132.35	Percussion
3	"	614	116.06	Rotary
4	"	373	113.87	"
5	"	161A	145.75	"
6	"	88E	111.06	"
7	"	399	122.83	"
8	"	399	136.08	"
9	"	377	130.67	"
10	"	576	145.81	"
11	"	47	126.86	"
12	"	369	120.02	"
13	"	Allot.157	44.72	Percussion
14	"	Town-Ship	118.05	"
15	"	76	132.28	"

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: Progress No. 3
Location: Hundred: Waikerie
Section 339
Commenced: 22.2.1965
Completed: 14.3.1965
Driller: M. Christiansen
Logged: G.T. Roberts Date: 18.3.1965

Bore No. 1 & 1A
Programme: Waikerie
Bore Serial No. 766/65
Drilling Method: Percussion
Total Depth: 183'
Reduced Level: 147.43
Salinity (p.p.m.): — at —
— at —



LOG			Remarks
0'	- 9'	Sump in sand and limy sand, fine-medium red and fawn.	
9	- 10	Kunkar, hard, gritty, pink with marl, pink.	
10	- 37	Sand, with kunkar bands and marly layers, fine-medium, red and fawn. Some fragments of greenish limestone near base.	
37	- 50	Sandstone very calcareous and or very sandy limestone tough, fawn, fossiliferous.	
50	- 100	Mainly marl and marly, rubbly limestone yellow and fawn. Limestone element increasing downwards.	
100	- 168	Mainly limestone fossiliferous. Some soft horizons.	
168	- 170	Marl, grey.	
170	- 183	Limestone with plentiful marly bands, brown and yellow-brown.	

Permeability estimates 1. Low, 2. Fair, 3 High.

Sample type: Percussion. Core ■ Sludge [15] Rotary. Dry ▨ Sludge ⊠

No S-4843 Jab
Date: 9.11.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: Progress No. 3
Location: Hundred: Waikerie
Section: 692
Commenced: 10.5.1965
Completed: 31.7.1965
Driller: M. Christiansen
Logged: G.T. Roberts Date: 26.8.1965

Bore No: 2
Programme: Waikerie
Bore Serial No: 847/65
Drilling Method: Percussion
Total Depth: 772'
Reduced Level: 132.35 (MSL)
Salinity (p.p.m.): -- at --
-- at --

Casing | Sample Type | Permeability Estimate | Water Cut | Water Level | Depth (ft) | Graphic Log

Sludge at 5' Intervals

0 - 3'	Sand, fine to coarse, brown.	
3 - 20	Sand, fine to medium, with kunkar fragments.	
20 - 25	Kunkar, clay, sandy, ostracod limestone.	
25 - 30	Sandstone, calcareous and/or limestone, sandy. Fossiliferous light brown and fawn.	
30 - 36	Sandstone, calcareous, tough recemented or kunkarised. Very coarse grain to fine gravel at top - medium to coarse at base. Rounded grains.	
36 - 37	Sand, fine to coarse rounded grains, slightly calcareous.	
37 - 48	Sandstone, calcareous, tough fine to coarse rounded grains at top, up to fine gravel at base.	
48 - 54	Limestone, calcarenitic fine sandy, hard and soft bands, slightly marly, fossiliferous. Mottled brown and grey.	
54 - 58	Clay, slightly calcareous with brown stained cracks, grey.	
58 - 85	Marls mainly with bands of harder silty marls or soft limestones, fawn.	
85 - 109	Limestones with bands of marl. Very fossiliferous, sandy marls at 90'. Less fossils at 105'. Grey-fawn.	

