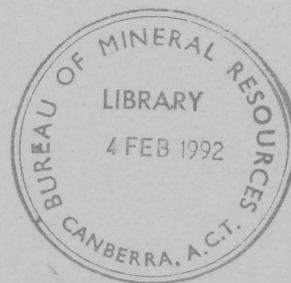


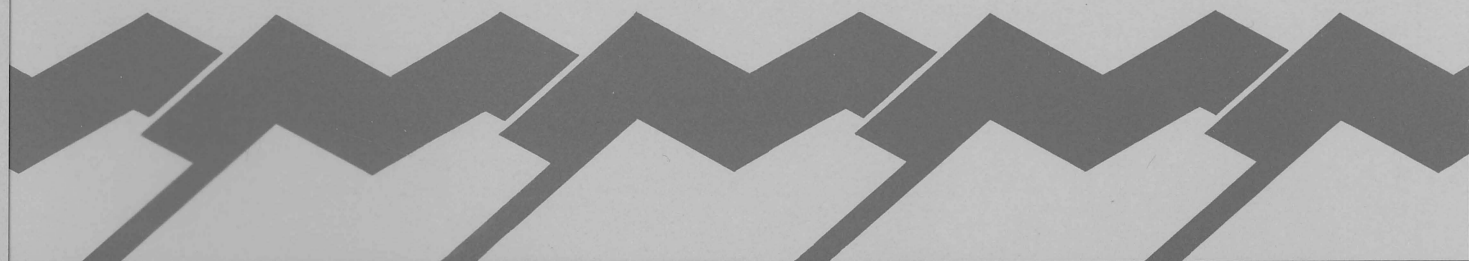
1991/109

C.4



Bureau of Mineral Resources, Geology & Geophysics

BMR PUBLICATIONS COMPACTUS
(LENDING SECTION)



R E C O R D

BMR RECORD 1991/109

**SURVEYS OF THE FAULT SCARP OF THE 1986 MARRYAT CREEK,
SOUTH AUSTRALIA, EARTHQUAKE**

by

J. ROGER BOWMAN & BRIAN C. BARLOW

1991/109

C.4

Information contained in this report has been obtained by the Bureau of Mineral Resources, Geology and Geophysics as part of the policy of the Government to assist in the exploration and development of mineral resources. It may not be published in any form or used in any way without the permission in writing of the Director.

**SURVEYS OF THE FAULT SCARP OF THE 1986
MARRYAT CREEK, SOUTH AUSTRALIA, EARTHQUAKE**

J. Roger Bowman and Brian C. Barlow

Australian Seismological Centre

Bureau of Mineral Resources

GPO Box 378

Canberra, ACT 2601

BMR Record 91/109



* R 9 1 1 0 9 0 1 *

© Commonwealth of Australia, 1991

This work is copyright. Apart from any fair dealing for the purposes of study, research, criticism or review, as permitted under the Copyright Act, no part may be reproduced by any process without written permission.

Inquiries should be directed to the Principal Information Officer, Bureau of Mineral Resources, Geology and Geophysics, GPO Box 378, Canberra, ACT, 2601.

ISSN 0811-062X
ISBN 0 642 17006 1

Abstract

A moderate-sized earthquake (M_S 5.8) earthquake on 30 March 1986 was associated with surface rupture near Marryat Creek in northernmost South Australia, 300 km southwest of Alice Springs. The fault scarp is shaped like a chevron that points toward the northeast. The north-south limb of the scarp is about 7.5 km long, and the WSW-ENE limb is 5.5 km long. Results of detailed surveying of the fault scarp give the shape and vertical displacement of the scarp at points along its full length.

