Department of Mines
South Australia

D.M. 780/56.
Hyd. 240

RB 43/7

SUBSURFACE DISPOSAL OF FLOODWATERS, BORDERTOWN DISTRICT.

INTRODUCTION

Following a request from the Engineering & Water Supply Department an inspection of the Bordertown District has been made during the period 19/6/56 - 27/6/56, in order to assess the possibilities of underground drainage methods for disposal of floodwaters. Plan No.56 - 165 accompanies this report.

Bordertown and low lying areas to the west are subject to periodical flooding from the Tatiara Creek and various measures have been adopted to minimise the effects of such flooding. In the vicinity of Cannawigara and areas to the west the flooding is aggravated by the waters of the Bulang Creek, moving north westerly through Mundulla.

In 1910 a line was surveyed to the north of Bordertown as the possible site of a channel to divert the waters of the Titiara Creek, but the scheme entailed excavation to a probable depth of 30 feet in parts, and was abandoned because of the high cost. A line for a proposed drain was also surveyed from Poocher swamp westward along the Cannawigara road to Kongal springs some 15 miles west of Bordertown. This scheme was also abandoned and the control of floodwaters was largely left to the individual landholders. At that time much of the country to the west of Bordertown was undeveloped and the control of floodwaters was not the problem which it subsequently became.

EXISTING FLOOD CONTROL METHODS

East of Bordertown flooding is generally not serious and is confined to the valley of the Tatiara Creek. The worst feature of the flooding in this area is the difficulty of moving stock and vehicles across the flooded parts. The creek channel has been straightened in certain areas and some banks have been constructed to prevent excessive flooding of the lowlands adjacent to the creek. These methods generally cause the floodwaters to flow more quickly through this area.

Several drainage bores have been constructed to

reduce waterlogging of the soil which occurs after heavy rains, especially along the broad andshallow tributary valleys of the Tatiara Creek. Such bores may be capable of disposing of 4,000-5,000 gallons per hour and are therefore quite useful for local drainage.

To the west of Bordertown where floodwaters occasionally cover large areas, especially beyond Boocher Swamp, extensive systems of banks have been constructed by the local landholders. In one instance these banks have the effect of forcing water to move westward along the Cannawigara road, as they were constructed along both sides of the road. The District council of Tatiara become perturbed about the damage to roads by floodwaters in this vicinity and elsewhere and in 1949 the Tatiara Drainage Trust was formed to investigate and advise on drainage problems.

Several drains have been excavated to runaway holes by the local landholders in the vicinity of Cannawigara. These include drains to Lampy's and Sandy Joe's runaway holes, constructed during 1955. These two runaway holes successfully disposed of large volumes of water during the floods of that year but the greater proportion of the water still flowed on down the Cannawigara road. Smaller drains have also been constructed to Scown's runaway hole, the drainage capacity of which has probably been increased by the cleaning out of debris. Several landholders have straightened the course of the creek through their properties by excavating new channels and occasionally by building banks along one or both sides.

Some of the drainage bores constructed in the area west of Bordertown have proved quite successful for draining swamps and waterlogged areas, but are unable to effectively reduce the volume of floodwaters.

HYDROGRAPHY

East of Bordertown the country is gently undulating with small depressions forming temporary swamps during the winter period. The main drainage of the area is the Tatiara Creek

flowing westerly from Victoria along a broad shallow valley in which the channel is poorly defined. The gradient along Tatiara Creek from the border to Bordertown is apparently rather flat, and consequently the movement of the water is normally sluggish. Although only flowing intermittently the large volume of water which occasionally runs in the creek causes widespread flooding.

A small plateau in the vicinity of Wolseley lies at approximately 100 feet above Bordertown and from it several broad shallow valleys trend north westerly to join the valley of the Tatiara Creek.

From Bordertown to the west the land surface is almost flat with only minor undulations and scattered unconsolidated sand dunes. Drainage is westerly but the gradient is very low and the channel of the Tatiara Creek becomes undefined beyond Connewigara. Toward the western boundary of the Hd. Wirrega the relatively high ground of the older dunes obstructs the slow westward movement of the floodwaters which swing toward the north west. The floodwaters eventually move through a gap in the dune system in this area and finally spread out on the low lands in the vicinity of the Keith - Naracoorte Road, which in one area was flooded to a depth of approximately 2 feet in 1955.