Remarks

1 Permeability estimates 1. Low, 2 Fair, 3 High.

Sample Type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No S-4644 Jab
Dr: 9.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigations
Report: Progress No. 3
Location: Hundred: Waikerie
Section: 692
Commenced: 10.5.1965
Completed: 31.7.1965
Driller: M. Christiansen
Logged: G.T. Roberts Date: 26.8.1965

Bore No. 2
Programme: Waikerie
Bore Serial No: 847/65
Drilling Method: Percussion
Total Depth: 772'
Reduced Level: 132.35 (MSL)
Salinity (p.p.m.): -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		3					109 - 129' Limestone very fossiliferous slightly sandy, some recementing. Yellow-brown.	
		1			129		129 - 131 Marl, fine sandy, grey.	
		1			131		131 - 140 Marl, silty with small fossils, grey.	
		1	3*		140		140 - 145 Marls and limestones, very fossiliferous, grey.	
		3			145		145 - 175 Limestone, shelly, slightly marly in places, slightly sandy. Some re-cementing (?) Grey.	
		1			175		175 - 195 Marls mainly, but with limestone, hard sandy at about 180, grey.	
		3	4*		195		195 - 215 Limestone, very fossiliferous slightly sandy, yellowish.	

Permeability estimates 1. Low, 2 Fair, 3. High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No. S-4644-a Job
Date: 9.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: Progress No. 3
Location: Hundred: Waikerie
Section: 692
Commenced: 10.5.1965
Completed: 31.7.1965
Driller: M. Christiansen
Logged: G.T. Roberts Date 26.8.1965

Bore No. 2
Programme Waikerie
Bore Serial No. 847/65
Drilling Method Percussion
Total Depth 772'
Reduced Level 132.35 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		3						
		1	5*		215		215 - 221' Marl and silty marl, fossiliferous grey and yellowish.	
					220		221 - 255 Limestone, slightly marly in places, fossiliferous, recemented (?) at base. Yellow-grey.	
		3						
					255		255 - 295 Limestone with silty marl bands particularly near base. Fossiliferous. Yellow-grey.	
		3						
					295		295 -311 Limestone shelly with soft marly layers (e.g. 310-311) some recementing. Grey.	
		3						

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary Dry ▨ Sludge ☒

No S-4644-b Jab

Date 9.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: Progress No. 3
Location: Hundred: Waikerie
Section 692
Commenced: 10.5.1965
Completed: 31.7.1965
Driller: M. Christiansen
Logged: G.T. Roberts Date 26.8.1965

Bore No. 2
Programme Waikerie
Bore Serial No 847/65
Drilling Method Percussion
Total Depth 772'
Reduced Level 132.35 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft.)	Graphic Log	LOG	Remarks
		3						
		1			311		311 - 313' Marl, soft, silty and sandy, grey.	
					313		313 - 358 Limestone, very fossiliferous, slightly marly, grey.	
			6th					
		3						
		3			358		358 - 365 Limestone, marly and marl, silty, rubbly, grey fossiliferous	
			7th		365		365 - 380 Limestone, marly, fossiliferous marl increasing downwards fossiliferous, grey.	
		3						
		1			380		380 - 450 Marls, silty and sandy, grey.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -TS- Rotary. Dry ▨ Sludge ⊠

No S-4644-c Jab
Date: 9.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: Progress No. 3
Location: Hundred: Waikerie
Section: 692
Commenced: 10.5.1965
Completed: 31.7.1965
Driller: M. Christiansen
Logged: G.T. Roberts Date 26.8.1965

Bore No. 2
Programme Waikerie
Bore Serial No. 847/65
Drilling Method Percussion
Total Depth 772'
Reduced Level 132.35 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft)	Graphic Log	LOG	Remarks
		1			410		450 - 508' Marls, slightly silty occasionally, grey and greenish-glauconitic.	
410					420			
420					430			
430					440			
440					450			
458				463				
467		1						
472								
480					508		508 - 570 Sands, soft, mainly fine and medium grained but some scattered coarse grains, clayey in places, greenish-yellow and grey-brown.	
		3						
575					570		570 - 645 Clays, silty in places, somewhat carbonaceous, greenish-grey becoming dark brown at 610'.	
592								
617		1			645		645 - 655 Sands, medium-coarse grained with shells, greyish-brown.	
		3			655		655 - 680 Probably interbedded sands and clay, dark with shells passing down into clay, carbonaceous silty, pyritic, dark brown.	
662		2						
		3			680		680 - 693 Sand, medium to coarse grain with shells, grey.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No. S-4644-d