Introduction

The Marryat Creek earthquake occurred on 30 March 1986 in an area of sparse background seismicity (Figure 1) and had surface-wave magnitude, M_S , of 5.8 and body-wave magnitude, m_b , of 5.7. The earthquake occurred on the eastern flank of the Precambrian Musgrave Block, which is part of the Central Cratonic province (Plumb, 1979). This area is considered to be a midplate, or stable continental, region. The 1986 earthquake ruptured the surface of the earth and produced a fault scarp in the shape of a chevron that measures 13 km along its trace (Plate A4/2555B). This earthquake joins only nine other midplate earthquakes world-wide for which there is documented surface faulting (Johnston and Bullard, 1990). Remarkably, four of these nine midplate surface ruptures have occurred in Australia in the past 25 years. The first three were in Western Australia: at Meckering in 1968 and Calingri in 1970 (Gordon and Lewis, 1980) and at Cadoux in 1979 (Lewis et al., 1981). The most recent was near Tennant Creek, NT in 1988 (Bowman, 1988). The presence of surface faulting at Marryat Creek provides a valuable opportunity to combine geological and seismological observations to investigate midplate seismogenesis. The first step in this process is to map and measure the fault scarp, and this report therefore presents the results of a detailed survey program that was carried out along the 1986 fault scarp between April and August, 1986.

The Marryat Creek Earthquake Sequence

The Marryat Creek main shock occurred at 0854 UTC on 30 March 1986 (Barlow et al., 1986). The focal depth of the main shock was estimated as 3 km from modelling of teleseismic waveforms, and the focal mechanism indicates reverse faulting with the compressional axis oriented northeast (Fredrich et al., 1988). The earthquake occurred in a sparsely populated region, and, as a consequence, only minor damage was reported to one homestead. Only 12 aftershocks are reported in the catalogue of the Australian Seismological Centre during 1986, but the nearest permanent seismograph station (ASP) is more than 300 km to the northeast, and events smaller than about magnitude 3 are not located routinely. The largest aftershock in the first three months after the main shock had a Richter magnitude, M_L , of 4.2, but a larger event of M_L 5.6 (m_b 5.5) occurred on 11 July 1986, more than three months after the main shock. The July shock was located about 10 km northwest of the March main shock and probably did not occur on or adjacent to the primary fault plane of the main shock (Bowman et al., 1992).

Surficial Geology of the Epicentral Region

In the vicinity of the Marryat Creek scarp, Precambrian rocks are overlain by Neogene clastic alluvial, colluvial and aeolian sediments and soils. The terrain in the vicinity of the fault scarps is monotonous with generally less than a meter or two of relief except near major drainages. Marryat Creek and an unnamed subsidiary drainage that is crossed by the fault scarp are incised as much as 5-10 m. Marryat Creek is usually dry, flowing only once every 5 years or so after heavy rainfall. Much of the modern landscape is mantled by a thin veneer of aeolian sand.

Survey Program and Observations

The survey program consisted of four main elements. The first element was a survey of the fault trace in April, 1986 using triangulation methods. The second aspect was a series of topographic profiles across the scarp, also carried out in April. Third, aerial photographs of the fault scarp were taken on 24 and 25 May 1986. Finally, the

fault scarps were re-examined and some levelling traverses reoccupied in August, 1986 to measure any deformation that may have been associated with the m_b 5.5 shock in July.

Plate B1/2555, at a scale of 1:10,000, shows the fault scarp, the locations of two benchmarks used as references, and the locations of temporary survey marks that were installed along the scarp at intervals of 300 to 1400 m (depending on the curvature of the scarp). The western limb of the scarp is about 5.5 km long with an average trend of 78° , and the southern limb is 7.5 km long with a trend of 5° . The straight-line distance between the western and southern ends of the scarps is 8.6 km. Coordinates of survey marks along the scarp are given in Table 1.

Plate B1/2555A1, which is also at a scale of 1:10,000, describes the terrain and vegetation along the scarp and shows the locations of detailed maps and topographical profiles. Numerous dead trees and bushes were observed near the scarp on the inside of the chevron in the month following the main shock. These were attributed to disruption of the tap roots by fault motion (McCue et al., 1987). Vertical displacements of the scarp are listed in Table 2 and shown as a function of distance along the scarp in Figure 2.