GEOLOGY & HYDROLOGY:

The hundreds of Tatiara and Wirrega occupy a portion of the Murray Basin, adjacent to the eastern boundary of the Padthaway horst. Shallow or outcropping granitic rocks occur toward the western boundary of the Hd. Wirrega, forming part of the Padthaway horst. Precambrian rocks do not outcrop further to the east, but have been struck at 600 feet during drilling for Bordertown water supply. This bore is the only one in the area which has penetrated the full Tertiary succession, the majority of bores being completed in the bryozoal limestone aquifer.

The log of this bore, drilled within the town, shows that bryozoal limestone occurs at a depth of approximately 85 feet and has a thickness of 185 feet. Beneath this horizon is a succession of clays and sands, glauconitic in part with a total thick-

ness of 185 feet. The Knight formation below, consisting of lignitic sands and clays with some limestone, extending from 385 - 600 feet, is also a source of good quality water in this area.

The bryozoal limestone extends throughout the Bordertown Area, its upper surface decreasing in altitude from east to west, with a variable thickness of younger deposits overlying it. The bryozoal limestone is normally quite permeable and frequently contains large solution cavities at or slightly abov the water table, which is normally near the upper surface of the limestone. A harder bend of variable thickness usually occurs at the upper surface of the limestone and may cause some difficulties during drilling. The more successful drainage bores of the area have apparently penetrated cavities in the bryozoal limestone and therefore are able to dispose of large quantities of water. One bore to the west of Bordertown is reported to drain water at the rate of 40,000 gallons per hour, but this is probably exceptional.

Overlying the bryozoal limestone is a thin bed of sandy limestones and calcareous sandstones, occasionally micaceous and sometimes fossiliferous. Well preserved oyster shells were observed in this horizon at the Sandy Joe runaway hole. Although normally quite thin this horizon is apparently continuous and thickens to the east of Bordertown, where a yellow micaceous sandstone is reported to occur in several bores with a maximum thickness of 80 feet. This horizon probably rarely exceeds 30 feet in thickness to the west of Bordertown where the old water supply bore penetrated 40 feet. Where observed in r naway holes it appears to be quite permeable and in some cases slightly cavernous.

Overlying this horizon is a thin clay bed generally light grey to brown in colour and extending over considerable areas to the east and west of Bordertown, although somewhat thicker in the east. This clay is generally impervious and dams have been constructed at many localities especially to the east of Bordertown. In addition many natural de-

pressions retain water for long periods during the dry summer months. In the swamps which contain runaway holes, such as Poochor and Mundulla the clay has possibly been removed by erosion at certain points thus allowing the water to penetrate the sandy limestone beneath, and then the bryozoal limestone. Subsequently current action and solution of the limestone would enlarge the runaway holes to their present state of development. These runaway holes occur in areas of shallow or outcropping limestone to the west of Bordertown. No runaway holes were observed to the east of Bordertown and none were reported to exist along the course of the Tatiara Creek in that direction, probably because of the greater thickness of sediments overlying the limestone. These runaway holes are capable of disposing of large quantities of surface water, but are unable to greatly reduce the effects of flooding. It is apparent that in some cases the clay has been washed down into the runaway hole and largely prevented the downward percolation of water. There are four runaway holes existing on sections 444 and 445 Hd. Virrega but only one is at present effective, the others holding water for considerable periods. These runaway holes, which are active at present, have small but well defined channels entering them, caused by the erosion of floodwaters.

Toward the western boundary of the Hd. Virrega the higher ground probably represents the northern continuation of the Naracoorte dune, which in this area is well preserved. However, towards the north west corner of the Hundred the dune, is not continuous and floodwaters are able to move through the area. Further north the possible extension of this dune continues along the same strike. Younger unconsolidated dunes occur sporadically throughout the area, especially north west of Bordertown and in the vicinity of Lampy's and Sandy Joe's runaway holes.