Date: 9.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: Progress No. 3
Location: Hundred: Waikerie
Section 692
Commenced: 10.5.1965
Completed: 31.7.1965
Driller: M. Christiansen
Logged: G.T. Roberts Date: 26.8.1965

Bore No. 2
Programme Waikerie
Bore Serial No. 847/65
Drilling Method Percussion
Total Depth 772'
Reduced Level 132.35 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft.)	Graphic Log	LOG	Remarks
					690			
					693			
		3					693 - 700' Sand with marl layers, pyritic fossiliferous, dark greenish-grey and grey.	
					700		700 - 770 Mainly clay with silty, carbonaceous clay bands, dark brown. Sandy, shelly band 748 - 749.	
					720			
		3			770		770 - 772 Sand, fine-medium grain a few shells, grey and grey-brown.	
					772			

STRATIGRAPHICAL SUMMARY

25(?)	- 48'	Norwest Bend Formation
48	-365'	Morgan - Mannum Formation
365	-380	Gambier Limestone or Ettrick Formation
380	-508	Ettrick Formation
508	-705	Buccleuch Group
705	-772	Knight Group

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary. Dry ▨ Sludge ⊠

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 614
Commenced: 8.6.1965
Completed: 8.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 9.6.1965

Bore No. 3
Programme Waikerie
Bore Serial No. 666/65
Drilling Method Rotary
Total Depth 21'
Reduced Level 116.06 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		1			4		0 - 2' Brown fine sand and soil. 2 - 4 Brown sand and kunkar.	
		1			7		4 - 7 Pink hard kunkar passing down into kunkarised green limestone.	
		1			12		7 - 12 Grey and greenish very clayey sand, sandstone with marl mainly fine grain but some coarse grains.	
		1 or 2			21		12 - 21 Fawn and yellow brown sandy and shelly limestone.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge -15- Rotary. Dry. Sludge

No S-4568 Jal
Date: 24.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 373
Commenced: 8.6.1965
Completed: 8.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 9.6.1965

Bore No. 4
Programme Waikerie
Bore Serial No. 666/65
Drilling Method Rotary
Total Depth 20'
Reduced Level 113.87 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft.)	Graphic Log	LOG	Remarks
		1			3		0 - 3' Pink tough kunker.	
					7		3 - 7 Grey greenish limestone passing down into buff marl.	
							7 - 8 Brownish and blue-green clay.	
					10		8 - 10 Rather marly buff clay.	
		1 or 2					10 - 20 Hard and soft banded yellowish sandstone (? fossils). Clayey layers.	
					20			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No. S-4580 Job
Date: 24.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 161A.
Commenced: 9.6.1965
Completed: 9.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 9.6.1965

Bore No 5
Programme Waikerie
Bore Serial No 666/65
Drilling Method Rotary
Total Depth 34'
Reduced Level 145.75 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft.)	Graphic Log	LOG	Remarks
		1			2		0 - 2' Brown mainly fine sand.	
		1			7		2 - 7 Pink fairly soft sandy kunkar.	
		1 or 2					7 - 27 Brown limy fine - medium sand.	
		1			27		27 - 31 Pink pebbly, sandy kunkar.	
					31		31 - 32 Green limestone and kunkar.	
					34		32 - 34 Very tough sandy limestone with oysters - poor recovery except for one oyster shell.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge [15] Rotary. Dry ▨ Sludge ☒

No S-4569 Job
Date: 24.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 88E
Commenced: 10.6.1965
Completed: 10.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date 10.6.1965

Bore No 6
Programme Waikerie
Bore Serial No 666/65
Drilling Method Rotary
Total Depth 15'
Reduced Level 111.06 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
					1		0 - 1' Brown fine sandy soil.	
					3		1 - 3 Pink and grey very tough kunkar.	
					5		3 - 5 Green kunkarised limestone passing down into buff marl.	
		1					5 - 11 Buff, pink and yellowish clayey fine sand.	
			13'	13'	11			
							11 - 15 Buff very hard sandy fossiliferous limestone.	
					15			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge ▭ Rotary. Dry ▨ Sludge ▩

Nº S-4570 Jab
Drlr: 24.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 399
Commenced: 10.6.1965
Completed: 10.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 10.6.1965

