COMMONWEALTH OF AUSTRALIA.

DEPARTMENT OF NATIONAL DEVELOPMENT.

BUREAU OF MINERAL RESOURCES
GEOLOGY AND GEOPHYSICS.

RECORDS.

1959/56

THE DRAINAGE PROBLEM AT DUFFY ST. AINSLIE

by

E. G. Wilson

THE DRAINAGE PROBLEM AT DUFFY ST. AINSLIE

by

E. G. Wilson.

RECORDS 1959/56

SUMMARY

The Dept. of Works requested a report on the drainage of Blocks 17, 18, 19 and 20, Section 102, Ainslie. Much of the area was waterlogged and drainage constituted a major problem in building.

An excellent catchment is present upslope from this area and a considerable amount of water would have been diverted underground during the heavy rains early in the year. The catchment is also fed by overflow from the reservoir, and by possible leakage from the reservoir or its serving mains. Underground water moves downslope in the hillside scree and along fractures in the underlying volcanics until a bar of shale is encountered near the affected blocks. The shale forces the water to move closer to the surface but the development of three feet of brown soil with a low permeability vertically above the probable position of the shale retards this movement; water backs up and a rise in the water-table results.

The problem is aggravated by leakage from the stormwater drain which flows along the hillside at the rear of these blocks. This drain, carrying water from catchments to the south, may flow for days after rain ceases; leakage adds to the underground water and delays recovery of the area.

The solution to the problem lies in draining below the brown soil, where hillside scree of a more permeable nature forms a mantle over the underlying shale. Adequate drainage will depend on intersecting sufficient of this material; holes should be sunk with a power auger at intervals along the lines of proposed drainage to be sure that sufficient material of suitable permeability lies below the brown soil. A system of drainage has been suggested in the conclusion and all drains should be filled to the surface with high permeability gravels.

INTRODUCTION

On the 20th of March 1959 the Department of Works asked the Bureau of Mineral Resources to report on the drainage problem on Blocks 17, 18, 19 and 20 of Section 102, Ainslie. On inspection, parts of the closely dotted area in Plate I were found to be waterlogged and pools of water were lying in the area. The investigation was carried out between the 27th of March and the 17th of April; heavy rain fell early in this period. Rainfall records are given in the Appendix.

THE DRAINAGE PROBLEM

The worst area is that closely dotted on Plate I where a heavy brown soil has developed below the change in slope of the hillside. The brown soil forms a thin layer over more permeable scree material in the upper portion of this area, but is much thicker in the lower portion with, apparently, insufficient permeable material beneath it to provide free drainage. Uprooting of trees and levelling by means of a bulldozer has broken the soil in many places allowing the water to reach the surface as springs. The water then collects in depressions in the brown soil to form stagnant pools.

Holes 1, 2, and 3 were sunk with a hand-auger to determine the permeability of the soils; power-auger holes, nos. 4-9, for electricity reticulation gave additional information. The movement of water from the stormwater drain was traced by fluorescent dyes.

Auger-hole 1

This hole is situated near the rear of Block 20. It passed through 9 inches of light brown soil into a yellow pebbly soil which persisted to the full depth of the hole at 3' 8". The yellow soil was fairly porous; the water level rose overnight to within 6 inches of the top of the hole. Subsequent measurements showed the water level falling about one and half inches per day.

Auger-holes 2 and 3

These holes were sunk in the driveway of Block 20 and in Block 18 respectively. Both holes passed through 2' 6" to 3 feet of heavy brown soil into a yellow pebbly soil. The saturated heavy brown soil had low permeability and passed little water into the hole, whereas the yellow soil was relatively porous; water from this material entered both holes from the bottom and in a few hours they were overflowing.

Auger-holes 4 to 9

These holes were bored by the power auger on 16th. and 17th of April. Holes 4 and 9 passed through brown soil to enter scree, holes 5 and 6 were in scree only; holes 7 and 8 passed through scree and entered shale at 6 feet in No. 7, and at 2 feet in No. 8. Water came to within 18 inches of the surface in holes 4 and 9; the other holes were dry.

Fluorescent dyes were placed in flowing water in the stormwater drain. Subsequently these dyes appeared in the affected area after travelling up to 70 yards in less than 18 hours.

