Director

RECORDS OF THE
GEOLOGICAL SURVEY
OF WESTERN AUSTRALIA

No. 1962/16.

TITLE: WATER SUPPLY EYRE HIGHWAY
EUCLA DIVISION

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DATE: 12th November, 1962.

58834/5/62—2m

REPORT ON WATER SUPPLY, EYRE HIGHWAY, EUCLA DIVISION.

by

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Record No. 1962/16

C O N T E N T S

12 November, 1962.

INTRODUCTION

An investigation was made along part of the Eyre Highway to assess the water potentialities of what is generally regarded as one of the dry Nullabor Plain sections of this overland route. The part investigated is that lying between the 136 and 312 mile posts east of Norseman.

The investigation was made at the request of the Department of Main Roads, who require additional watering points for future road-forming and surfacing purposes.

Established settlements en route include Balladonia (136 mile post), B.P. John Eyre Motel-Caiguna (232 mile post) and Cocklebiddy (272 mile post). A map of the route accompanies this report.

PHYSIOGRAPHY

This section of the overland route traverses a flat to mildly undulating surface forming part of the Nullabor Plain. The typical surface appearance is that of lightly timbered limestone rises interspersed with low scrubby and grassy flats. Local elevation differences are gradual, and range in height from a few feet to 50 feet. These are more pronounced in the eastern part (between the 210 and 312 mile posts).

Limestone surfaces are generally kunkarised (i.e. with lime coatings, cements and nodules) and overlain by veneers of powdery and nodular calcareous soils. Karst and sub-karst features including collapsed surfaces, caves, sinkholes and dissolution holes as well as gilgai depressions are developed locally.

Flats and rises follow a general north-east orientation conforming with the configuration of this sedimentary basin and with the regional trend of the crystalline (gneissic) basement. Some of the flats form foci for run-off waters and may approach salina (salt-pan) form. The general fall of the country is low in gradient and basinwards (south-east), towards the "Bight". Defined drainage lines are restricted to the immediate coastal strip.

GEOLOGY

The sequence of limestones underlying the Nullabor Plain is referred to in literature as the "Eucla Limestone". This sequence has resulted from marine ingressions that were effective during the

Upper Eocene and Lower Miocene. Their present distribution defines the "Eucla Basin".

The uppermost formation has been referred to as the "Nullabor Limestone". It forms the topmost marine formation and extends with remarkable lithologic and faunal uniformity over the whole of the Nullabor Plain. This limestone is mostly hard and dense, and ranges in colour from grey and white, to cream. Megafossils are preserved mainly as moulds and casts.

Kunkarisation is general over the surface but limestone sections can be observed in caves, sinks, and along the dissected south coast escarpment. This latter feature is a bold erosion escarpment formed by cliffs up to 250 feet high. It extends in a prominent arc from Pt. Culver to Twilight Cove on the south coast, thence through Madura and Eucla before passing South Australia. In its eastern extension, the escarpment has been referred to as the "Hampton Scarp" and is believed by some authors to be a fault scarp.

Mesozoic (and possibly Palaeozoic) sediments underlie the limestones in deeper parts of the basin. These are not exposed but their presence has been indicated locally by deep bores. The basin is flanked to the west by charnockitic and granulitic gneisses believed to be Lower Proterozoic in age.

WATER SUPPLY

General:

In view of the excellent pastoral potential of the area, the existence, and reliability of good quality waters would be of considerable economic importance. However, the low rainfall (approx. 6 inches per annum), high evaporation factor, relatively flat topography, and absence of drainage over the region, make the hydrological situation unfavourable and do not enhance pastoral prospects.

Groundwater has been obtained within 90 feet to 450 feet of the surface over parts of the Nullabor Plain and, except for some northern marginal areas, the water is generally too saline even for sheep. Some of the deeper caves that reach the water table

may provide stock supplies where accession of storm waters produces a "cream" of better quality.

Pressure waters are available from deeper aquifers (lower limestone formations and Mesozoic strata). From the available data, some of these aquifers could contain better quality waters that would be useful for stock purposes.

The present sources of domestic and stock waters for established settlements, pastoral holdings and Main Roads Department use are mainly from roof catchments, earth and rock dams or underground tanks.

The available sources of water supply over this part of the route, and relevant bore information over other parts of the Nullabor Plain, are given in tabular form and are further discussed below.

Natural Sources:

Granitic rock catchments (and shallow soaks) exist at Balladonia (136 mile post) and further west. The catchments at Balladonia have been improved by damming and these give useful supplies providing there are sufficient rains.

