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THE DRAINAGE PROBLEM AT TORRES STREET, RED HILL.

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INTRODUCTION

Water-logging between Torres Street and Wickham Crescent, particularly on blocks 15 and 16, became apparent in 1951. Following on investigations by N.H. Fisher and the writer in 1953, as requested by the Department of Works, a system of deeper drains was completed by the leaseholder in block 16 in 1954 and these appeared to have relieved the situation in that block up to the end of 1955.

During the particularly wet year of 1956, however, which began with heavy storms in January, the situation deteriorated; seepage and water logging continued over the relatively dry summer of 1956-57 and, in places, even became worse. In April, 1957, the Department of Works asked the Bureau to investigate the problem further; this report summarises the results of fairly comprehensive investigations since that time.

The generous co-operation of the Soils and Land Research Divisions, C.S.I.R.O., Canberra and of Dr.T.Talsma C.S.I.R.O. Griffith, is gratefully acknowledged; the source of the trouble and possible ways of remedying it are seen more clearly in the light of data on soil profiles and of some permeability determinations.

CAUSE OF WATER-LOGGING:

Blocks 15 and 16 are situated in a shallow depression which heads on the slopes of Red Hill and falls eastward toward Manuka (see Plate 1). The underlying rock in the depression and on the slopes shedding into it is a quartz-porphyry which weathers readily, producing scattered low outcrops and dominantly sandy soils. Blocks 15 and 16, in the depression, are covered with a deep mantle of soil except at the eastern boundary of block 16 where boulders and outcrops of porphyry are evidence of a narrow meridional bar.

The importance of this bar was emphasised by N.H. Fisher in 1953; the rock bar has apparently a lower permeability than the deeply weathered porphyry up-gradient from it, under blocks 15 and 16, and tends to act as a dam against sub-surface drainage eastwards.

Soil profiles in the water-logged area on portions of blocks 14, 15 and 16 show, in general, two main layers - an upper zone of clayey soils ranging from2' - 6' in depth above a zone of more sandy soil with clay pockets which results from the deep weathering of the porphyry. This sandy, strongly weathered material passes into partially weathered rock a few feet below the surface toward the eastern boundary of block 16, approaching the porphyry bar, but persists to a minimum depth of 10' - 12' toward the western limit of the block.

Initially it was thought that this more sandy layer had sufficient permeability to allow adequate drainage but bailing and recovery tests particularly in holes Nos. 6, 7, 8 and 9 (see Plate 2) indicated that the permeability of the material was in fact, low. This was eventually confirmed by Dr.Talsma

(C.S.I.R.O. Griffith) and Mr.Chapman (Land Research, C.S.I.R.O.) in separate permeability measurements. In particular, Mr. Chapman, using the fluorescene dispersion technique measured the movement down-gradient from hole 7 to hole 5 and calculated an apparent velocity of about 8" per day. Dr.Talsma found evidence of strong vertical pressure in piezometers sunk to a depth of 6 feet.

It thus became apparent that none of the soil profile so far explored up-gradient from the porphyry bar is readily drainable; weathered porphyry is relatively more permeable than the overlying clay soils but its permeability is low.

Unfortunately the remainder of the profile between the very weathered porphyry penetrated to 12' in hole 7 and the underlying unweathered rock is beyond the limit of auger holes under blocks 15 and 16; from data provided by water bores in localities where geological conditions are very similar, one may be fairly confident of a layer some 10'- 20' thick of weathered porphyry in which the degree of weathering and the clay content decrease with depth until fresh or little weathered rock is reached. This layer toward the bottom of the weathered porphyry profile commonly has relatively high permeability and provides in many places useful supplies of ground water.

Thus the complete profile under blocks 15 and 16 is likely to consist of a zone of relatively permeable weathered porphyry (inferred) overlain by relatively impermeable very weathered porphyry beneath a surface layer of black soil.