Plate B1/2555A2, at a scale of 1:1,500, shows the trace of the scarp and survey marks near the apex of the chevron. Although the two limbs of the scarp are more or less linear, this plate shows that, in detail, the scarp front undulates and is characterized by lobes of surficial faulting such as near mark 686. Vertical displacements along the scarp from the insets on Plates B1/2555A are listed in Table 3 and shown in Figure 2. The scatter in the observations of vertical displacements is due to a combination of genuine variations along strike of fault throw and dip and of errors in estimating scarp height in the predominantly sandy terrain.

Plate A3/2555C consists of 10 sheets presenting detailed maps and cross sections at scales of 1:20 to 1:250. Where possible, these cross sections were made along dry stream beds that serve as a reference surface prior to deformation from the earthquake. Collectively, these sheets demonstrate that the block on the concave side of the scarp has been uplifted relative to the ground to the north and east of the scarp. Vertical displacements of the scarp are listed in Table 4 and shown in Figure 2. The morphology

of the scarp, best illustrated by sheets 2 and 8, is characteristic of reverse faulting along a plane dipping toward the concave side of the scarp, and shallow excavations across the scarp revealed fresh shear zones dipping at angles of 45° to 60° in that direction. These observations support the interpretation that the main shock at Marryat Creek involved primarily reverse faulting (McCue et al., 1987; Fredrich et al., 1988; Machette et al., 1992). The impression in the ground of a tree trunk that lay across the scarp also indicates a 50-cm component of left-lateral slip (sheet 10). Left-lateral slip on the western limb and right-lateral slip on the southern arm are also inferred from offsets of minor stream beds and cattle tracks by McCue et al. (1987) and Machette et al. (1992). The total absence of fences, sealed roads or other linear, man-made features made the assessment of lateral motion difficult.

Figure 2 shows the vertical displacement across the scarp as a function of distance along the scarp derived from the tables on Plates B1/2555A1 and B1/2555A2. The vertical displacement reaches a maximum of 80 to 90 cm near the apex of the chevron and tapers to zero at the ends of the scarp. It is common for displacement to diminish at the ends of faults (e.g., Crone et al., 1992). There are no known levelling data from the epicentral area prior to the 1986 earthquake, so it is not possible to quantify further the deformation associated with this event.

Three separate sets of aerial photographs were taken of the fault scarp, all from a height of 1050 m above sea level (550 m above ground level) and at a scale of 1:3600. In the afternoon of 24 May 1986, black and white photographs were taken only of the apex and south limb of the scarp (SVY SA 3444). In the morning of 25 May 1986, black and white (SVY SA 3428) and colour (SVY SA 3429) photos were taken along the entire scarp. Figure 3 is a sample photograph from the afternoon run on 24 May (SVY SA 3444, 007). The scarp is a generally linear, dark grey to black feature just west of the prominent north-south wheel tracks. Survey mark 111 is inside the circular set of wheel tracks approximately midway along the scarp. The dry creek beds that cross the scarp about one third and two thirds of the way from the top of the photo are the sites of level traverses shown in sheets 5 and 4 of Plate A3/2555C. The southern limb of the scarp is

more prominent in the aerial photos than the western limb because the angle of the sun casts a shadow over the uplifted block. Locally, the scarp is sinuous, anastomosing and discontinuous where displacement shifts from one strand to its neighbour.

The results of the August, 1986 survey are best summarised by an excerpt of a letter from the Australian Survey Office (F.W. Timms, written communication, 1986):

On Monday 18th August I remeasured the distances and differences in level between the monitor-marks placed in April 1986 and carried out a visual inspections of the N-S and part of the E-W scarp of the 1986 earthquake. No differences in measurement compared to the original distances were read and there were no visible changes in the scarp after the latest 'quake in July.

["Rabbitter Jack" was a commercial hunter who was at a bush camp about 5 km from the scarp at the time of the 30 March 1986 earthquake. He regularly drove throughout the area surrounding the scarp and was the first to discover the scarp where it crossed a flat dirt road near the apex.] "Rabbitter Jack" said he had seen some new small cracks at the western end of the scarp after the 11th July 'quake.... Before meeting "Rabbitter Jack" and as I left the scarp site to find him... I carried out a careful visual inspection of the western end of the scarp... but did not see the new cracks later described by him.

