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PRELIMINARY REPORT ON THE GROUNDWATER RESERVES OF THE ALICE SPRINGS AREA

by

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RESERVES OF THE ALICE SPRINGS AREA

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SUMMARY

The principal resources of good quality groundwater available in the Alice Springs district are in the alluvial basins near the Todd River. The smaller Town Basin lies within the ranges north of Heavitree Gap and the larger Farm Area Basin is south of Heavitree Gap at the western end of the Emily Plain.

Plans have been prepared showing the available information on the floor of the basins, water levels and the salinity of the groundwater. The large number of water analyses available has delineated areas of saline groundwater and there has been a consequent reduction in the reserves of potable water calculated by Owen (1954). The available potable water stored in the basins is estimated to be of the order of

Town Basin	330 million gallons
Farm Area Basin	720 million gallons.

These reserves are supplemented by water moving through the basins for a considerable period after floods. It is suggested, however, that the Town Basin may prove inadequate to meet the demands made on it over a long period of drought. The draw on the Farm Area Basin is small compared to the reserves available.

Investigations are being continued to obtain more accurate quantitative data, particularly on recharge of the basins during periods of river flow.

INTRODUCTION

Water for the township of Alice Springs has always been obtained from porous beds in the alluvial basin along the Todd River between the Bungalow and Heavitree Gap. In recent years another alluvial basin further downstream has been developed to supply water to the Farm Area and the aerodrome.

The most comprehensive report available on the water reserves available to Alice Springs is by Owen (1954). His report gives the history of investigations prior to 1954. Much of the present report is a reconsideration of Owen's Report with regard to the additional data now available. Owen did not consider the Farm Area Basin which has been proved to be larger than the Town Basin and to contain a large quantity of good quality water.

Since 1954 the Department of Works has carried out test drilling of the town basin south of the hospital and there has been considerable private boring, particularly in the east side and Gap Road areas. The number of bores in the Farm Area has doubled in the last three years.

During the present survey a detailed geological map is being prepared, bores accurately located, water samples collected for analysis, and available data on the bores recorded. No reliable information is available on more than half the bores known to have been drilled. The data on the individual bores will be presented with the final report.

The base map for the plotting of water supply data was compiled from plans made available by the Northern Territory Lands and Surveys Branch and the Department of Works. It should be noted that topographic control is generally not good and that it has been possible to draw contours for part only of the Town Basin. There is negligible topographic control for the Farm Area Basin.

A valuable addition to Owen's report is the large number of water analyses carried out in recent years by the Animal Industry Branch. The areas containing potable water are being delineated, and data obtained on factors which might cause variations in the salinity of the groundwater.

Geological investigations are being continued, particularly to obtain information on variations in the groundwater with different seasonal conditions. Investigations of the groundwater basins are also being made by the Department of Works, and a geophysical survey of the basins by the Bureau of Mineral Resources is almost complete. The work on this area has been freely discussed with Mr. D. Dyson of the geophysical party and these discussions have influenced the writer's interpretations of the bedrock profile of the basins.

GEOLOGY

Only brief notes on the geology are included in this report. Full discussion of the influence of the geological structure on the subdivision of the groundwater basins will be made in the final report when the full results of the geophysical survey are available.

The following geological succession is present in the area:-

4. Quarternary: Soil unconsolidated sands and clays.

3. Cretaceous and/or tertiary: Freshwater sediments in places consolidated into "billy".

2. Upper Proterozoic and Lower Palaeozoic: Thick sequence of folded sandstones. and limestones.

1. Archeozoic: Gneiss and schist with intrusive pegmatite.

Archeozoic

The gneiss is a coarse-grained foliated rock with tor-like bouldery outcrop and is locally known as granite. The schists seldom crop out near the alluvial basins but have been found under the alluvium in boreholes . Both the gneiss and schist are intruded by pegmatites and dolerite dykes.

Proterozoic - Palaeozoic

A thick sequence of alternating sandstones and lime-stone-shales is present south of Heavitree Gap, although near Alice Springs much of the succession is concealed by alluvium. The established succession and approximate stratigraphic thicknesses are as follows:

Ellery Creek Conglomerate	4,000 + feet
Tempe Sandstone	3,000 "
Waterhouse Formation (limestone-shale)	2,000 "
Chocolate Sandstone	1,000 "
Pertatataka Formation (sandstone-shale)	2,000 "
Bitter Springs Dolomite	1,500 "
Heavitree Quartzite	1,000 "

Cretaceous-Tertiary

The flat-topped hills near the Oil Storage Depot are capped by "billy", believed to be a silicified sediment of Cretaceous or Tertiary age. Similar material crops out on low rises north of the Todd River toward the Heavitree Range. It is probable that similar, but unsilicified, sediments underlie parts of the Farm Area basin but these will be difficult to distinguish from the Quaternary alluvium on the information supplied by percussion drilling. Also regarded as being of this age are scattered, but widespread, cappings of horizontal sands and gravels on the low rises of the Missionary Plain south of the alluvial basins.

Quaternary

Unconsolidated gravel, sand, silt and clay fill the several basins along the Todd River and its tributaries. The maximum known depth of alluvium in the Town Basin is 73 feet but much greater thicknesses are present in the Farm Area Basin, although the basal sediments of this basin may be older than Quaternary. Owen states: "Little is known of the distribution of the different grades of material of which the beds are composed, but it is certain that lenticular bedding is common, and it is improbable that the sediments of the basin, having been laid down and reworked by a meandering stream, contain any particular bed that persists for any great distance."

PHYSIOGRAPHY

Five physiographic units can be recognised in the Alice Springs district. They are:

1. The Burt Plain
2. The rugged irregular hills of metamorphic rocks forming the main part of the MacDonnell Ranges.
3. The Heavitree Range and the sandstone ranges south of it.
4. The eastern extension of the Missionary Plain.
5. The "Town" and "Farm Area" alluvial basins.

Burt Plain

The headwaters of the Todd River are on a high level area in the south-east corner of the Burt Plain. The drainage characteristics of this area have not yet been investigated but it is known that surface flow in the Todd River drainage basin usually first occurs in or near this area.