Bore No. 7
Programme: Waikerie
Bore Serial No: 666/65
Drilling Method: Rotary
Total Depth: 35'
Reduced Level: 122.83 (MSL)
Salinity (p.p.m.): -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		1			0 - 1		Brown fine sandy soil.	
					1 - 3		Brown fine sand with soft kunkar.	
					3 - 5		Pink very tough kunkar.	
		1 or 2			5 - 14		Red very limy sand, fine to coarse becoming clayey and less limy to base.	
					14 - 15		Greenish and brown fresh water limestone.	
		1			15 - 25		Brown and green-grey sandy clay becoming clayey sand downwards.	
		2			25 - 27		Yellow-buff, lime, limy sand becoming greenish at base.	
					27 - 32		Yellow mainly fine sand.	
					32 - 33		Very coarse grey sand with oysters.	
					33 - 35		Fine-coarse buff sand with oysters.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge. F13

No S-4571 Jab

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 399
Commenced: 10.6.1965
Completed: 10.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 18.6.1965

Bore No. 8
Programme: Waikerie
Bore Serial No: 666/65
Drilling Method: Rotary
Total Depth: 22'
Reduced Level: 136.08 (MSL)
Salinity (p.p.m.): -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		2			2		0 - 2 Light brown fine - medium limy sand.	
					7		2 - 7 Brick red fine clayey sand.	
		1			13		7 - 13 Pink pebbly and massive kunkar becoming marly at base.	
		2			22		13 - 17 Oysters in greenish clayey sand.	
							17 - 22 Oysters in fine sand to fine gravel - light brown and grey.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. -13- Rotary. Dry. Sludge.

No. S-4572 Ja

Date:

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report No. 3
Location: Hundred: Waikerie
Section 377
Commenced: 11.6.1965
Completed: 11.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 18.6.1965

Bore No. 9
Programme Waikerie
Bore Serial No. 666/65
Drilling Method Rotary
Total Depth 33'
Reduced Level 130.67 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		2			0 - 2		Brown fine - medium sand.	
					2 - 4		Brown clayey limy sand.	
					4 - 6		Pink pebbly kunkar.	
					6 - 12		Brown sandy kunkar and sand.	
					12 - 14		Kunkarised green limestone.	
		1			14 - 15		Brownish marl.	
					15 - 18		Brown and green clay with sand and limy nodules.	
					18 - 22		Brown and green-yellow very clayey sand.	
					22 - 27		Fawn fine clayey sand.	
					27 - 30		Brownish fine to coarse sand with shell fragments.	
		2			30 - 33		Fawn mainly fine and medium clayey sand.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -15- Rotary. Dry ▨ Sludge ⊠

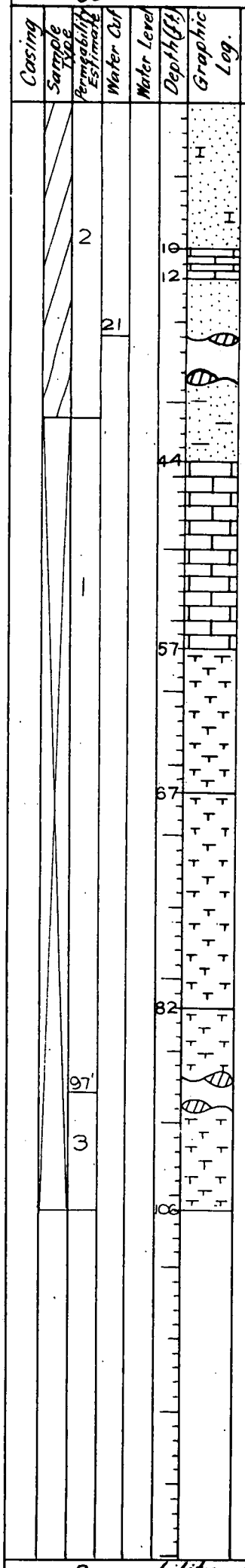
No S-4573 Jab
Date: 24.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project RIVER MURRAY DRAINAGE INVESTIGATION
Report No. 3
Location Hundred: Waikerie
Section: 576
Commenced: 16.6.1965
Completed: 16.6.1965
Driller T. Jarvis
Logged G.T. Roberts Date 18.6.1965