HYDROLOGY

The outcrops found on the slopes above the waterlogged area are part of the Ainslie Volcanics. The shale excavated by the power-auger from holes 7 and 8 is believed to be of

Silurian age. It is very likely that the Ainslie Volcanics rest unconformably on the shale; waterlogging is probably brought about by the shale acting as a bar to the movement down slope of underground water. Faulting has taken place along the western slopes of Mt. Ainslie; quartz veins found in the shale may indicate a fault in this area, perhaps an offshoot of the Oakes Fault. Faulting could also be postulated as a means of placing the shale in a position to block the movement of underground water.

Plate I shows the relationship of the drainage problem to its catchment area. Sixteen acres of permeable scree surround the main gully in which a number of six foot anti-erosion walls have been placed; this arrangement forms a very efficient means of diverting water underground. The stormwater drain flows to the north and the movement of dyes indicates that some leakage takes place. This leakage also joins the underground water and since, in this case, the drain flowed for three days after cessation of rain, it must retard the recovery of the area. The amount of leakage at any point would probably depend on the depth of water flowing in the drain and the time for which it flowed. Runoff from every catchment above the drain to the south passes along this channel, therefore a number of catchments contribute to this leakage. The stormwater drain is 1½ miles long; given approximately the same soil permeability, leakage would tend to increase from point to point as one proceeds north, because a greater volume of water will be moved in the drain towards its northern end. However, the length of the period in which water is present in the drain is not expected to vary significantly along the channel way.

Plate II is a cross-section of the area. Water entering the catchment on the slopes passes through the hillside scree into fractures in the Ainslie volcanics. These fractures are diagrammatically represented in the cross-section with possible movement of water along fractures indicated by small arrows. The water slowly moves down-hill through scree on top of the volcanics and by following fractures until shale is encountered. The shale is relatively impermeable, and the water must flow above it. Development of brown soil of low permeability at the foot of the slope and vertically above the probable position of the shale, means that the path of underground water is constricted. Backing up takes place causing a rise in the water table and pressure is exerted by the weight of underground water further up the slope. With sufficient influx of sub-surface water, the piezometric surface (the surface to which water tends to rise) rises above ground level in the lower part of the hill slope and springs and seepages develop.

The existence of springs from fractures in the basement rock is problematical. Any such springs may be fed by water entering the rock higher up slope than the area of Plate 1. This water would be under much higher pressure and could require special drainage measures in addition to those suggested in this Record.

It is possible that a large reservoir of underground water exists in a basin to the east, and it may be charged by other catchments in addition to the one shown on Plate I. If faulting is responsible for the position of the shale, such a basin could be deep and extensive. Finally, the area under consideration may be only one of a number of outlets from such an underground basin; these outlets operate when the water table is high and will continue until the level is reduced.

WATER-TABLE

The high water table indicated by the water levels in the auger-holes is attributed to the following factors:

(1) Rainfall of almost 15 inches was recorded in Canberra between 27/1/59 and 4/4/59. This rainfall is the equivalent of 5,400,000 gallons in the 16 acre catchment immediately up-slope from the affected blocks. The greater part of this water would have gone underground into the porous hillside scree assisted by the anti-erosion measures in the gullies.

(2) The path of natural drainage is a small gully which has been filled in below the stormwater drain and permits no run-off.

(3) Leakage occurs from the drain.

(4) Any overflow from the reservoir during the summer months finds its way underground.

In addition any leakage from the reservoir itself or from the serving main, which follows the line of Foveaux St., would contribute to the supply of sub-surface water.

CONCLUSIONS

The drainage problem is acute on Blocks 17 and 18; it should also be taken into account for building on Blocks 19 and 20 where special attention to the strength of foundations and damp coursing may be required. The level of the ground water in auger-hole 1 indicates that Blocks 19 and 20 are subject to periodic saturation.

The principal factors responsible for the high water table cannot be controlled, but possible contributing factors should be checked; the water main and reservoir might be checked for leaks, and overflow from the reservoir prevented. Leakage from the stormwater drain is not regarded as a prime cause of the problem, but it undoubtedly delays recovery of the area once water-logging has occurred.