"Metamorphic" Ranges

This area has a north-south width of approximately 12 miles near Alice Springs between the Heavitree Range and the

Burt Plain. The greater part of the Todd River catchment above the township lies in this area, which corresponds to the area of outcrop of the Archeozoic rocks. The hills are rugged and irregular with soil cover thin and patchy in distribution. As both the porosity and permeability of the rocks are low there is a relatively high degree of run-off and flow in the Todd River - therefore larger, more frequent, and more readily initiated than might be anticipated from the available climatic data. This factor is very significant in considering the recharge of the alluvial basins.

"Sandstone" Ranges.

This area is characterised by regular linear ranges of sandstone (or "quartzite") separated by low rises of softer sediment or shallow alluvium. The rocks of this area are generally much more permeable than those in the "metamorphic" ranges with consequent reduction in run-off. The greater part of any run-off in this area is absorbed by the alluvium in the intervening valleys. Very little water is available to the main alluvial basins as run-off from this area.

Missionary Plain.

An area of low rises separated by broad watercourses. The drainage pattern of the area is poorly integrated. Run-off is low so most of the water lost from this area is removed by evaporation.

Alluvial Basins

The main alluvial basin is that forming the Emily Plain, of which the Farm Area Basin is the north-western part. The surface of the basin has gentle slopes, mainly parallel to the streams.

The presence of fixed sand dunes on the alluvium in the Farm Area Basin shows that there has been little deposition over much of the basin in recent times. In this basin a former course of the Todd River is clearly indicated south-west of the dune area instead of the north, where the present channel is situated.

The margins of the basins are formed by a shallow cover of sheet-wash detritus on bedrock. True river deposits in the Town Basin are probably limited to an area little over one square mile, although the basin as generally understood, is approximately 3 square miles in area. The area of the Farm Area Basin appears to be at least 10 square miles. Its south-eastern limits have not been determined by mapping or drilling.

Drainage System

The watersheds of the Todd River system are shown on plate I. The catchment areas given in the following table are approximate but indicate the relative importance of the different catchments:

Todd River (above Charles)	180	square	miles
Charles River	30	"	"
Town Basin	3	"	"
Todd tributaries (Charles-Heavitree Gap)	20	"	"

Farm Area Basin	10 square miles
Todd tributaries (Heavitree Gap-Emily junction)	20 " "

Todd catchment above Emily junction approx. 260 sq.m.

HYDROLOGY

Aquifers

The aquifers are those beds which will yield useful quantities of water to a bore or well. The porosity of a bed is not the significant factor as fine-grained clays and silts while able to hold large quantities of water will not yield this water to a bore. The specific yield of a bed, i.e. the quantity of water it will yield to a bore is significant only in beds in which the openings are of reasonable size. In alluvium, therefore, useful supplies of water will be confined to beds with large proportions of sand or gravel. The permeability of a bed is important as it controls the rate at which water may be pumped from a bed, and the speed of recharge.

The metamorphic rocks underlying the town basin, where fresh, have a very low porosity and except for occasional fractures do not have appreciable permeability. Where weathered both porosity and permeability are greater but are still low compared to the best aquifers in the alluvium.

Most of the sandstones ("quartzites") in the area are not easily drilled, although they probably contain water in fractures.

Some of the limestones south of Heavitree Gap yield moderate to large quantities of water but such water is usually unsuitable for human consumption and sometimes unsuitable for irrigation.

It has usually been considered that the greater proportion of the unconsolidated sediments ("alluvium") in the town basin will yield water readily. This is contrary to evidence obtained in recent boring which suggests that less than half the alluvium yields water readily, and that at least one quarter of the alluvium will not yield any significant quantity of water.

Most of the alluvial materials when observed in situ can be classified into the following types.

1. Clear coarse sand and gravel.
2. Sand with a silt-clay matrix.
3. Fine sand with subordinate silt.
4. Fine micaceous sand with silt-clay matrix.
5. Impermeable clays and silt-clays.

Unfortunately, in drilling, the samples are usually "washed", so that types 1 and 2 may be confused, as may types 3 and 4. This can lead to overestimation of the proportion of water-yielding beds, as almost all water extracted is obtained from types 1 and 3.

Plate II. shows the available information on the bedrock contours of the town basin. It will be noted that the greater part of the contouring is indefinite and over-simplified. It is hoped that the geophysical work will assist in a more accurate delineation of these contours.

The following bedrock irregularities are known to be significant in the storage or flow of groundwater.

(1) The constriction at Heavitree Gap. This was previously believed to be a shallow bar but the geophysical work suggests that there may be a relatively deep channel through the Gap.

(2) The bedrock "high" between the Todd River and the Army Well area south of the hospital.

(3) The constriction south-east of Billygoat Hill.

(4) Several bars (or constrictions) occur in the river channel between the Todd Well and the Bungalow.

(5) The area of shallow bedrock between Anzac and Billygoat Hills along the line of the railway.

(6) The bars in the Todd Channel east of the hospital.

Very little information is available on the floor of the farm area basin as no bores have been carried to bedrock in the main part of the basin. The geophysical traverse indicates depths of up to 100 feet north of Mt. Blatherskite and depths of 200-400 feet south of it. No bedrock contours could be drawn. It is probable that the floor is irregular with a tendency to buried ridges along the trend of the outcropping sandstone ridges. The static water levels appear to indicate a "bar" or "terrace" in the floor along the line of the Mt. Blatherskite Range.

In both basins there is a greater proportion of relatively clean sands in and near the present and former channels of the main streams. An overall coarsening of grainsize is noticeable towards the upstream limits of the basin. However, beds of all types are widespread throughout the basins and it has not been possible to trace any particular "marker" bed for any distance.

Water Table

The water table is the surface below which the earth is saturated with water. In practice the levels measured are those to which water rises in a borehole - the static water level (plate III.). Under the simplest groundwater conditions the two levels are the same but there are two complications. "Perched" waters are present in the basins i.e. waters which are held at a higher level than the main water table by a "floor" of impermeable material e.g. a clay layer. A perched water probably explains some of the anomalously high points shown in the static water level map. If waters enter a permeable bed at a high level and are then capped at a lower level by an impermeable bed they may become "pressure" waters which when tapped by a bore rise above the natural water table at this point. Such conditions are not known in the shallow town basin but are present in the farm area basin to some extent.