Bore No 10
Programme Waikerie
Bore Serial No 666/65
Drilling Method Rotary
Total Depth 106'
Reduced Level 145.81 (MSL)
Salinity (p.p.m.) -- at --
-- at --



LOG	Remarks
0 - 2 Brown sandy soil.	
2 - 10 Fawn limy sand and soft kunkar.	
10 - 12 Hard pink sandy kunkar.	
12 - 33 Mainly brown fine - coarse clayey sand - increasing clay downwards.	
33 - 44 Mainly brown clayey sandy but with traces of light green clayey sand.	
44 - 49 Hard fawn limestone.	
49 - 57 Yellow marly limestone.	
57 - 67 Greenish marl.	
67 - 82 Grey marl (with hard bands ?).	
82 - 97 Yellow marly limestone.	
97 -106 Very sandy limestone.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No S-4574 Job

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Waikerie
Section: 47
Commenced: 24.6.1965
Completed: 24.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 7.7.1965

Bore No 11
Programme Waikerie
Bore Serial No 666/65
Drilling Method Rotary
Total Depth 21'
Reduced Level 126.86 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
					1		0 - 1 Brown fine soil and kunkar.	
					3		1 - 3 Pink, pebbly kunkar.	
		1			6		3 - 6 Green limestone (?) passing down into grey marl.	
							6 - 13 Variegated brown and greenish clay with white, hard marly layers.	
		2			13		13 - 21 Yellow brown and greenish fine clayey sands with cemented layers and rounded quartz grains.	
					21			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary. Dry. Sludge. Sludge.

-13-

No S-4575 Job

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report No. 3
Location: Hundred: Waikerie
Section: 369
Commenced: 25.6.1965
Completed: 25.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 7.7.1965

Bore No. 12
Programme Waikerie
Bore Serial No. 666/65
Drilling Method Rotary
Total Depth 23'
Reduced Level 120.02 (MSL)
Salinity (p.p.m.) -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
		2			0		0 - 5 Brown fine to medium slightly clayey sand.	
		1			5		5 - 6 Pink pebbly kunkar.	
							6 - 11 Marly kunkar passing down into grey sandy marl and greenish grey fine sand.	
		2			11		11 - 12 Very clayey green and brown fine sand.	
							12 - 16 Greenish and grey brown fine sand with hard layers.	
							16 - 22 Yellow-fawn and green-yellow mainly fine slightly micaceous sands.	
					23		22 - 23 Yellow-brown fine calcareous sand with occasional coarse grains.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No S-4576 Jal

Date: 24.8.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: Progress Report No. 3
Location: Hundred: Waikerie
Section: Town Allot. 157
Commenced: 2.8.1965
Completed: 12.8.1965
Driller: M.H. Christiansen
Logged: G.T. Roberts Date: 20.8.1965

Bore No: 13
Programme: Waikerie
Bore Serial No: 331/66
Drilling Method: Percussion
Total Depth: 200ft.
Reduced Level: 44.72
Salinity (p.p.m.): — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft.)	Graphic Log	LOG	Remarks
130'2" of 6" Casing		1 & 2	30'	13' 15' 21'	35 45 70 110 130 200		0' - 35' Sand, fine, silts and clays. A few coarser grains. Fawn. 35 - 45 As above, but with an increasing content of fine and medium sand. 45 - 50 Sand. Fine to coarse sub-rounded quarts grains. Light brown. 50 - 75 Sand, fine-medium passing down into mainly coarse-grain calcareous throughout. Grey. Fossil wood at 50 - 51', carbonaceous particles below 51ft. 75 - 110 Sand, fine and medium clayey (?) with reworked fossiliferous limestone. Grey becoming fawn at base. 110 - 130 Limestone, marly, fossiliferous, grey. 130 - 200 Limestone, coarse texture fossiliferous. Marly towards base.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary Dry ▨ Sludge ▩