Collapsed limestone surfaces locally form deep caves that reach the water table and are capable of yielding large quantities of saline water. The equipped cave source near Cocklebiddy (269 mile post) is providing ground water from a depth of 320 feet (approx.). A further cave source with ground water at a similar depth also exists 6 miles north of 266 mile post.

Small dry sink-holes noted at the 210 mile post and $\frac{1}{2}$ mile east of the 228 mile post may contain small supplies after rainy periods. Other rock-hole or sink-hole sources known within the region are generally of small capacity, unreliable and too remote to be of any significance.

Underground Sources:

The water level in the Cocklebiddy caves is reputed to oscillate with the coastal tides. This would suggest that in the Cocklebiddy area the present water level (320 feet approx.) is that of the water table and that interconnected subterranean

openings occur. Elsewhere over the Nullabor Plain the quantities, qualities and depths to ground and pressure waters would be dependent on the aquifer utilised and the position within the Basin.

From the known data (see tables) it is likely that brackish or saline waters could be expected over most of the Nullabor Plain at depths ranging from 90 feet to 450 feet. Other deeper aquifers of variable quality and pressures could also be expected. Artesian supplies are unlikely but could occur south of the coastal escarpment.

The salinities of the ground waters along the Transcontinental Railway range from 200 grains to 400 grains per gallon and are locally as high as 700 grains per gallon. Taking into account the motion of ground water in the Eucla Basin, it is probable that the quality of waters would deteriorate towards the south-east. From the known data, the quality of water available along this part of the Eyre Highway is generally poor and too saline for stock. The quality may improve towards the margin of the Basin (Balladonia end).

The available ground water information along the Balladonia to Madura part of the Eyre Highway is summarised below:

Eyre No. 1 Water Bore: Drilled 75 yards from Eyre No. 1 stratigraphic hole (Exoil Pty.Ltd.) to a depth of 90 feet. The bore encountered salt water between 80 feet and 90 feet. Total solids 3590 grains per gallon, supply quoted as 250 gallons per hour.

Eyre No. 1 (15 miles south of Madura) and Gambanga No. 1 (5 miles north of 189 mile post):

These stratigraphic holes penetrated a sequence of Tertiary limestones and older strata, and entered granitic basement at 1708 feet and 1279 feet respectively. Although rocks of high permeability, and certainly carrying water, were intersected in both bores, the drilling purpose precluded the exact determination of aquifer positions or the testing of quality and quantity of water.

Cocklebiddy Caves: Water is available from these caves at a depth of approximately 320 feet. Total solids are reputed to be approximately 1200 grains per gallon.

A. Angus pastoral holding, 10 miles north of 312 mile post:
It is reputed that this bore struck pressure water at 434 feet and that the water level rose 38 feet. The quality of the water is reputed to be poor ("2 oz."water).

Madura No. 1 Bore: Situated at Madura, reached a total depth of 2041 feet where it struck an artesian flow of 5700 gallons per day. Total solids amounted to 629 grains per gallon. Pressureless and sub-artesian waters, both quoted as salty, were encountered at 100 feet and 905 feet respectively.

Madura No. 2 Bore: Located 30 miles north of Madura. Sunk to 425 feet, struck water with a total salt content of 674 grains per gallon at 410 feet. The supply is stated to be "good".

Earth Dams and Underground Tanks:

Successful earth dams exist in the limestone country at Balladonia (137 mile post), Caiguna (237 mile post) and Cocklebiddy (272 mile post). There are no defined drainage lines but the existing dams are favourably sited in flats or depressions and are fed by suitable drainage channels constructed to collect waters draining from adjacent limestone rises.

Underground tanks (equivalent to sealed dams) also exist in similar flats 6 miles south of the 172 mile post, Cocklebiddy (272 mile post), and at the 312 mile post.

Roof Catchments:

The domestic requirements of the established settlements rely mainly on waters collected from roof catchments. For replenishment, these sources are entirely dependent on the irregular and low rainfall and, in most instances, the supplies are barely sufficient to meet total requirements. During dry spells, these sources are further augmented by waters carted from the nearest available dam or, as at Cocklebiddy, supplies may be eked-out by utilising saline ground water for general and ablution use.

Constructed roof catchments, catering for the emergency requirements of travellers, exist at the 172 mile post (3x1000 gallon tanks) and at the 208 mile post (6x1000 gallon tanks).

These are sufficient for current needs and provide useful supplies in a dry and uninhabited section of the route.