The average water table gradient from the Bungalow to Heavitree Gap (using levels for September 1956) is some 14 ft/mile. The gradient appears to be somewhat steeper from the Todd Well to Bent Tree Well than elsewhere in this section.

There will tend to be a steepening of the water table gradient at places where the flow of water is restricted. In the alluvial basins such restrictions could be due to:

(1) Bedrock bars causing a shallowing of the basin.

(2) Narrowing of the basin between bedrock "highs".

(3) Bands of fine-grained, relatively impermeable beds in the alluvium.

The bedrocks, bars and highs have been previously discussed. Impermeable beds in the alluvium have been reported in many boreholes but are not consistent over any great area. It is almost certain that the high water table near the Causeway is due to perched waters on an impermeable bed. Other instances of such beds effecting the water table are less definite.

Variations in the static water level may be considered under the following four types:

(1) Rapid rises in level during and just after floods in the Todd River.

(2) A slower fall in level during the succeeding dry period.

(3) Local depressions in the water table due to heavy pumping.

(4) Possible long-term changes due to the heavy draw on the basin as a whole.

Information on the effect of flow in the Todd River has been given by Owen. In bores near the river a rise of 14 feet in six weeks was measured in 1938-1939. The extent of the rise is partly dependent on the length of the preceding dry period and partly on the characteristics of the flood. A sudden highcrested flood may carry most of the water beyond the basins, while a slower, longerlasting flood with the same total quantity of water may add much more water to the basin. In the outer parts of the town basin after a flood rises are of the order of one foot and in outer parts of the farm area basin may be too small to be readily detected.

The fall in water level after the peak rise is slower and generally gradual. A few cases of irregular fall in level have been noted (Owen, graphs of levels in 1943-1944). The rate of fall in level appears to decrease after some months but the basin does not become stagnant. During the 1927-1929 drought water levels fell up to 4 feet below the previously known limit (an effect which could not be due to the small draw at that period).

The fall in water level in the Army Well area each summer appears to be related more to the heavy pumping than the overall basin levels. Elsewhere pumping effects are very localised, because of the high permeability of the aquifers and the small quantities drawn.

Information on longer term changes in water level is mostly qualitative and largely obscured by the marked seasonal changes. However, the following indications have been noted.

(1) The static water level at Heavitree Gap is reported to be lower than in the pre-war years.

(2) In the "Old Town" area water levels are similar to those measured in 1941. It appears that the water levels now fall more rapidly than in pre-war years but recover completely following a flood.

(3) The army measurements of water level (1943-1944) show a water table in the southern lobe up to 4 feet higher than that of recent years. This present low level is apparent as far west as bore R_D and therefore cannot be explained as a pumping affect.

(4) Measurements of static water level in the Army bores by the Department of Works over the period 1952-1956 show a gradual decline in average annual level. This is not due to drought years.

In the farm area insufficient surface levels are available to establish water table contours. North of the Mt. Blatherskite Range the static water level is -30 feet below the land surface. Another area of shallow water occurs along the Todd River for about two miles beyond this range. Elsewhere in the basin the static water levels range from 50 to 250 feet below the surface, the waters often rising 50 or more feet above the aquifer. The changes in water level after floods are probably similar to those in the town basin, but the effect on the outer parts of the basin will be very small.

Quality of Water

(1) Salinity

Salinity, as used in this report, is the total content of inorganic salts in solution in the water, not the concentration of sodium chloride in the water. Material in suspension is not considered. Very few water analyses were available to the writers of earlier reports on Alice Springs water supply and the importance of this aspect was not realised. A recent sampling programme has shown that a large part of the town basin contains water, the salinity of which is too high for human consumption.

The following salinity limits were adopted for the suitability of waters for different purposes.

Salinity	Suitability
0 - 300 p.p.m.	Excellent all purposes.
300 - 700 "	Suitable for all purposes.
700 - 1200 "	Near limit of potability for town supply. Suitable for irrigation.
1200 - 2000 "	Unsuitable for town supply, near limit for irrigation.
over 2000 "	Stock only to maximum 10,000 p.p.m.

These limits are based on the total dissolved solids and should be qualified by consideration of the proportions of the constituent salts. Most of the waters in the Alice Springs area with a suitable T.D.S. are not excessively hard but some have a higher sulphate content than desirable for human consumption (e.g. Amoonguna No. 7 bore). There are a number of bores in the town basin which have fluoride contents far in excess of that suitable for human consumption. Some of the waters in the basins contain alkali in a concentration higher than that normally recommended for irrigation purposes but this aspect has not been examined.in detail.

The distribution of different salinities is shown in Plates IV. and V. The samples on which these maps are based were taken over a period of several months. It is known that in parts of the basins there are marked changes in salinity with seasonal conditions. In general the good quality water is in the alluvium, the lowest salinities being recorded near the river. Water in bedrock, except where subject to good recharge, is of poor quality.

Only limited information is available on vertical changes in salinity but in general the upper water is the best. In the farm area basin there are instances of the lower water having a similar T.D.S. to the upper water but having less favourable proportions of constituent salts.

The salts dissolved in the groundwater are mainly derived from the rocks through which the water passes. Salt content is increased with evaporation and transpiration and reduced by a recharge of fresh water.

The greater part of the sodium chloride is probably salt brought in by runoff upstream and the bicarbonates produced by reaction of carbondioxide in rain water with soil minerals. The lime,magnesia, sulphate and fluoride appear to be mainly from the weathering of the rocks through which the water passes. In particular a high sulphate content is present in waters from the pyritic Bitter Springs Dolomite and high fluoride in waters from the metamorphic rocks with highest fluoride contents where pegmatites are abundant.