Thus, surface deformation from the July event must have been negligible at the site of the 30 March scarp. It is worthy of note, however, that the July shock lay 10 km north-northwest of the March main shock (Bowman et al., 1992). The location of the main shock itself is not accurately known, but if the main shock occurred in the centre of a fault plane that dips to the southwest and whose surface trace is given by the scarp, then the July event probably occurred too far from the March scarp to expect displacement on that scarp. Even if the main shock epicentre was at the southern extreme of the southern scarp limb, the best July epicentre lies north of the March fault scarp. In either case, the most likely site of minor secondary deformation, such as cracking, would have been on the western end of the western limb.

Acknowledgements

We thank the then Australian Survey Office (now the Australian Surveying and Land Information Group) for conducting the surveying program that is reported here. In particular we thank Senior Surveyor Frank Timms and his assistant Eric "Echo" Grafling for their dedicated efforts which allowed the scarp to be tracked over a much longer distance than was first realised.

References

- Barlow, B.C., Denham, D., Jones, T., McCue, K., Gibson, G., and Greenhalgh, S., 1986. The Musgrave Ranges earthquake of March 30, 1986, *Trans. Roy. Soc. S. Aust.*, **109**, 187-189.
- Bowman, J.R., 1988. Constraints on locations of large intraplate earthquakes in the Northern Territory, Australia from observations at the Warramunga Seismic Array, *Geophys. Res. Let.*, **15**, 1475-1478.
- Bowman, J.R., Crone, A.J., and Machette, M.N., 1992. The recurrence of midplate earthquakes near Tennant Creek and Marryat Creek, Central Australia, Electrical Power Research Institute Report, Palo Alto, CA, in press.
- Crone, A.J., Machette, M.N., and Bowman, J.R., 1992. Geological investigations of the 1988 Tennant Creek, Australia, earthquakes: Implications for paleoseismicity in stable continental regions, *U.S. Geological Survey Bull.*, in press.
- Fredrich, J., McCaffrey, R., and Denham, D., 1988. Source parameters of seven large Australian earthquakes determined by body waveform inversion, *Geophys. J.*, **95**, 1-13.
- Gordon, F.R., and Lewis, J.D., 1980. The Meckering and Calingiri earthquakes October 1968 and March 1970, *Geological Survey of Western Australia Bulletin 126*, 229 p.
- Johnston, A.C., and Bullard, T., 1990. The Ungava, Quebec, earthquake—Eastern North America's first modern surface rupture [abs.], *Seism. Res. Let.*, **61**, 152-153.
- Lewis, J.D., Daetwyler, N.A., Bunting, J.A., and Moncrieff, J.S., 1981. The Cadoux earthquake, 2 June 1979, *Geological Survey of Western Australia Report 11*, 133 p.
- Machette, M.N., Crone, A.J., and Bowman, J.R., 1992. Geological investigations of the 1986 Marryat Creek, Australia, earthquake, *U.S. Geological Survey Bull.*, in preparation.
- McCue, K., Barlow, B.C., Denham, D., Jones, T., Gibson, G., and Michael-Leiba, M., 1987. Another chip off the old Australian block, *EOS*, **68**, 609-612.
- Plumb, K.A., 1979. The tectonic evolution of Australia, *Earth-Sci. Rev.*, **14**, 205-249.

Plate Captions

Plate A4/2555B. Trace of fault scarp near Marryat Creek superimposed on a photomosaic of the area. Large black rectangle shows area of Plates B1/2555 and B1/2555A1.

Plate A4/2555B has been omitted from the hardcopy of Record 1991/109.

Plate B1/2555. Marryat Creek earthquake escarpment survey: Field survey and locality.

Survey marks are shown by numbers inside small boxes.

Plate B1/2555A1. Marryat Creek earthquake escarpment survey: Escarpment details.