POTENTIALITIES

Additional watering points for Main Roads Department use could be provided by the construction of earth dams or the establishment of water bores at suitable localities along the route. The earth dam sources would be entirely dependent on the irregular and low rainfall for recharge and would not survive dry periods. The bore sources would provide a permanent source of water supply. The potentialities of these sources are summarised below:

Earth Dams:

Flats or depressions in the limestone terrain occur at regular intervals along the route; approximately at every mile between the 210 and the 312 mile posts and to a lesser degree west of the 210 mile post. These soil flats consist of powdery grey-white calcareous soils containing kunkarised nodules.

The soils are generally porous but where flats show "pan" affinities or serve locally as drainage loci, appreciable thicknesses of clay-loam soils of better "holding" qualities may be developed. The successful earth dams are located in such soils. These clay-loam soils are distinguished by a characteristic red-orange colour and may support strong blue bush or samphire growth.

Despite the soil characteristics, the solid limestone surface may lie at sub-surface and the presence of a suitable depth of soil should be established before an earth dam is attempted. (A Proline borer proved successful for this purpose at Cocklebiddy).

The construction of dams in these terrains would require extensive "puddling" before a satisfactory seal is obtained. Similarly, the adjacent catchment surface may require compaction by rolling to consolidate the powdery calcareous soil surfaces and improve run-off qualities.

Other more expensive sealing methods (bitumenisation) may be required in poor "holding" ground where watering points are essential and where the clay-loam soils are lacking.

Bores:

Water bores could be established anywhere along the route east of the Balladonia property (at least 10 miles east of the granitic basement at Balladonia would be necessary). From the available data, shallow ground waters have been obtained over parts of the Nullabor Plain at depths ranging from 90 feet to 450 feet.

For the investigated section of the Eyre Highway, the depths to the uppermost limestone aquifers are expected to range from 300 feet to 450 feet, with the probability of shallower waters towards the Balladonia end. Supplies from the limestone aquifers would be subject to extreme variations but can be expected to yield 5,000 to 25,000 gallons of water per day.

Pressure waters (sub-artesian) are probable in some of the deeper aquifers in or below the limestones. In general, the quality of underground waters would be mainly saline but better quality supplies are possible towards the margin of the Basin, or from the deeper aquifers.

CONCLUSIONS

The investigation showed that apart from the provision of additional roof catchments, the main sources of further water supply would be from earth dam or bore sources.

Earth Dams:

Suitable sites for earth dams exist over most parts of the route and recommendations for selection and treatment of sites has been given in the text. These sources would provide fresh water but cannot be regarded as permanent.

Bores:

Bore sites could be selected anywhere along the route east of the granitic basement at Balladonia (say east of the 146 mile post). The depth to suitable supplies of ground or pressure waters would be dependent on the aquifer utilised and the position within the basin. For this part of the route, the depth to the uppermost aquifers could range from 300 feet

to 450 feet with the probability of shallower supplies towards the Balladonia end.

In general the quality of such waters is expected to be poor and, except for local instances, would be too saline for stock. The bore sources would be regarded as permanent sources of water supply and would provide adequate waters for road-forming and surfacing purposes.

The established Enoil bore 5 miles north of 189 mile post could be tested and equipped if required for future use.

Table 1.

Watering Points, Balladonia to 312 m.p.

Eyre Highway

Locality	Source of Supply	Remarks
"Balladonia" at 136 m.p.	Granite rock catchments, shallow soak, roof catchments.	Used for station domestic and stock purposes.
137 m.p.	Earth dam in limestone terrain.	
172 m.p.	Constructed roof catchment	G.W.S. 3-1000 gal. tanks.
6 miles south of 172 m.p.	Underground tank	G.W.S.
5 miles north of 189 m.p.	Enoil bore, Gambanga No.1, 1282 feet total depth.	Not equipped, quality and supply not recorded.
208 m.p.	Constructed roof catchment.	G.W.S. 6-1000 gal. tanks.
* 209 m.p.	Earth dam in limestone terrain.	Dry (22/10/62).
"Caiguna B.P. Motel" at 232 m.p.	Roof catchment	Motel use only
2½ mile east of 237 m.p.	Earth dam.	Contained water (22/10/62)
6 miles north of 266 m.p.	Cave extending to water table approx. depth 320 feet.	Not equipped, salinity approx. 1200 grns/gal.
* 269 m.p.	Cave extending to water table approx. depth 320 feet.	Equipped, salinity approx. 1200 grns/gal.
Double Bluff at 278 m.p.	Roof catchment, earth dams, and water under soil.	Motel and station use. G.W.S.