Very little information is available on changes in the salinity of the basin waters over a long period of time. Two 1942 analyses of the Town Well and the Slaughterhouse Well show respectively somewhat lower and higher salinities than recent analyses. No trends can be established. Monthly samples of waters from the Town Supply Wells have been taken by the Department of Works for the past two years. The analyses (apart from fluoride content) have been very consistent throughout this period. There is definitely no suggestion that the salinity of the Town Supply Wells is increasing, in fact there is some possibility that the salinity of the Army Well No. 2 may be falling slightly. However it should be noted that during this period recharge conditions have been slightly better than average.

Sampling of bores in the farm area basin near the Todd River before and after the heavy rains of February, 1956, showed marked changes in some of the groundwater salinities. It is suggested that this was due to the filling of higher aquifers from the underflow of the Todd River. The salinity of the main part of the basin did not change to a marked degree.

On the limited number of complete analyses available it has not been possible to compile maps showing concentrations of individual salts. These might be expected to yield valuable data on the movement of the groundwater and the source areas of some of the undesirable constituents. For the acid radicle the usual order of abundance is bicarbonate greater than chloride greater than sulphate. In highly saline waters the proportion of chloride is much higher than bicarbonate. In waters of very low salinity the proportion of bicarbonates is very high and of sulphates very low, frequently nil. The control exerted on the concentration of salts by rock types has already been noted.

In the town basin where high fluoride contents are common the distribution of this element may be critical in the selection of further draw-points for the town supply. Unlike all other chemical constituents the fluoride concentration varies markedly from time to time. The concentration in the Army Wells has varied from zero to 2 p.p.m. Therefore at bores which have only been sampled once or twice it is very difficult to calculate the average fluoride content.

An inverse correlation between fluoride content and rainfall has been noted by Mr. Jephcott, Chemist, A.I.D. The cause of this marked fluctuation has not been ascertained but cannot be due to dilution as the other salts are not effected. It may be due to absorption by organic material or clay promoted in some manner by percolating rainwater.

(2) Bacterial Contamination

Although this aspect has given rise to some concern there is very little data on which to base a discussion of the contamination which has been detected in the town supply wells. There are some grounds for believing that the main source of contamination may be at the wells rather than within the basin as a whole. In particular the Army Wells appear to be well away from likely sources of pollution. The pollution of the Todd River Well has been discussed by Owen.

Movement of Water

The general trend of groundwater movement will be across the contours of the static water level (Plate III.), moving towards the areas with lower water table. The movement of groundwater is also reflected in the salinity plans (Plates IV. and V.) as some water movement will occur from areas of low salinity to those of higher salinity. This is because areas of high salinity are in general areas of groundwater stagnation.

The rate of movement and the amount of water moving through any bed depend upon:

(1) The cross-sectional area of the bed.

(2) The permeability of the bed.

(3) The gradient of the groundwater surface.

Relatively little movement will occur through the bedrock and the clay layers present in the alluvium. The main movement will be along the lenses of clean sand and gravel. These will be concentrated in the old and present stream channels and will generally be elongated in the direction of these channels. Unfortunately little information is available on the location of these channels but to some extent they follow the depressions on the floor of the basins.

Information on the rate of flow is confined to observations on the rate of spread of the higher water levels with flooding in the river. Figures and graphs of these changes are given by Owen. However in a bore on East Side (section 49a) there is reported to be a 2-foot rise in level approximately two days after the river runs. This gives an apparent rate of flow of 300 feet/day, under a hydraulic gradient not greater than 150 ft/mile. It may be more reasonable to regard this sudden rise as a pressure effect -- a large quantity of water has been added forming a steep groundwater mound under and near the river which sinks towards the general water table displacing the adjoining water outwards and upwards. If such is the case then Owen's figures also may not be true rates of flow. Dye, or similar, tests are desirable to check these apparent high rates of flow. A knowledge of the rate of flow in the more permeable beds will assist in assessing the extent to which the town basin will be subject to loss by subsurface flow through Heavitree Gap during a long drought. Such loss reduces the storage available for pumping at the time when it is most needed.

With the withdrawal of water by pumping the water level in the vicinity of the bore is lowered and there is a flow of water towards the point of withdrawal. With light pumping the effect is purely local but heavy pumping can cause a reversal of the direction of movement over a large area. It would appear that to date the heavy pumping at the Army Wells has increased flow to these from the Todd River but that the cone of depression has not been so extensive as to bring in saline water from the west. There appears to have been a slight overall reduction in salinity at Army Well No. 2 in the period 1954-1956 which reflects the increased flow from the low salinity areas near the river. However if a drought period causes a major fall in groundwater levels near the river a serious salt influx could occur in this well. It should be noted that the Bent Tree Well appears to be placed to intercept the fresh water recharge to Army Well No. 2.

<u>Recharge</u>

The basins are replenished by:

(1) Rain falling on the sandy soils overlying the alluvium.

(2) Direct intake from the Todd River and its tributaries.

(3) Movement of groundwater down-gradient from the head-water areas.

Although a considerable period may elapse before some of the water reaches the basins it is all derived from rainfall. A drought period will cause a natural fall in water level because the basins are not stagnant and groundwater is continually flowing from them to the south and east.

Assuming a 12-inch average rainfall on the Todd catchment above the Bungalow then in an average year 30,000 million gallons of water will fall on this area. The Alice Springs rainfall during the period of observation has ranged from 2 to 28 inches and it is probable that similar variations occur in the catchment area. Only a fraction of the rainfall will become run-off in the river channel. At present no quantitative data are available on run-off from the Todd catchment. The writer suggests that the average annual run-off would be only of the order of several hundred million gallons. The greater part of the rainfall is lost by evaporation and plant transpiration.

The surface area of the basins is relatively small and "rain falling directly on the basin does not add appreciably to the storage by downward percolation through the soil, as the low run-off on the alluvial plain is partly offset by high evaporation. It is at least possible that such direct addition to the groundwater from the surface is a cause of pollution" (Owen). This statement is also true of the Farm Area despite its greater surface area.