The static water level for water cut in the bryozoal limestone decreases from east to west indicating a general movement of water in that direction. The water level to the

west of Bordertown is normally within 40 feet of the surface, and occasionally deeper depending on elevation. East of the town the static water level may be 100 feet or more from the surface. In the vicinity of the runaway holes during the periods when they are covered with water it has been reported that the water level in some bores rises significantly and may even overflow. However these conditions are not likely to be of long duration. The drainage capacity of the various runaway holes appears to differ considerably. The runaway holes on Section 722 Hd. Wirrega are reported to drain the Hundulla swamp, an area of 800 acres, in "two or three days". The other extreme is reported for a runaway hole on Section 33 Hd. Wirrega, which required 3 months to drain a swamp of 250 acres, the water falling at the rate of 1 inch per day. The Poocher swamp, an area of approximately 500 acres is reported to have been filled in 3 days and if no further rain it has been drained by the runaway hole in "three or four days". Reports of rapid draining of the swamps must be treated cautiously. It is apparent that a small fall of the water level in these large saucer shaped depressions will result in a large reduction in the surface area of the water, thus giving the impression of rapid drainage.

METHODS OF ALLEVIATING FLOODING

1. Surface Drainage

Probably the best method for the permanent removal of floodwaters and reducing to a minimum the possibility of extensive flooding is to excavate and straighten the channel of the Tatiara Creek over its whole length. This is thought to be the best long term attack because of the increasing runoff from lands under development in the catchment area. To the west of Poocher swamp it would be necessary to construct a drain which could possibly follow the course of the floodwaters. Such a drain would have to be of considerable length and as the gradient is very low it would also need to be broad to dispose of the large quantities of water. Such a project would involve considerable expense, however, as a long term project in con-

junction with possible future drainage works west of Bordertown, it may become necessary.

To alleviate the situation in Bordertown it would be possible to construct a diversion channel from a point approximately 1½ miles north of the town to rejoin the main channel some 2 miles west of Bordertown. This would be over a much shorter route than that envisaged in 1910. However, excavation of such a diversion may be costly in view of the fact that there are numerous sand dunes occurring in the area to the north west of the town, especially between the Cannawigara road and the Dukes Highway. Possibly the diversion could be constructed to the east of these dunes from the vicinity of Section 2 to Section 138 Hd. Tatiara. However, this diversion would not assist the flood position a few miles to the west of the town.

11. UNDERGROUND DRAINAGE

(a) West of Bordertown. Runaway holes appear to offer the best possibilities for underground drainage in this area. However, not all runaway holes are at present being used and the drainage of many could probably be improved by artificial means. Several drains have recently been constructed to runaway holes, with encouraging results and new works of this nature should further alleviate flooding. The runaway holes at Poocher and Mundalla swamps can only dispose of a relatively small proportion of the floodwaters and therefore development of other runaway holes to the west is recommended. For example, the runaway hole on Section 27 Hd. Virrego, in the path of the channel from Poocher swamp could possibly be cleaned out and its drainage capacity increased. There are in several areas apparently "extinct" runaway holes, such as those on Section 444 Hd. Virrego, caused by the deposition of clay over the base. It might be possible to clean out these and some of the more active runaway holes to restore them

to their full drainage capacity. It may be necessary to clean out some of the smaller runaway holes by hand but mechanical methods are thought to be more suitable in the larger holes. For excavating in the base of a runaway hole a machine such as the "Benoto" Hammer Grab may be suitable. These machines are capable of cutting a hole up to 3'3" in diameter and should have no difficulty in penetrating the limestone in this district. Thus ideally a runaway hole could be cleaned out to expose rock and at the base one or more large diameter holes could be drilled to assist drainage, together with some means to prevent clay being washed down from the sides.

It is possible that trenches, excavated in some of the depressions would assist in disposing of surface waters. An excavation to the base of the clay, which is up to 15 feet thick, would probably provide very useful drainage, as the water would then be in contact with the permeable calcareous sandstone surface beneath. This sandstone overlies the bryozoal limestone at a depth of 30 - 40 feet in the Poocher swamp area and at a lesser depth to the west. The drainage could be greatly increased by drilling large diameter holes to water level from the base of the trenches, possibly by means of the "Benoto" Hammer Grab.