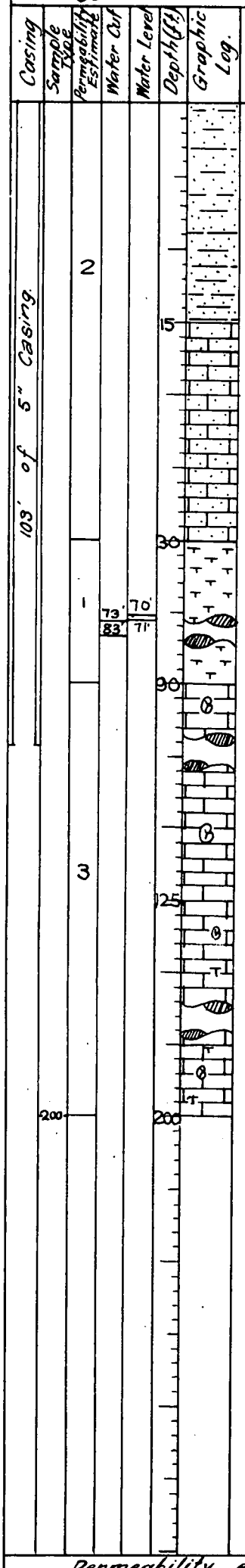
No: S-4844 Jab
Date: 9.11.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: Progress Report No. 3
Location: Hundred: Waikerie
Section: Waikerie Township
Commenced: 14.8.1965
Completed: 25.8.1965
Driller: M. Christiansen
Logged: G.T. Roberts Date: 26.8.1965

Bore No. 14
Programme Waikerie
Bore Serial No. 346/66
Drilling Method Percussion
Total Depth 200ft.
Reduced Level 118.05
Salinity (p.p.m.) — at —
— at —



LOG

0' - 15' Clay and fine sand, heavily polluted with sewage.

15 - 30 Limestone, hard sandy with many coarse grains of quartz, grey and fawn.

30 - 90 Mainly marl and marly limestone, fawn and light yellow.

90 - 105 Limestone, very fossiliferous, coarse texture, fawn.

105 - 125 Limestone, marly, fossiliferous, light yellow.

125 - 200 Limestone, fossiliferous, apparently with marly horizons throughout. Grey to 185', fawn and light yellow below.

Remarks

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Rotary. Dry ▨ Sludge F13 Sludge ☒

No S-4845 Jab

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BORE LOG

Project: RIVER MURRAY DRAINAGE INVESTIGATIONS
Report: PROGRESS REPORT NO. 3
Location: Hundred: WAIKERIE
Section: 76
Commenced: 17.9.1965
Completed: 27.9.1965
Driller: D. PHILLIPS
Logged: G.T. ROBERTS Date 18.10.1965

Bore Nº 15
Programme WAIKERIE
Bore Serial Nº 384/66
Drilling Method PERCUSSION
Total Depth 250'
Reduced Level 132·28
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	LOG	Remarks
110' of 6" Casing	Sludge samples at 5 ft. intervals	2			18	0' - 18' Sands, fine-medium grained, highly calcareous.	
		2			32	18 - 32 Sands fine to medium with kunkar.	
		1	35	34	75	32 - 75 Marl mainly with thin limestone bands yellow-fawn.	
		2		94½	110	75 - 110 Limestone, sandy mainly with marly bands, fawn.	
		3	130		205	110 - 205 Limestone, very fossiliferous, some recrystallised horizons fawn to light brown.	
		1			220	205 - 225 Marl and limestone silty, yellow-fawn.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion Core ■ Sludge ⊟ Rotary Dry ▨ Sludge ⊠

Nº 9-4846 Jab
Date: 9.11.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: RIVER MURRAY DRAINAGE INVESTIGATIONS
Report: PROGRESS REPORT NO. 3
Location: Hundred: WAIKERIE
Section: 76
Commenced: 17.9.1965
Completed: 27.9.1965
Driller: D. PHILLIPS
Logged: G.T. ROBERTS Date: 18.10.1965

Bore No: 15.
Programme: WAIKERIE
Bore Serial No: 384/66
Drilling Method: PERCUSSION
Total Depth: 250'
Reduced Level: 132:28
Salinity (p.p.m.): -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
	Sludge samples at 5' intervals	3			225		225' - 250' Limestone, very fossiliferous, grey and light brown.	
					250			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotar. Dry. Sludge.