The main replenishment of the basins comes from the Todd River, partly when it flows and partly from the underflow in the sandy beds (the underflow is actually a groundwater movement but is conveniently considered with the surface flow). Other additions will come from the various Todd tributaries which flood directly on to the basins but experience suggests that their contribution is relatively minor, even in the case of the Roe which has a catchment area of the same order as the Todd. The effect of many of the minor streams seems to be that they bring water to the basin with a small but significant salt content. Most of the water then evaporates and as these streams lack underflow the salt is left as another addition to the marginal saline waters of the basins.

Even a "small" flood in the Todd River which does not flow past Heavitree Gap may add as much as 50 million gallons to the basins. Large floods which run for periods up to two weeks and carry past Amoonguna could carry several hundred million gallons but there is only an average of about one of these floods a year. In addition to surface flow there is also a major addition to the basins from the underflow of the river. As a small flood with surface flow of the order of 50 million gallons may cause a rise in water levels which requires at least 100 million gallons the underflow in these cases must be of the same order as the surface flow.

An important factor is the regularity of floods. Long-standing residents of the town report that the river may not flood for up to eighteen months, although in the last few years there have been at least two floods a year.

Artificial recharge of the basins needs to be considered but difficulties are:

(1) The moderately steep water table gradient and consequent flow from the basins.

(2) Flowing water is available for short periods only so that the recharge system would need to be very efficient. Also such water may not be available for long intervals.

(3) The lack of knowledge of the shape of the floor and the distribution of permeable beds of the basins which largely controls groundwater movement.

More detailed knowledge of the basin is needed before the suitability of any of the suggested schemes can be assessed.

Capacity of Basins

A revision of Owen's figures for the town basin and the calculation of the quantity of water stored in the farm area basin has been attempted in the accompanying table. The quantities given are those which are believed to be available for extraction by pumping and which are of potable quality (total dissolved salts less than 1200 p.p.m). In using these results the following points should be recognised:

(1) No allowance is made for the natural flow into and from the basins, the water being treated as "static". This point is discussed in a later section.

(2) The area of the alluvial basins is accurately known.

(3) The area of potable water in the town basin is reasonably known but the salinity limits are doubtful in the greater part of the farm area basin.

(4) The thickness of saturated alluvium in the town basin is reasonably known but a minimum figure only is available for the farm area basin.

(5) The proportion of the saturated alluvium which will yield water to a bore is an estimate only and has probably been seriously overestimated in past reports.

Quantity of Available Potable Water - Town Basin

Portion	Area (in acres)	Thickness saturated alluvium (in feet)	Thickness water-yielding	Specific yield	Potable Water (million gallons)
Todd River - Charles junction to Bungalow	70	20	15	15	40
Todd River - Charles Junction to Hospital	70	25	15	12	30
Todd River - Hospital to Heavitree Gap	130	25	15	12	60
East Side	100	20	10	12	30
"Old Town"	80	25	15	10	40
Gap Road area (east of railway)	300	20	12	10	100
Charles Basin					?10
Conellan's Basin					?10
Fresh Water in bedrock					?10
Town Basin (total)	-	-	-	-	330

Quantity of Available Potable Water
Farm Area Basin

Portion	Area (in acres)	Thickness saturated alluvium (in feet)	Thickness water yielding	Specific yield	Potable water (in million gallons)
North of Mt. Blatherskite Range	280	?40	20	12	180
Amoonguna - Mt. Blatherskite	500	?200	30	6	240
Aerodrome - Animal Industry Station	450	?200	30	6	200
South-East					?100
Farm area basin (total) -		-	-	-	720

(6) The specific yield of the beds is also an estimate and this is liable to serious error (perhaps greater than ± 50 per cent of the estimate made). The estimate is based on the comparison of this basin with others having apparently similar characteristics.

Nevertheless the figures indicate that available stored water in the town basin may be considerably less than generally believed. This is principally due to the exclusion of non-potable water from the reserves. It is also indicated that the resources of the farm area basin are considerably larger than those of the town basin and are far from being fully developed.

In addition to the reserves shown in the tables there are appreciable quantities of more saline water some of which will be suitable for the irrigation of salt-tolerant crops such as lucerne and most of which will be suitable for watering stock.

The continued presence of an appreciable groundwater gradient within the town basin and the non-formation of extensive cones of depression indicates that a large part of the water pumped from the basin is not being drawn from storage but from water flowing through the basin. This is particularly marked for a period of one to three months after a flood (depending on the size of the flood). However during a long drought the greater part of the water pumped will be drawn from storage.

It should be noted that the equipped wells in the town basin (private or town supply) could not effectively draw much more than half of the stored water in the basin.

UTILIZATION

Prior to 1939 draw from the groundwater resources was confined to the town basin and such draw would have been slight compared with the capacity of the basin. During the war years consumption was much higher, probably being of the same order as draw in recent years. There was a marked drop in pumping after the war but there has since been a steady increase in draw until the following figures were reached in 1955-1956:

Town Basin -	Town supply	120 million gallons
	Private	?40 million gallons
	Approximately	160
Farm Area Basin		?80 million gallons

This available information on water levels indicates that to date the town basin has been more than adequate for all demands made on it. The water shortages in Alice Springs have been due to inadequacies in one or more of (1) number of draw-points (2) pump capacity (3) storage (4) reticulation system. At one stage pumping was made more difficult by a slight lowering of the water table but there was never any basis for the suggestion that the basin was near its exhaustion.

However, in recent years, since heavy pumping was initiated, the basins have not been tested by a major drought. Furthur, the occurrence of such a drought cannot be reliably predicted. It is suggested that when a major drought does occur it will not be possible to continue the present rate of draw from the town basin and certainly not from the present draw points for the town supply.

Present development of the farm area basin makes only a small demand on the reserves available in that basin. This basin should therefore be available to supplement the town basin unless there is a much more extensive development of irrigation in the farm area.