Locations of Plates B1/2555A2 and A3/2555C are shown as dashed boxes.

Plate B1/2555A2. Marryat Creek earthquake escarpment survey: Escarpment details near apex of scarp.

Plate A3/2555C. Marryat Creek earthquake escarpment survey: Large scale maps and cross sections.

Figure Captions

Figure 1. Map of earthquakes of magnitude 5 and greater for the period 1897 to 1990 from the catalogue of the Australian Seismological Centre. Marryat Creek is shown as a star, earthquakes of magnitude below 5 as small diamonds, and earthquakes of 5.5 and greater as large diamonds.

Figure 2. Vertical displacement of the scarp as a function of distance along the scarp measured from survey mark 125 at the west end of the scarp. Squares are from the general survey of the scarp (Table 2), diamonds are from the large scale survey near the apex of the scarp (Table 3) and circles are from detailed topographic profiles shown in Plate 2555C.

Figure 3. Aerial photograph (007, SVY SA 3444) of the fault scarp near survey mark 111. The scarp is immediately to the west of the north-south trending wheel tracks.

Table 1. Coordinates of survey marks along the Marryat Creek scarp (from Plate 2555).

Station	Easting	Northing	Longitude °E	Latitude °S	Elevation (m AS)	Marker type*
101	284258.60	7092368.56	132.8398	-26.2712	513.134	GIP
102	284583.05	7092945.63	132.8431	-26.2660	513.417	SP
103	284644.58	7093462.25	132.8437	-26.2614	513.769	SP
104	284488.06	7094042.93	132.8421	-26.2562	512.588	SP
105	284481.44	7094345.75	132.8420	-26.2534	512.021	SP
106	284682.00	7094767.89	132.8440	-26.2497	511.043	SP
107	284872.88	7095264.95	132.8459	-26.2452	513.596	SP
108	284847.92	7096519.78	132.8457	-26.2340	520.404	SP
109	284859.65	7097530.92	132.8458	-26.2249	510.182	SP
110	284865.45	7098128.56	132.8459	-26.2195	509.315	SP
111	284966.19	7098538.78	132.8469	-26.2159	506.247	SP
112	284977.56	7099070.12	132.8470	-26.2111	509.070	SP
113	284953.48	7099302.48	132.8467	-26.2090	506.415	SP
114	284900.79	7099655.10	132.8462	-26.2059	508.237	SP
115	284850.73	7099829.71	132.8457	-26.2043		SP
116	284638.96	7099927.00	132.8436	-26.2034	503.104	SP
117	284256.57	7100123.44	132.8398	-26.2017	505.885	SP
118	283592.76	7100438.72	132.8332	-26.1988	508.224	SP
119	282955.56	7100255.24	132.8268	-26.2005	509.743	SP
120	282549.65	7100168.43	132.8228	-26.2013	511.325	SP
121	282193.49	7099953.25	132.8192	-26.2032	515.934	SP
122	281569.64	7099929.16	132.8130	-26.2034	522.950	SP
123	281151.98	7099885.20	132.8089	-26.2038	526.620	SP
124	279826.97	7099621.34	132.7956	-26.2062	535.664	SP
126	280181.97	7099606.54	132.7992	-26.2063	528.434	GIP
201	284927.87	7095530.25	132.8465	-26.2428	512.396	GIP
202	284800.46	7097300.43	132.8452	-26.2270	511.569	GIP
204	285011.59	7098770.02	132.8473	-26.2138	505.644	GIP
205	284567.88	7100003.21	132.8429	-26.2027		WT
206	284522.64	7100041.94	132.8425	-26.2024	505.557	GIP
207	284103.40	7100229.85	132.8383	-26.2007		PAD
208	283774.82	7100339.49	132.8350	-26.1997		MF
210	283543.19	7100383.45	132.8327	-26.1993	508.082	GIP
220	284907.23	7099612.00	132.8463	-26.2063		GIP
301	284178.47	7092416.56	132.8390	-26.2707	513.136	SP
302	284597.96	7092319.41	132.8432	-26.2716	511.483	SP
303	274709.66	7099698.17	132.7446	-26.2055	508.451	SP
304	285005.54	7099951.48	132.8473	-26.2032	503.492	SP
305	283534.45	7100239.67	132.8326	-26.2006	508.303	SP
306	283605.49	7100647.45	132.8333	-26.1970	510.488	SP
307	279576.43	7099192.11	132.7931	-26.2100	528.196	SP
308	279318.52	7099533.33	132.7906	-26.2070	530.756	SP