A third method of underground drainage in this area is the construction of a number of bores. These should be reasonably successful for local drainage such as small swamps or waterlogged areas, but are thought to be incapable of taking large volumes of floodwaters. Provided the bores are properly constructed and fitted with trash racks to prevent debris getting down the borehole, they should give long service. However, the drilling of successful holes is largely a matter of chance. Unless the drill penetrates a cavern in the bryozoal limestone the rate of drainage is not likely to be high, but may be sufficient for small areas.

(b) Rest of Bordertown Cavernous bryozoal limestone is known to occur in this area but at a greater depth and hence runaway holes have not developed. The surface of the bryozoal limestone

averages approximately 100 feet below the surface and some cavities have been struck during drilling. Consequently it is considered that the prospects of obtaining drainage by boring are good. These bores could not dispose of floodwaters but they should alleviate the position by draining underground some of the surface waters of the broad tributary valleys of the Tatiara Creek. Therefore it is recommended that a programme of test drilling in this area be given serious consideration. Such drainage bores could initially be spaced at approximately 2 mile intervals to reduce mutual interference. It is suggested that 10 drainage bores be located in the following Sections 169 173, 162, 308, 314, 300, 305, 334, 837, 327, 313, of the Hd. Tatiara, at the points indicated on the plan. It would be necessary to drill to an average depth of about 120 feet, giving a total footage of 1,200 feet. These must be regarded as trial bores and the results of drilling may indicate areas where more intensive drilling could be undertaken.

(c) Effect of Underground Drainage on Watertable If a programme of extensive underground drainage is carried out it is apparent that large quantities of water would pass into the bryozoal limestone aquifer within a relatively small area. While this water is passed in sufficiently slowly to allow of dispersal it is unlikely that there will be a marked rise in the water table. However, during flood periods all drainage points would be taking water to their maximum capacity and some rise in the water table can be anticipated. Even with the existing underground drainage, cases have been reported of a marked rise in the water table during the flood of 1955, but they were not of long duration.

The long term effects of discharging large volumes of water into the underground supply cannot be assessed. It would be necessary to have a series of observation bores on which measurements of the static water level could be carried out at regular intervals over a considerable period.

111 Dams. It might be possible to construct flood control dams along the course of the Tatiara Creek east of Bordertown but the topography does not generally appear to be suitable for such a project, and a topographic survey would be needed to determine their practicability or otherwise. Such dams should retain water quite well as there are usually considerable thickness of clay in this area.

SUMMARY & CONCLUSIONS:

A large area in the Bordertown District is underlain by a permeable and in places cavernous bryozoal limestone, which is capable of accepting large volumes of drainage water. To the west of Bordertown where this horizon is normally within 40 feet of the surface, numerous runaway holes have developed. These provide natural drainage underground for a portion of the floodwaters which occasionally come down the Tatiara and Naiang Creeks. However, the greater proportion of the floodwaters spread out over the flat country to the west of Carnavigare. The low lying parts of Bordertown are also subject to periodical flooding when the Tatiara Creek overflows its banks.

Probably the best method for the permanent removal of floodwaters is the excavation and straightening of the channel of the Tatiara Creek and the construction of a drain to the west. This is probably too expensive to be considered at the present stage, but all schemes for flood control in this area are likely to be expensive.

The drainage capacity of many runaway holes could probably be improved by artificial means and trenches could be excavated in certain areas where the clay cover is thin. Drainage bores would be useful for draining restricted areas and a drilling programme is recommended east of Bordertown. Underground drainage of water in this area will alleviate to some degree, the flooding of the town and areas to the west.

With large scale underground drainage some rise in the water table can be expected, and to determine the long

term effects of such drainage it would be necessary to have a series of observation bores.