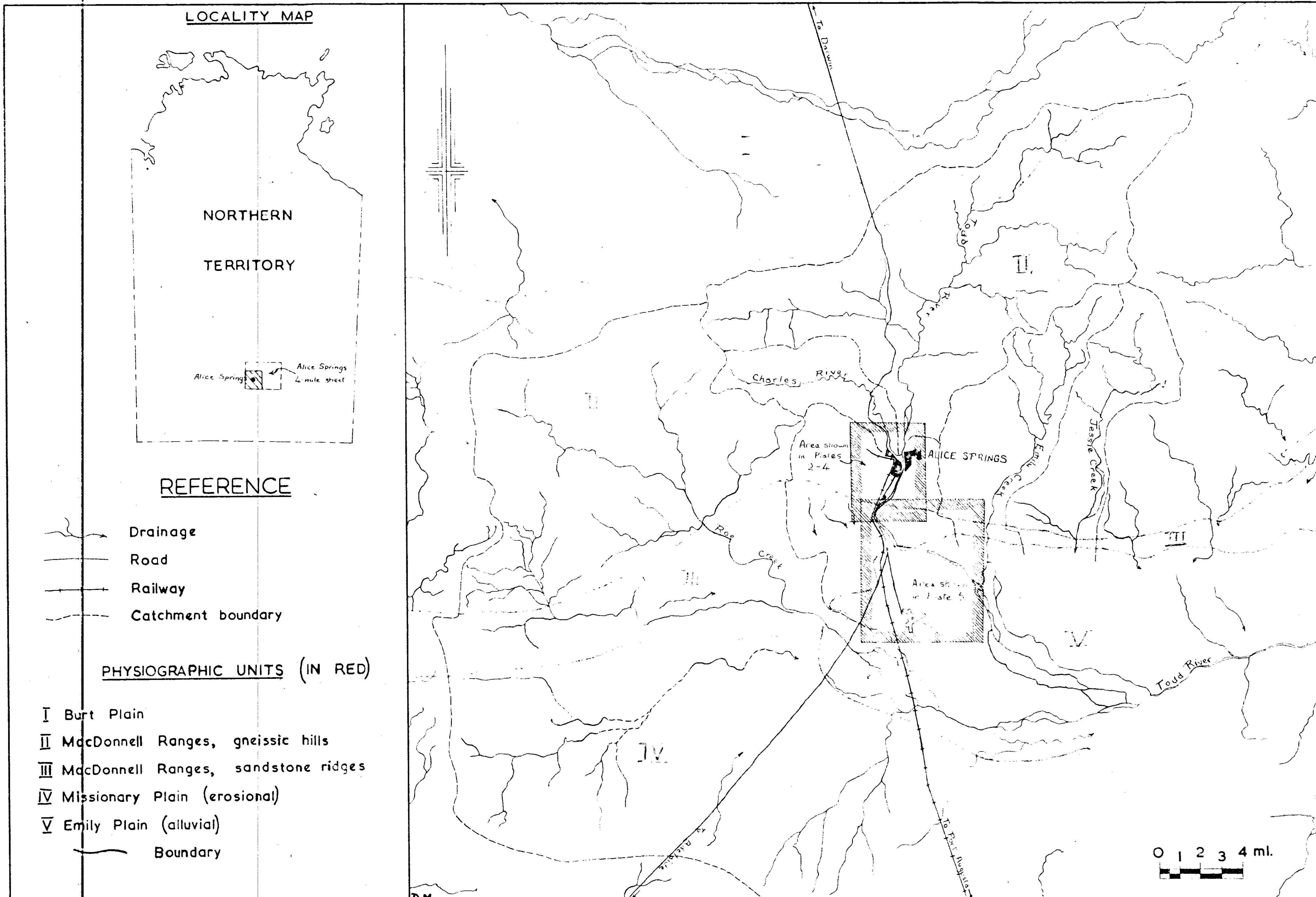
It has already been noted that waters which are unsuitable for human consumption may be suitable for irrigation or for stock. Consideration should be given to developing these poorer quality waters so that the better waters may be reserved for the town supply.

ACKNOWLEDGEMENTS

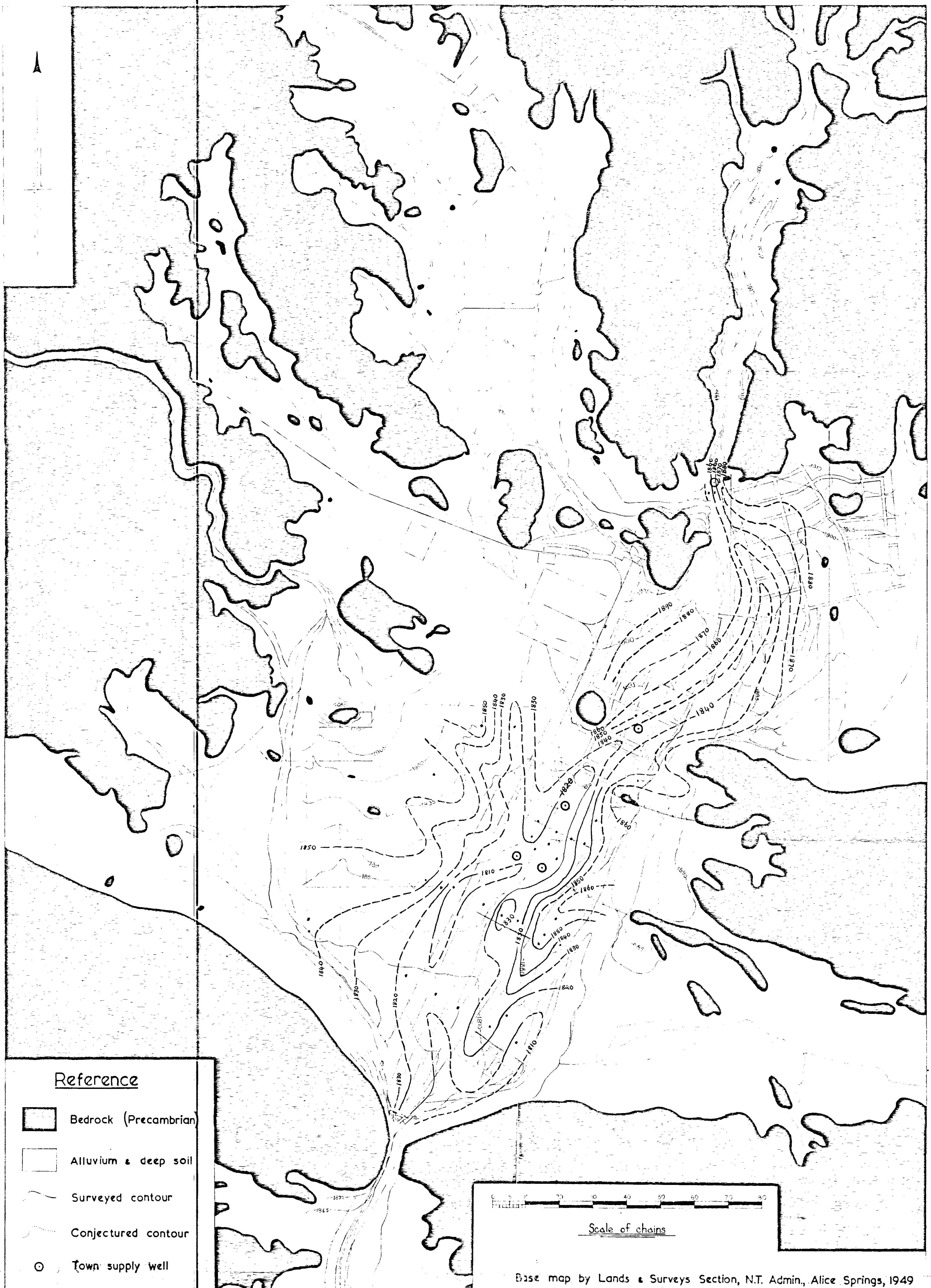
Much of the work on which this report is based was carried out by resident geologists D.E. Catly, D. Moore and G.R. Ryan. Mr. D.N. Sett of the Geological Survey of India worked with the resident geologists for a period of two months. The information supplied by Messrs. J.C. King, D.D. Smith and other officers of the Department of Works is gratefully acknowledged. The writer had many helpful discussions with Messrs. W. Wiebanga and D.F. Dyson who conducted the geophysical survey of the alluvial basins.