* SP=star picket; GIP=galvanized iron pipe; WT=wheel track; MF=mound feature.

Table 2. Vertical displacement of scarp as function of distance from the western end of the scarp (from Plate 2555A/1).

Station	Easting	Northing	Longitude °E	Latitude °S	Distance (km)	Height (m)
100	284392.10	7092368.00	132.8412	-26.2712		
400	284432.90	7092606.60	132.8416	-26.2690	12.98	0.01
401	284585.40	7092956.60	132.8431	-26.2659	12.63	0.03
402	284614.50	7093297.50	132.8434	-26.2628	12.27	0.04
403	284649.00	7093461.80	132.8437	-26.2614	12.08	0.15
404	284678.80	7093522.00	132.8440	-26.2608	12.02	0.2
405	284576.40	7093745.10	132.8430	-26.2588	11.82	0.05
406	284492.00	7093899.90	132.8421	-26.2574		
407	284501.20	7094058.40	132.8422	-26.2560	11.53	0.04
408	284465.10	7094182.30	132.8419	-26.2549	11.42	0.03
409	284510.70	7094319.30	132.8423	-26.2537		
410	284695.00	7094783.10	132.8442	-26.2495	10.78	0.03
411	284782.00	7095026.30	132.8450	-26.2473	10.52	0.12
412	284852.90	7095272.30	132.8457	-26.2451	10.26	0.2
413	284905.50	7096108.90	132.8463	-26.2376	9.43	0.35
414	284898.20	7096333.80	132.8462	-26.2356	9.20	0.2
415	284878.50	7096522.80	132.8460	-26.2339	9.00	0.2
416	284838.40	7096952.30	132.8456	-26.2301	8.58	0.2
417	284815.80	7097519.00	132.8454	-26.2250	8.02	0.25
418	284808.50	7097850.70	132.8453	-26.2220	7.68	0.25
419	284856.60	7098115.30	132.8458	-26.2197	7.42	0.45
420	284892.20	7098375.60	132.8461	-26.2173	7.16	0.5
421	284967.40	7098538.40	132.8469	-26.2159	7.00	0.2
422	285011.60	7098934.40	132.8473	-26.2123	6.62	0.4
423	284996.70	7099065.40	132.8472	-26.2112	6.48	0.45
424	284959.30	7099301.70	132.8468	-26.2090	6.25	0.35
425	284903.30	7099523.70	132.8462	-26.2070	6.02	0.35
426	284910.30	7099655.40	132.8463	-26.2059	5.89	0.3
427	284882.40	7099810.00	132.8460	-26.2045	5.70	0.4
428	284854.40	7099839.90	132.8458	-26.2042	5.65	0.7
429	284802.50	7099858.20	132.8452	-26.2040	5.56	0.5
450	284770.70	7099865.20	132.8449	-26.2040	5.55	0.4
430	284728.10	7099890.20	132.8445	-26.2038	5.48	0.5
431	284659.50	7099960.60	132.8438	-26.2031	5.38	0.5
432	284615.70	7099986.10	132.8434	-26.2029	5.35	0.7
433	283225.80	7100339.40	132.8295	-26.1997	3.95	0.2
434	282956.30	7100249.90	132.8268	-26.2005	3.66	0.2
435	282704.80	7100159.50	132.8243	-26.2013		
436	282619.90	7100121.80	132.8235	-26.2017		
437	282568.30	7100096.20	132.8230	-26.2019	3.26	0.3
438	282371.60	7099994.40	132.8210	-26.2028	0.00	
439	282169.90	7100001.70	132.8190	-26.2028	2.84	0.15
440	281894.20	7099998.40	132.8163	-26.2028	2.57	0.25
441	281660.30	7099985.30	132.8139	-26.2029	2.34	0.2
442	281556.50	7099969.10	132.8129	-26.2031	2.23	0.2
443	281370.10	7099932.90	132.8110	-26.2034	2.03	0.2
444	281357.60	7099927.60	132.8109	-26.2034	2.01	0.1
351	281125.40	7099890.20	132.8086	-26.2038	1.80	0.2
445	280855.30	7099891.70	132.8059	-26.2037		
446	280548.20	7099846.90	132.8028	-26.2041	1.20	0.3