On the nearby slopes which direct both surface and sub-surface water into the depression, surface soils are commonly permeable and initiate considerable sub-surface drainage. However, the soil profiles may be complex, as pointed out by Dr.van Dijk (C.S.I.R.O.)*; sequences with up to four well-defined soil horizons can be found and water accumulations and drainage are related to this layering. The clayey layers tend to produce perched aquifers in the soil above them and seepages tend to occur where clayey layers are truncated by the ground surface.

Although the pattern of sub-surface drainage is complicated, it is clear that a considerable portion of the water running into the soil on the slopes of the depression ends up in the weathered porphyry below blocks 15 and 16 where its eastward migration is slowed by the porphyry bar.

In this migration, the water can follow either of two possible courses - it can move down-gradient in the mantle of soils and weathered rock, or it can move in cracks in the fresh and partly weathered rock. Probably both processes are operative in this area although it is not known which process supplies more water to the weathered profile under blocks 15 and 16; data from water bores would indicate that a considerable proportion of the water is likely to come from cracks in the partly weathered rock in which case water falling outside the immediate catchment of the depression may find its way to the profile under blocks 15 and 16.

The net result is that the complete weathered profile is kept full of water but the relatively impermeable surface layers restrict free rise of water to the natural water table and induce the strong vertical pressure shown by the piezometers. Except in times of drought, the water table is at or very near the surface, with the tendency (as Dr.Talsma has proved) for seeps and springs to break out at spots where the permeability of the surface clay soils is above average,

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*. "Some problems of water seepage in the Canberra District" by D.C. van Dijk.

The area is therefore an intermittent swamp and has been so for a long time. The grey to black colour of the surface clay soils results from this intermittent swampy condition and the distribution of these black soils in the depression and extending up the slope in blocks 14 and 15 indicate the extent of the swamp in the past. Furthermore, residents with a knowledge of Canberra, before the present urban development began, remember times when a spring ran from this swampy area. It is unfortunate that buildings were erected on blocks 15 and 16 during the dominantly dry cycle which ended in 1949; in a wetter cycle, e.g. since 1950, the swampy character of the area could not have been overlooked.

To summarise then, two houses have been built on an intermittent swamp, which is dry on the surface during comparatively dry cycles, but is water logged in wet cycles. This pattern has existed for a long time and will continue in the future unless the pattern of climate itself changes.

Ground water tends to be dammed up in weathered porphyry beneath a layer of relatively impermeable clay soil and very weathered porphyry; drains provided in the area are ineffective after heavy rain because they do not reach below these low permeability soils. In fact, as far as sub-surface drainage is concerned, urban development has tended to aggravate rather than alleviate the problem; frequent watering of gardens on the slopes surrounding the depression supplies additional ground water, much of which must add to the storage under blocks 15 and 16; the sealing of roads in the swampy area has somewhat restricted the area in which water can escape by seepage.

REMEDIAL MEASURES

Prior to 1953 there was no drainage system designed to counter water logging in this area because the problem was not apparent. Remedial measures in block 16 suggested in 1953 and carried out in 1954, were put in by the leaseholder but the Department of Works provided a drain to the north-east corner of the block on the lowest possible elevation; however, the drains in block 16 could not be dug to the maximum depth set by the elevation of the sump in the north-east corner because a rib of porphyry immediately west of the sump, and 3.5' higher, proved too hard for manual excavation. The system was designed to drain weathered porphyry beneath the surface clay soil and the main drains shown on plate 2 exposed an average of some 2' of this layer.

This system which includes shallower feeder drains, appeared quite effective in 1954-55 when the water table dropped considerably, but subsequent events would indicate that they hasten rehabilitation rather than prevent water logging and that the improvements noted in 1954-55 were basically due to the drier spell which lasted from February, 1954, until October, 1955. In abnormally wet periods, such as the twelve months beginning October, 1955, the system cannot adequately cope with the rising water table because the very weathered porphyry exposed in the drains will not yield water at a sufficient rate; moreover on the evidence of permeabilities in the material exposed in auger holes, to a maximum depth of 12', it is unlikely that the deepening of these drains by 3' to their maximum depth relative to the sump could provide the protection required.