Reference

Owen, H.B. 1954. Report on Geological Investigation of Underground Water Resources at Alice Springs.


LOCALITY MAP
NORTHERN
TERRITORY
Alice Springs
Alice Springs 4-mile sheet
REFERENCE
Drainage
Road
Railway
Catchment boundary
PHYSIOGRAPHIC UNITS (IN RED)
I Burt Plain
II MacDonnell Ranges, gneissic hills
III MacDonnell Ranges, sandstone ridges
IV Missionary Plain (erosional)
V Emily Plain (alluvial)
Boundary
To Darwin
Todd River
Charles River
Area shown in Plates 2-4
ALICE SPRINGS
Emily Creek
Jessie Creek
Roe Creek
Area shown in Plate 5
Todd River
To Port Augusta
To Adelaide
II
III
IV
V
0 1 2 3 4 ml.
D.M.

ALICE SPRINGS ALLUVIAL BASIN



BEDROCK CONTOUR MAP

—1850 Contour, control good

--1850 Contour, control poor

• Observation point

Contour interval, 5 feet

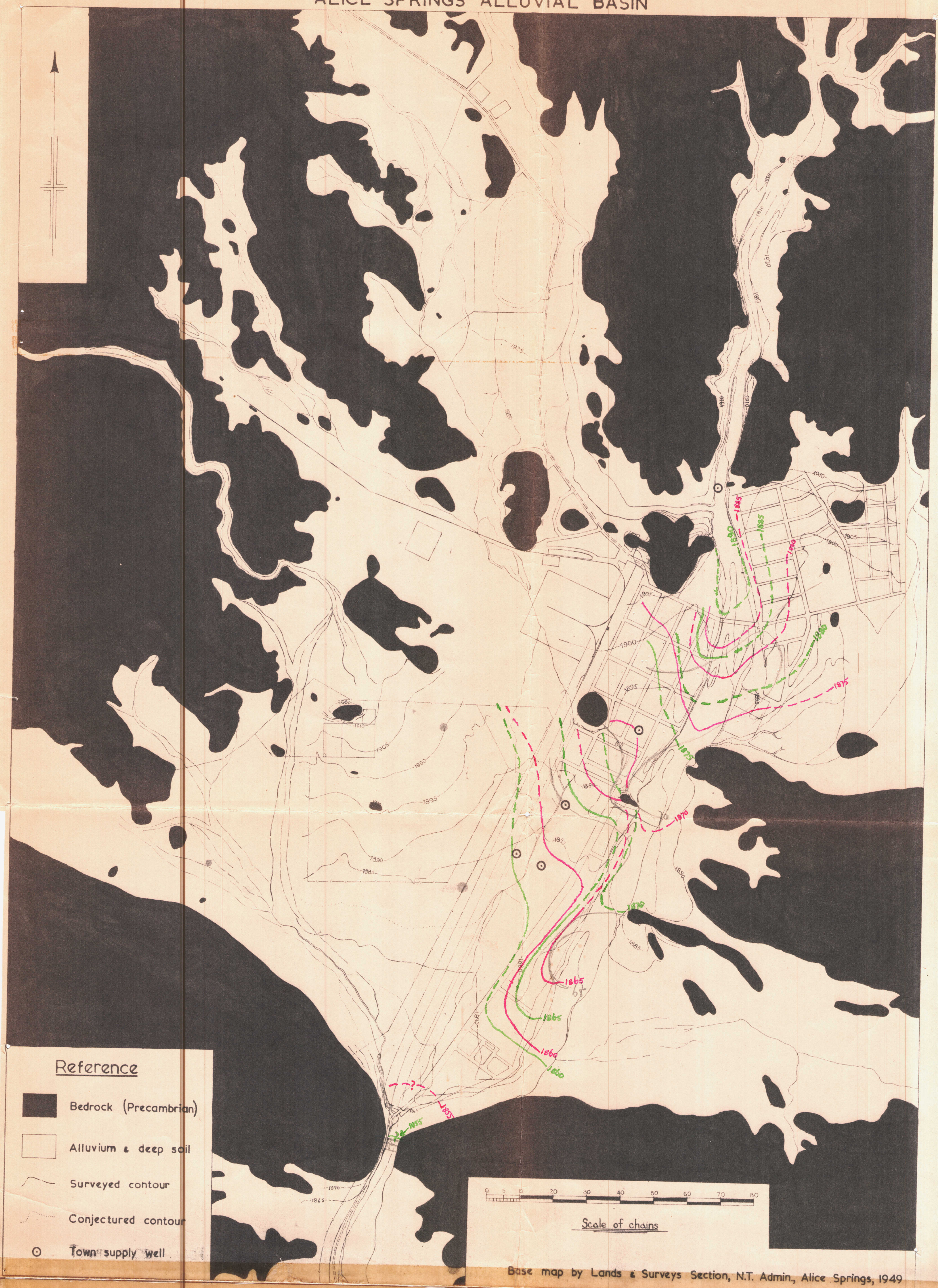
Resident Geologist's Office,

ALICE SPRINGS, N.T.

Nov., 1956.

D.M.

ALICE SPRINGS ALLUVIAL BASIN



STATIC WATER-LEVEL CONTOUR MAP

1st September, 1956

1870 Contour, control good