447	280195.50	7099707.60	132.7993	-26.2054	0.84	0.15
448	280034.10	7099634.50	132.7977	-26.2061	0.65	0.1
449	279832.10	7099554.60	132.7957	-26.2068	0.44	0.1
125	279436.70	7099351.10	132.7918	-26.2086		

Table 3. Vertical displacement of scarp as function of distance from the western end of the scarp (from Plate 2555A/2).

Station	Easting	Northing	Longitude °E	Latitude °S	Distance (km)	Height (m)
664	284589.70	7099997.00	132.8431	-26.2028	5.40	0.6
665	284530.30	7100020.10	132.8425	-26.2026	5.33	0.2
666	284512.90	7100021.90	132.8424	-26.2026	5.32	0.5
667	284450.60	7100054.90	132.8417	-26.2023	5.25	0.7
668	284435.90	7100059.40	132.8416	-26.2022	5.23	0.9
669	284409.60	7100075.00	132.8413	-26.2021	5.20	0.8
670	284405.20	7100080.30	132.8413	-26.2021	5.20	0.5
671	284372.30	7100099.70	132.8410	-26.2019	5.16	0.5
672	284349.90	7100105.80	132.8407	-26.2018	5.14	0.3
673	284239.60	7100115.40	132.8396	-26.2017	5.04	0.3
674	284233.80	7100121.40	132.8396	-26.2017	5.03	0.3
675	284214.50	7100127.30	132.8394	-26.2016	5.01	0.5
676	284209.70	7100136.90	132.8393	-26.2016	5.00	0.2
677	284184.10	7100157.80	132.8391	-26.2014	4.97	0.4
678	284125.30	7100191.00	132.8385	-26.2011	4.90	0.35
679	284107.80	7100224.90	132.8383	-26.2008	4.87	0.35
680	284068.90	7100265.70	132.8379	-26.2004	4.82	0.3
681	284040.30	7100281.10	132.8376	-26.2003	4.79	0.35
682	284022.30	7100308.90	132.8375	-26.2000	4.76	0.4
683	284009.80	7100316.40	132.8373	-26.1999	4.75	
684	283922.00	7100337.00	132.8365	-26.1998	4.66	0.3
685	283861.60	7100330.80	132.8359	-26.1998	4.60	0.3
686	283839.70	7100347.00	132.8356	-26.1997	4.58	0.04
687	283836.00	7100329.40	132.8356	-26.1998	4.58	0
688	283822.90	7100323.20	132.8355	-26.1999	4.57	0.3
689	283744.10	7100356.10	132.8347	-26.1996	4.48	0.15
690	283673.70	7100365.10	132.8340	-26.1995	4.41	0.4
691	283647.10	7100373.90	132.8337	-26.1994	4.39	0.4
692	283625.70	7100376.90	132.8335	-26.1994	4.36	0.35
693	283392.10	7100388.00	132.8312	-26.1993	4.13	0.15

**Table 4. Vertical displacement
of scarp from detailed profiles
(Plate 2555C)**

Sheet	Distance (km)	Height (m)
1	10.00	0.48
2	8.25	0.26
3	7.95	0.31
4	7.00	0.30
5	6.76	0.48
6	5.89	0.31
7	5.51	0.62
9c	5.30	0.36
9d	5.32	0.42
10	4.28	0.20