While it is not directly applicable to this problem, it is worth noting that where a natural watercourse is intersected by a stormwater drain, it should not be assumed that the old watercourse is redundant. It is still the outlet for underground seepages and springs; if it is to be filled in, filling should be used which will still allow it to perform its drainage function.

The solution of the problem lies in draining below the brown soil, where auger holes 2 and 3 indicate more permeable material is present. Thickness of the brown soil is 2' 6" to 3 feet, therefore any system of drainage must be planned to take in water below that level. The rate at which water entered the holes does not indicate high permeability; therefore adequate drainage will depend on intersecting sufficient underlying material to make it effective. It is possible that shale directly underlies the brown soil in places and if so, these sections would not be suitable for draining. To prove that suitable material for draining is present, boring with a power-auger at intervals along the lines of proposed drainage is recommended.

Blocks 17 and 18 do not appear to be served with a drain along Duffy St., therefore, a drain could be placed along the front of Blocks 17 and 18 to take household drainage as well as to drain the area. Since the problem is at its worst in the driveways serving Blocks 19 and 20 a rubble drain up the easement between the two blocks is suggested. The location of spur drains into Blocks 17 and 18 is indicated on Plate I. In the event of shale being encountered in the main drain along Duffy St., additional drains off this main drain would have to be taken upslope in order to intersect permeable material. All drains should be filled to the surface with high permeability gravel.

APPENDIX

Rainfall Record from the Climatological Station of Canberra at the Forestry and Timber Bureau, Yarralumla.

JANUARY		FEBRUARY		MARCH		APRIL	
Date	Points	Date	Points	Date	Points	Date	Points
		1	--	1	27	1	76
		2	--	2	--	2	178
		3	--	3	123	3	30
		4	--	4	18	4	5
		5	--	5	256	5	--
		6	22	6	7	6	--
		7	75	7	--	7	--
		8	--	8	31	8	--
		9	--	9	--	9	--
		10	--	10	--	10	--
		11	--	11	--	11	--
		12	127	12	--	12	--
		13	8	13	--	13	--
		14	--	14	--	14	trace
		15	152	15	--	15	7
		16	--	16	--		
		17	--	17	--		
		18	--	18	1		
		19	95	19	--		
		20	--	20	--		
		21	--	21	--		
		22	--	22	--		
		23	--	23	--		
		24	--	24	--		
		25	5	25	2		
		26	47	26	1		
27	43	27	--	27	--		
28	--	28	36	28	--		
29	--			29	20		
30	--			30	2		
31	--			31	1		
Totals	43		567		489		296