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BORDERTOWN AREA
GEOLOGICAL PLAN AND SECTION
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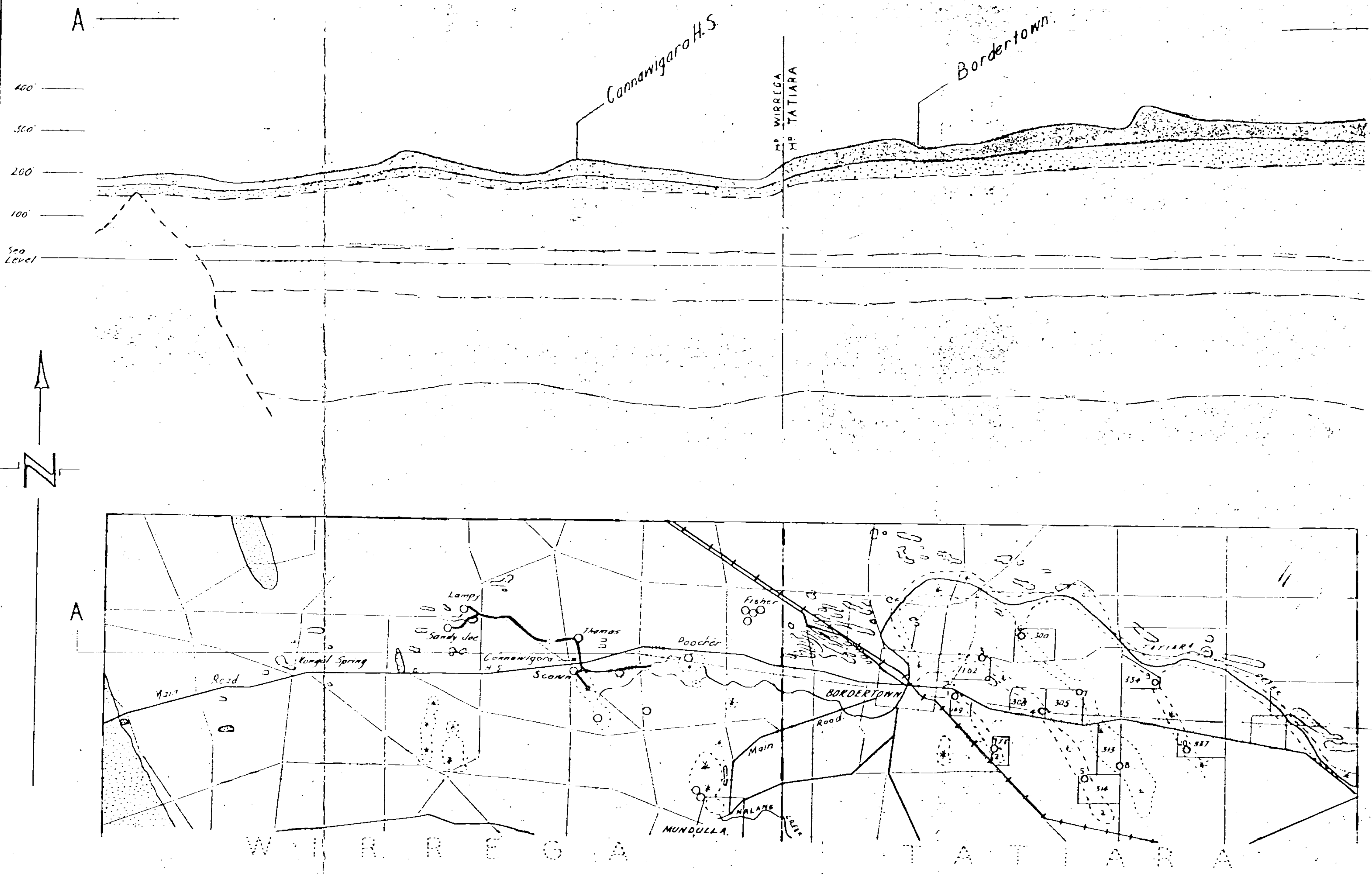
56-165



LEGEND

SECTION

- Sand, travertine & clay
- Yellow sandy limestone, sand & clay
- Bryozoal limestone
- Light grey sandy clay
- Lignitic clay, sand & grit
- Precambrian schist
- Granite

PLAN

- Unconsolidated dunes
- Consolidated calcareous dunes
- Granite outcrop
- Runaway holes
- Drains
- Suggested drainage bores.

To accompany report by R.G. Shepherd.