DEPARTMENT OF MINES
SOUTH AUSTRALIA

RIVER MURRAY - DRAINAGE INVESTIGATION

PROGRESS REPORT NO. 3

PROGRAMME - HOLDER

Bore Number	Hundred	Section	Reduced level (M.S.L.)	Drilling Method
1	Holder	172	133.03	Rotary
2	"	162	131.90	"
3	"	127	137.53	"
4	"	298	118.22	"
5	"	120	133.21	"
6	"	125	132.32	"
7	"	119	134.92	"
8	"	166	139.48	"

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Holder
Section: 172
Commenced: 28.6.1965
Completed: 28.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 6.7.1965

Bore No. 1
Programme Holder
Bore Serial No. 901/66
Drilling Method Rotary
Total Depth 25'
Reduced Level 133.03 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
					0		0 - 2' Fine to coarse brown sand with kunkar.	
					2		2 - 3 Mainly kunkar.	
					3		3 - 6 Fawn and light brown fine to coarse sand and kunkar.	
					6		6 - 9 Reddish clayey limy fine and medium sand.	
					9		9 - 10 Mainly pink sandy kunkar.	
					10		10 - 11 Greenish limestone.	
					11		11 - 15 Brown and fawn clayey fine sand, slightly limy.	
					15		15 - 25 Coffee and yellow-brown, mainly fine clayey sands with scattered rounded quarts grains up to fine gravel.	
					25			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Rotary: Dry. Sludge. Sludge.

No. S-4671 Jab

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Holder
Section: 162
Commenced: 28.6.1965
Completed: 28.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 6.7.1965

Bore No. 2
Programme: Holder
Bore Serial No: 901/66
Drilling Method: Rotary
Total Depth: 26'
Reduced Level: 131.90 (MSL)
Salinity (p.p.m.): — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft.)	Graphic Log	LOG	Remarks
					0 - 1		Dark brown clayey soil.	
					1 - 4		Brown fine to medium limy sand.	
					4 - 6		Tough pink kunkar passing down into marl.	
					6 - 8		Dark green limestone above fawn marl.	
					8 - 13		Greenish-yellow fine grain clayey sand, slightly limy.	
					13 - 21		Yellow-grey fine clayey sand with scattered rounded coarse grains. Micaceous.	
					21 - 26		Yellow and grey fine to coarse clayey sand. Some fine gravel grains.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -15- Rotary. Dry Sludge ▨ ☒

No S-4672 Jab.
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Holder
Section: 127
Commenced: 29.6.1965
Completed: 29.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 6.7.1965

Bore No: 3
Programme: Holder
Bore Serial No: 901/66
Drilling Method: Rotary
Total Depth: 30'
Reduced Level: 137.52 (MSL)
Salinity (p.p.m.): — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
					0			
					2		0 - 2' Mainly brown kunkar.	
							2 - 18 Fawn passing down into brown fine and medium clayey sands. Limy throughout and with kunkar fragments. Very clayey 15 - 16'.	
					18		18 - 26 Yellow and greenish yellow fine clayey sand with a few coarse grains.	
					26		26 - 30 Coffee and chocolate-brown fine to coarse sands, slightly micaceous.	
					30			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

No S-4673 Jak
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Holder
Section: 298
Commenced: 29.6.1965
Completed: 29.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 6.7.1965

Bore No. 4
Programme Holder
Bore Serial No. 901/66
Drilling Method Rotary
Total Depth 14'
Reduced Level 118.22 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Oil	Water Level	Depth(ft)	Graphic Log	LOG	Remarks
					0			
					3		0 - 3' Dark brown fine clayey sand.	
					6		3 - 6 Hard sandy lumkar and marl.	
					8		6 - 8 Hard green lumkarised limestone (?) over grey marl.	
					14		8 - 14 Fine sand - fine gravel, grey and fawn. Shell fragments. Clayey.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core. Sludge. Rotary. Dry. Sludge.