Table 1 (Continued)

Locality	Source of Supply	Remarks
* 2 miles north of 272 m.p.	Earth dam in limestone terrain	Contained water (22/10/62)
302 m.p.	Underground tank	G.W.S.
North east of 312 m.p.	Bore 434 feet total depth	A.Angus' property 2.ozs.water, rose 38 feet.

* Available for Main Roads Department use.

m.p. = mile post

G.W.S. = Goldfields Water Supply.

Table II.

TRANSCONTINENTAL RAILWAY BORES.

Location on Railway Line	Total Depth (feet)	Top Water Struck (feet)	Supply of top water (gallons per day)	Quality of top water	Depth of principal water bearing bed below surface (feet)	Approx. supply of principal water bearing bed (gallons per day)	Total solids (grns. per gallon)	Diameter of casing	Remarks
205 miles (Narethea)	449	No top water			445		Salt water		Decomposed granite at 440 ft.
220 miles (Narethea)	236	139	96	Very good				6 ins.	
235 miles (Rawlinna)	323	194		Fairly good	300	10,000	218	6 ins.	Static level 179 ft
250 miles (Rawlinna)	401				350	7,000		6 ins.	
279 miles (Rawlinna)	480				397	4,000	2 ozs.	6 ins.	
280 miles (Rawlinna)	884				394	10,000	Too saline for human consumption or irrigation	6 ins.	
264 miles (Rawlinna)	402				262	10,000	1½ ozs. (no salt)	6 ins.	
310 miles (Rawlinna)	1372	395	4,000		1,270	10,000	182	6 ins.	
319 miles (Rawlinna)	415				384	20,000		6 ins.	
337 miles (28m.west of Loongana)	1372	412		300 gr/gall. Total salt	1,344	30,000	225	6 ins.	Static level 420 ft calyx granite at bottom
337 miles	412				300	30,000	373	6 ins.	Static level 5 ft.

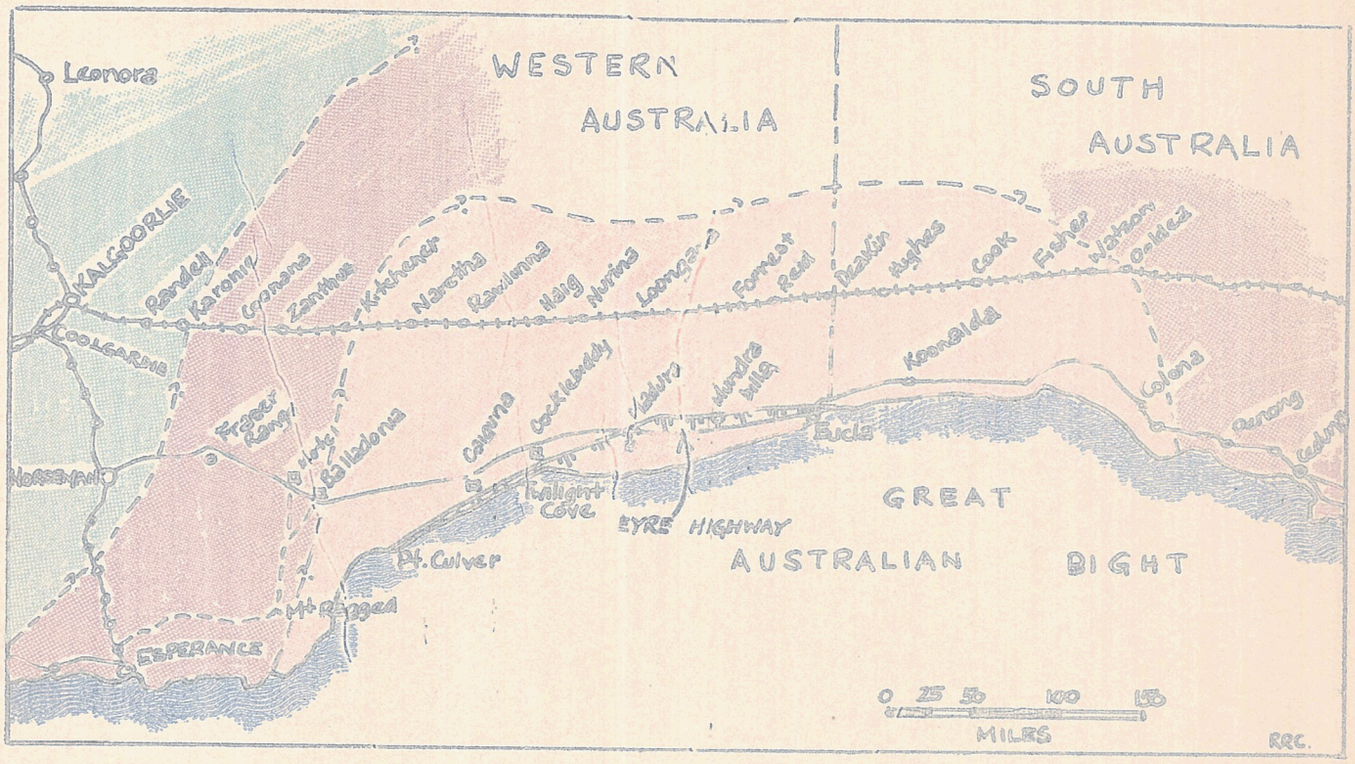
Table II (Continued)