Assuming the existence of more permeable weathered porphyry toward the bottom of the profile underneath the swamp, the water table could be controlled either by sufficiently deep drainage in block 16 or by preventing much of the recharge water from entering the storage in the swamp. Since the problem is common to two blocks, 15 and 16, and impinges on at least two other blocks, 14 of section 3 and 1 of section 2, remedial measures should be designed to tackle the swamp as a whole rather than in one part of it.

The installation of deep contour drains to prevent water reaching the swamp cannot be recommended with confidence as a solution to the problem because they would exert little control on the supply of water reaching the storage through rock fractures; cut-off drains should be regarded as ancillary measures rather than as major controls. The better solution is adequately to drain the swamp in virtually the same way as natural stream erosion has drained similar swamps in other localities. The draining of this swamp presents a problem only because the existing drainage system eastward of the porphyry bar is not sufficiently low to allow deep drainage to be installed without pumping.

The water table might also be controlled by pumping but information on the characteristics of the bottom of the weathered profile is required to assess the feasibility of this method and the number of bores required; relief by a main drain would be more permanent and might be cheaper in the long run.

Additional information is required therefore before the optimum location and depth of a main drain can be indicated or the feasibility of an alternative pumping scheme assessed. The recommended procedure is as follows:

1. A bore should be sunk to fresh rock near auger hole No.7 on the boundary between blocks 15 and 16 (see plate 2). This should be cored if possible and cased. The bore is required for:

   (a) Exploration of the entire weathered profile and confirmation of a permeable layer near bedrock.

   (b) Determination of depth to bedrock to aid interpretation of any geophysical work.

   (c) Pumping tests to check the feasibility of control by a bore, and

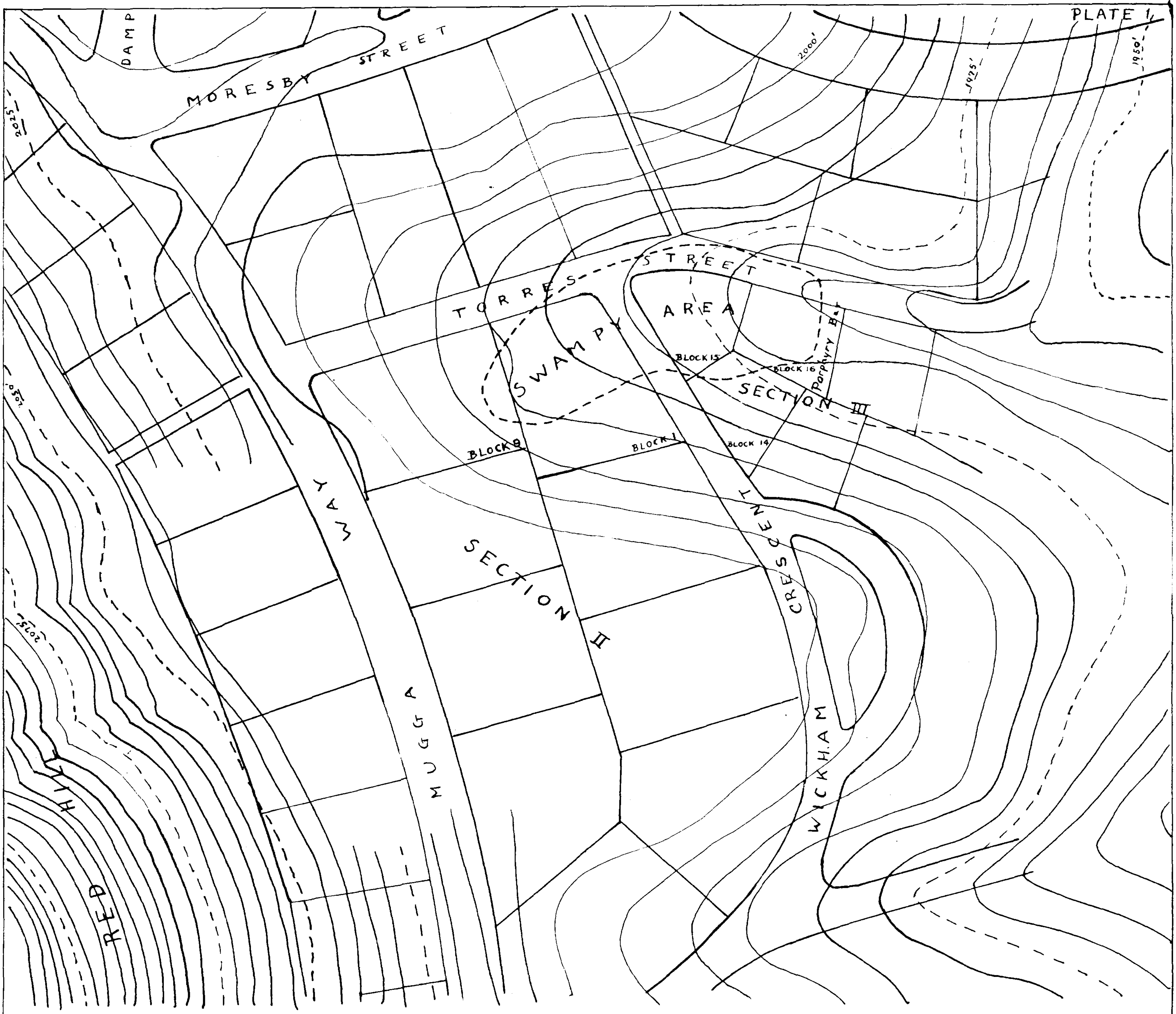
   (d) Possible temporary relief of water logging by pumping if required before drainage project completed.