-15-

No S-4674 Job
Date: 3.9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Holder
Section: 120
Commenced: 29.6.1965
Completed: 29.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 6.7.1965

Bore No. 5
Programme Holder
Bore Serial No. 901/66
Drilling Method Rotary
Total Depth 25'
Reduced Level 133.21 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
					2		0 - 2' Fine brown sand and hard massive pink kunkar.	
					7		2 - 7 Fawn very limy fine sand and kunkar.	
					9		7 - 8 Brown clayey slightly limy sand.	
					11		8 - 9 Pink sandy kunkar.	
					20		9 - 11 Greenish limestone and kunkar passing down into marly sand.	
					23		11 - 20 Variegated yellow, fawn and greenish fine clayey sands. Limey. Some coarse grains. Very clayey-green at 15'.	
					25		20 - 23 Fine to coarse yellow-fawn somewhat clayey sands.	
							23 - 25 Fawn and yellow very fine micaceous sand.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary. Dry ▨ Sludge ☒

No. S-4675 Job
Date: 3-9-65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Holder
Section: 125
Commenced: 29.6.1965
Completed: 29.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 6.7.1965

Bore No. 6
Programme: Holder
Bore Serial No: 901/66
Drilling Method: Rotary
Total Depth: 21'
Reduced Level: 132.32 (MSL)
Salinity (p.p.m.): — at —
at —

Casing	Sample Type	Permeability Estimate	Water Out	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
					1		0 - 1' Thin brown fine soil over pebbly kunkar.	
					6		1 - 6 Mainly fawn kunkar with fine sand.	
							6 - 7 Very clayey limy fine sand - damp.	
							7 - 13 Fine brown clayey, limy sand with kunkar.	
					13		13 - 17 Fine green clayey sand.	
					18		17 - 21 Light brown and fawn fine to coarse sand. Mainly fine grain - scattered coarse grains.	
					21			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary. Dry ▨ Sludge ⊠

No S-4676 Jab
Date: 9.65

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Holder
Section: 119
Commenced: 29.6.1965
Completed: 29.6.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 6.7.1965

Bore No. 7
Programme Holder
Bore Serial No. 901/66
Drilling Method Rotary
Total Depth 25'
Reduced Level 134.92 (MSL)
Salinity (p.p.m.) — at —
— at —

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (Ft.)	Graphic Log	LOG	Remarks
					0			
					2		0 - 2' Brown fine clayey sand.	
					5		2 - 5 Mainly pink kunkar pebbly with fine sand.	
					8		5 - 8 Green limestone over grey marl.	
					20		8 - 20 Mainly variegated grey, green and yellowish fine clayey sands slightly calcareous.	
					25		20 - 24 Yellowish and greenish fine clayey sand with some rounded coarse grains.	
							24 - 25 Grey and fawn fine sand to fine gravel. Calcareous.	

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary Dry ▨ Sludge ▩

No. S-4677 Jab
Date: 3.9.5

S. A. DEPARTMENT OF MINES

BORE LOG

Project: River Murray Drainage Investigation
Report: No. 3
Location: Hundred: Holder
Section: 166
Commenced: 1.7.1965
Completed: 1.7.1965
Driller: T. Jarvis
Logged: G.T. Roberts Date: 6.7.1965

Bore No. 8
Programme: Holder
Bore Serial No: 901/66
Drilling Method: Rotary
Total Depth: 20'
Reduced Level: 139.48 (MSL)
Salinity (p.p.m.): -- at --
-- at --

Casing	Sample Type	Permeability Estimate	Water Cut	Water Level	Depth (ft)	Graphic Log	LOG	Remarks
					0			
							0 - 5' Brown fine limy sand with kunkar fragments. Clayey at base.	
					5		5 - 10 Mainly grey and pink kunkar marly at base.	
					10		10 - 18 Fawn, grey and greenish variegated clayey fine sands.	
					18		18 - 20 Oyster bed in fine yellow-fawn sand.	
					20			

Permeability estimates 1. Low, 2 Fair, 3 High.

Sample type: Percussion. Core ■ Sludge -13- Rotary Dry ▨ Sludge ⊠

No S-4678 Jab
Date: 3·9·65