Location on Railway line	Total Depth (feet)	Top Water Struck (feet)	Supply of top water (gallons per day)	Quality of top water	Depth of principal water bearing bed below surface (feet)	Approx. supply of principal water bearing bed (gallons per day)	Total solids (grns. per gallon)	Diameter of casing	Remarks
351 miles (Loongana)	404				304	24,000		6 ins.	
380 miles (Loongana)	1470				1,340		295	6 ins.	
400 miles (Forrest)	387				264	24,000	Fresh	6 ins.	
420 miles	996				940	250,000	378	6 ins.	Static level 401 Calyx drill.
430 miles	371				290	40,000	217	6 ins.	
440 miles (near Deakin)	400				284	24,000		6 ins.	

Table III.

MADURA BORES

Location on Railway line	Total Depth (feet)	Top Water Struck (feet)	Supply of top water (gallons per day)	Quality of top water	Depth of principal water bearing bed below surface (feet)	Artesian (A) or Sub-artesian (S)	Approx. supply of principal water bearing bed	Total solids (grns/gall)	Diameter of casing	Remarks
Madura (No.1 Bore)	2041	100		Salt	905	S.	31,000 (flow)	Salt		Calyx Drill
					1979	A.	1,000 "			
					2041	A.	5,700 "	629		
Madura (No.2 W.S. & D. Madura)	425				410		"good"	674		



CAINOZOIC Nullarbor Limestone

PROTEROZOIC Charnockitic Gneisses

ARCHAEAN Granitic & Metamorphic Rocks

MAIN ROAD

RAILWAY

APPROXIMATE GEOLOGICAL BOUNDARY

LIMESTONE ESCARPMENT

ROUTE MAP OF EYRE HIGHWAY
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APPENDIX

WATER SUPPLY B.P. JOHN EYRE MOTEL

CAIGUNA - 232 M.P. EYRE HIGHWAY

GENERAL

This new motel has been designed so that an average of 6" rainfall per annum would provide 55,000 gallons annually from the roof catchments This supply is considered inadequate to meet the future demand and further supplementary sources are required.

POTENTIALITIES

It is likely that the present roof catchment would provide adequate "domestic water" if restricted to this use. The main call for other waters would be for general and ablution purposes to cater for "over-night stoppers".

Other than cartage and the construction of further roof catchments, additional water supplies would only be provided from earth dam or bore sources. The recommendations given in the main report would apply to this locality and the alternate sources are further commented upon below

Earth Dams:

A successful earth dam exists half a mile east of the 237 mile post (6 miles east of the Motel). There should be no reason why further earth dams could not be constructed in similar environments along the same or other flats of this vicinity. The flat opposite the Motel site would probably be amenable to dam construction providing suitable "holding" ground is present. (See main report). Sealing and surface treatment (bitumenisation) may be required if the ground is not suitable.

Bore Source:

A depth of approximately 300 feet would be required before an adequate supply of ground water is reached. This could be located at the Motel site. The quality of the water would be approximately 1000 grains per gallon and although useful for "washing off the dust" would not be suitable for "lathering".

The problem could be overcome by mixing saline water with roof catchment supplies and utilising the mixture in the ablution blocks. In this way the annual requirement of 100,000 gallons could be approached.

CONCLUSIONS

Rock hole sources known in this area are too small, remote, and unreliable to be of any significance.

Additional fresh waters would only be provided from dam sources and further roof catchments. These sources cannot be regarded as permanent and would fail during drought periods.

Saline water from a bore located at the site could augment the present supply if utilised for general and ablution use (either direct or mixed with the fresh water). The bore source would be regarded as permanent.