2. From the data provided by Item 1 details of a permanent solution or solutions should be worked out, probably either a pumping scheme or the location of a main drain running from the porphyry bar along the depression, and extending into block 1 of section 2. Such a drain would need pipes and gravel fill and, unless other arrangements were made, the drain would have to discharge into a sump with automatic pumping equipment to lift the water into the existing drainage channels east of the porphyry bar.

   The bore should be drilled by Failing rig if possible; total cost by contract would probably lie between £150 - £200. Pumping tests could be carried out by the geological section, Bureau of Mineral Resources.

   In addition, any opportunity will be taken to arrange a resistivity survey of the area with a view to determining bed-rock profile and depth of weathering; this information would guide the location of a drain or additional bores.

   In conclusion the drainage problem in section 3, Red Hill, might well be regarded as a warning against building on patches of grey-black soil in the Canberra area before drainage has been investigated; these soils commonly denote intermittent swamps, or areas which have been swamps in the past, and need careful investigation.



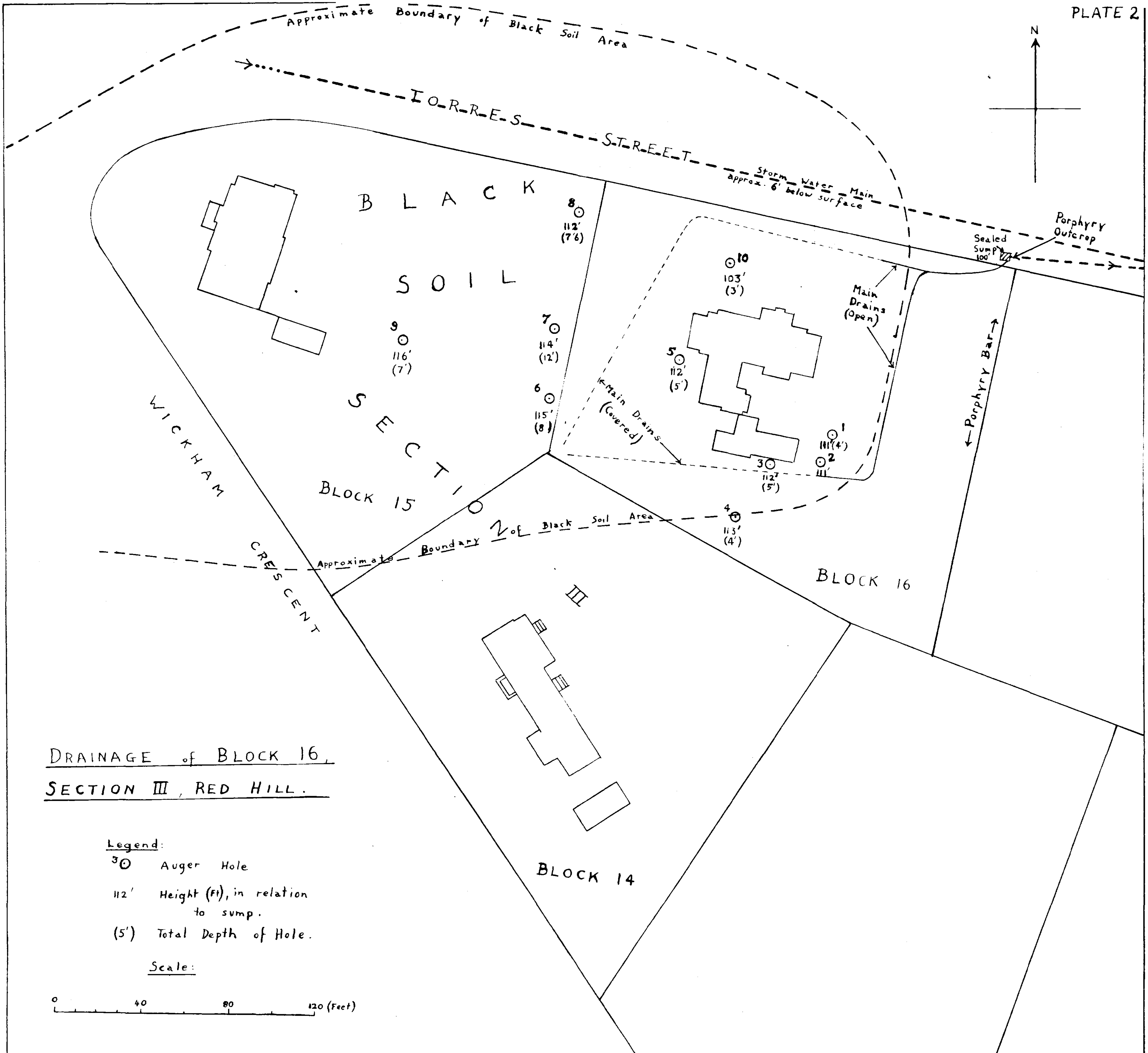
DEPRESSION and SWAMPY AREA,
TORRES ST., RED HILL.

Scale:

0 200 400 Ft.

Contours: 5ft. interval.

PLATE 2



DRAINAGE of BLOCK 16,
SECTION III, RED HILL.
Legend:
Auger Hole
112' Height (Ft), in relation to sump.
(5') Total Depth of Hole.
Scale:
0
40
80
120 (Feet)
N
Approximate Boundary of Black Soil Area
TORRES STREET
Storm Water Main
approx. 6' below surface
Porphyry Outcrop
Sealed Sump
100'
Main Drains (Open)
Main Drains (Covered)
Porphyry Bar
BLACK SOIL SECTION III
WICKHAM CRESCENT
BLOCK 15
BLOCK 16
BLOCK 14
8
112'
(7'6)
9
116'
(7')
7
114'
(12')
6
115'
(8')
10
103'
(3')
5
112'
(5')
1
111' (4')
2
111'
3
112'
(5')
4
113'
(4')