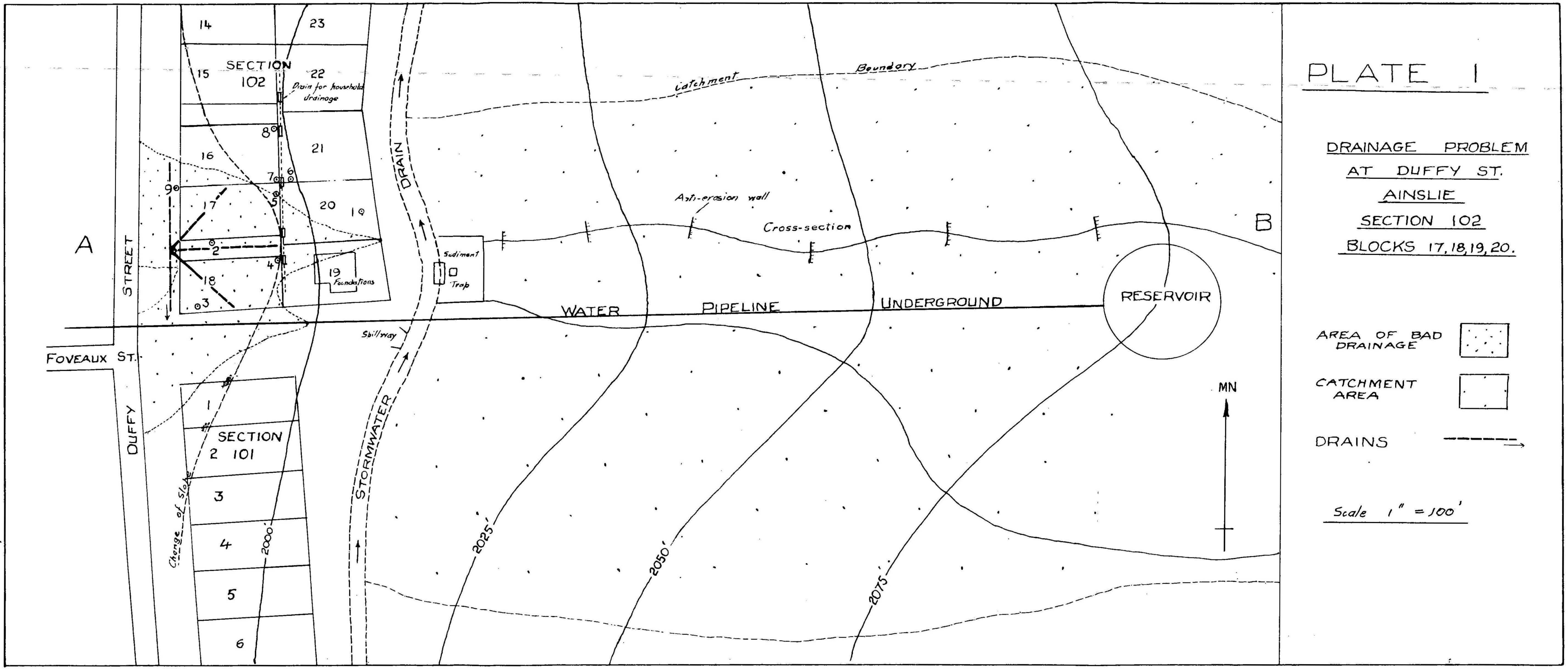
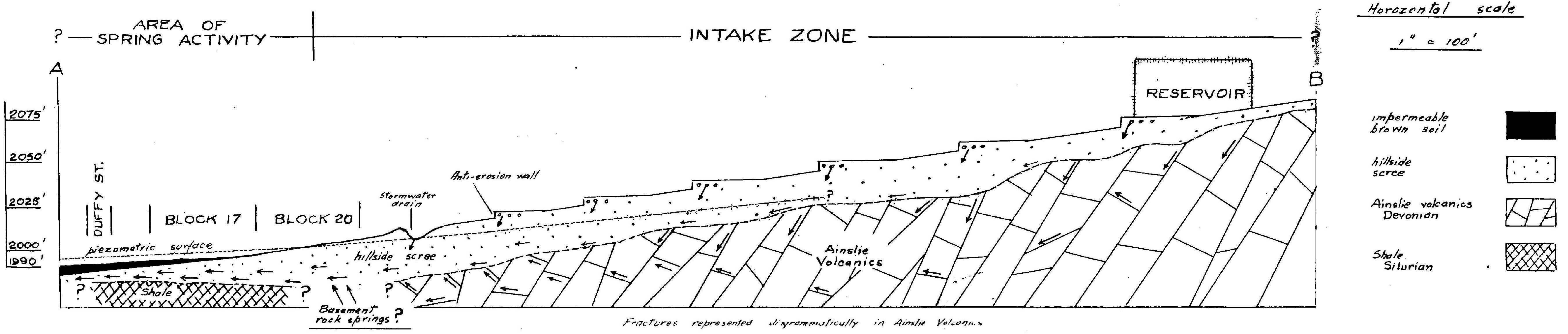


PLATE I
DRAINAGE PROBLEM
AT DUFFY ST.
AINSLIE
SECTION 102
BLOCKS 17,18,19,20.
AREA OF BAD DRAINAGE
CATCHMENT AREA
DRAINS
Scale 1" = 100'
MN
A
B
RESERVOIR
WATER PIPELINE UNDERGROUND
Catchment Boundary
Anti-erosion wall
Cross-section
STORMWATER DRAIN
Sediment Trap
Spillway
Foundations
Drain for household drainage
SECTION 102
SECTION 101
DUFFY STREET
FOVEAUX ST.
Change of slope
2000
2025'
2050'
2075'

CROSS - SECTION

PLATE II

DRAINAGE PROBLEM AT DUFFY ST. AINSLIE, SECTION 102



Fractures represented diagrammatically in Ainslie Volcanics

Arrows indicate movement of underground water