1870 Contour, control poor

1st November, 1956

1870 Contour, control good.

1870 Contour, control poor

Contour interval, 5 feet.

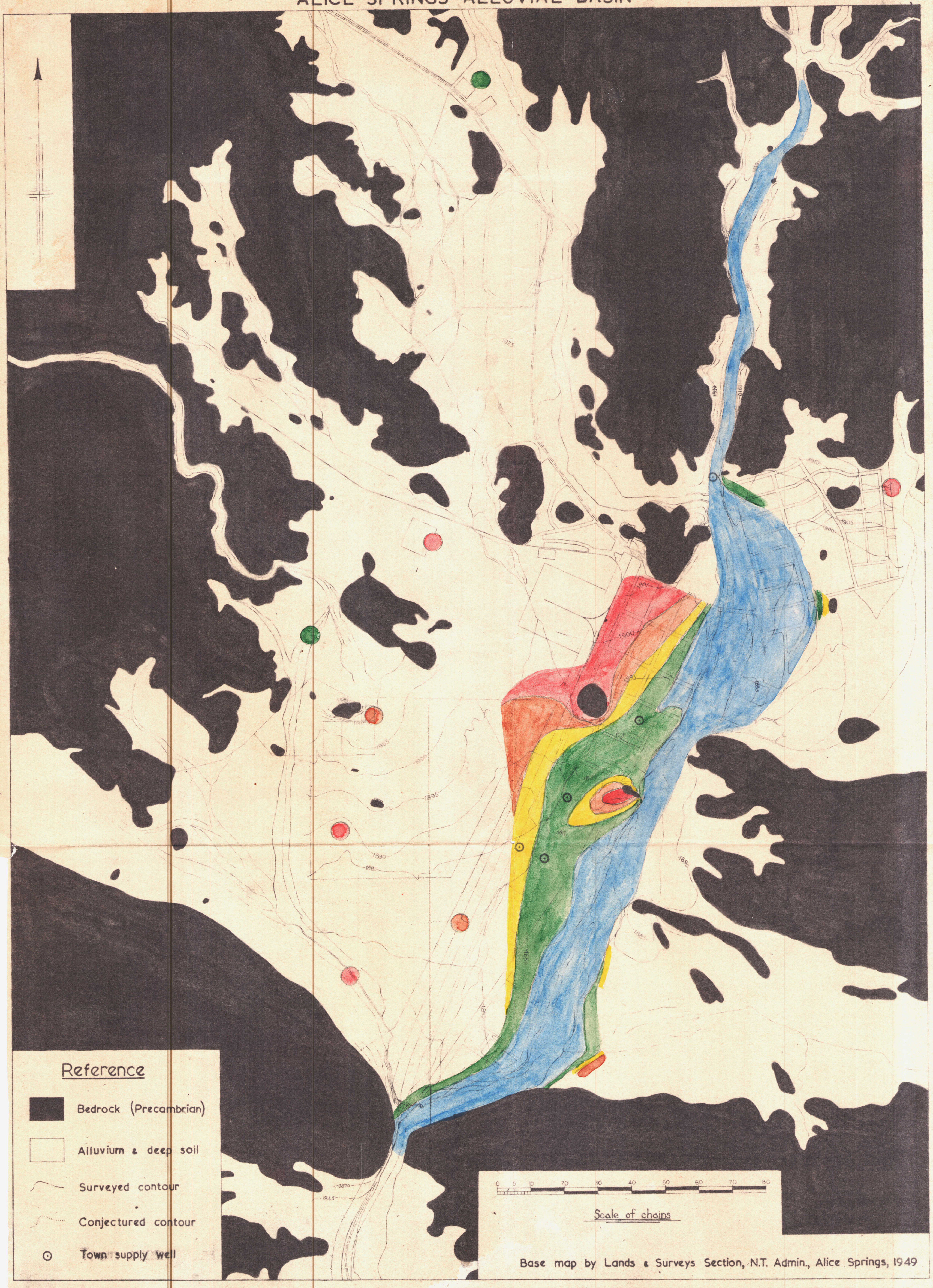
Resident Geologist's Office,

ALICE SPRINGS, N.T.

D.M.

Nov., 1956.

ALICE SPRINGS ALLUVIAL BASIN



SALINITY MAP

Total Dissolved Salts	Suitability
0-300 p.p.m.	Excellent for all purposes.
300-700 p.p.m.	Suitable for all purposes.
700-1200 p.p.m.	Near limit of potability for town supply, suitable for irrigation.
1200-2000 p.p.m.	Unsuitable for town supply, near limit for irrigation.
more than 2000 p.p.m.	Suitable only for stock (to 10,000 p.p.m.)

○ Isolated observation point

NOTE: Where water of low salinity overlies more saline waters only the smaller value has been plotted.
The suitability given above is only approximate, since the effect of individual constituents has been ignored.

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Nov., 1956

D. M.

Record 1957/6
Plate 5

FARM AREA ALLUVIAL BASIN