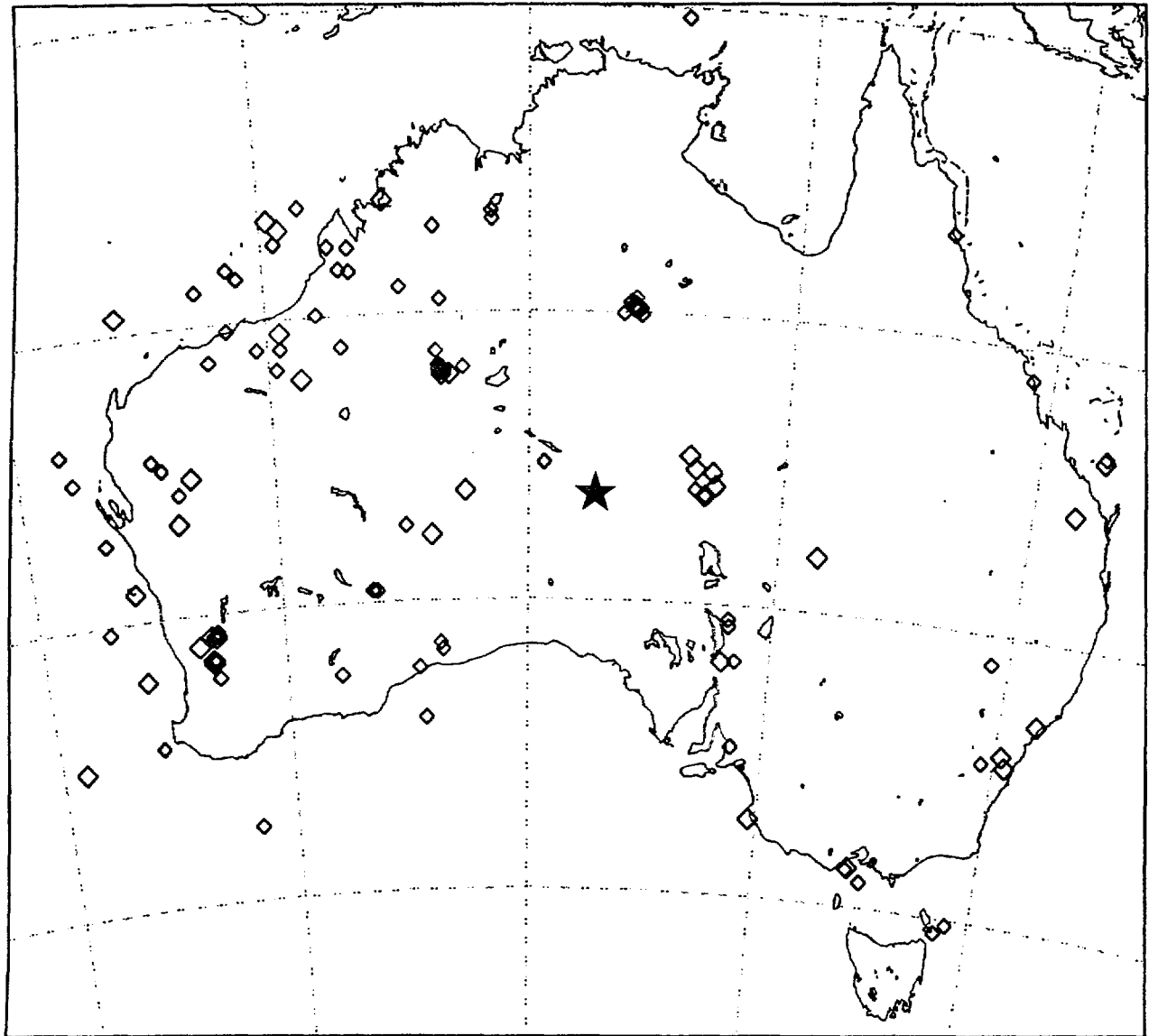


Figure 1

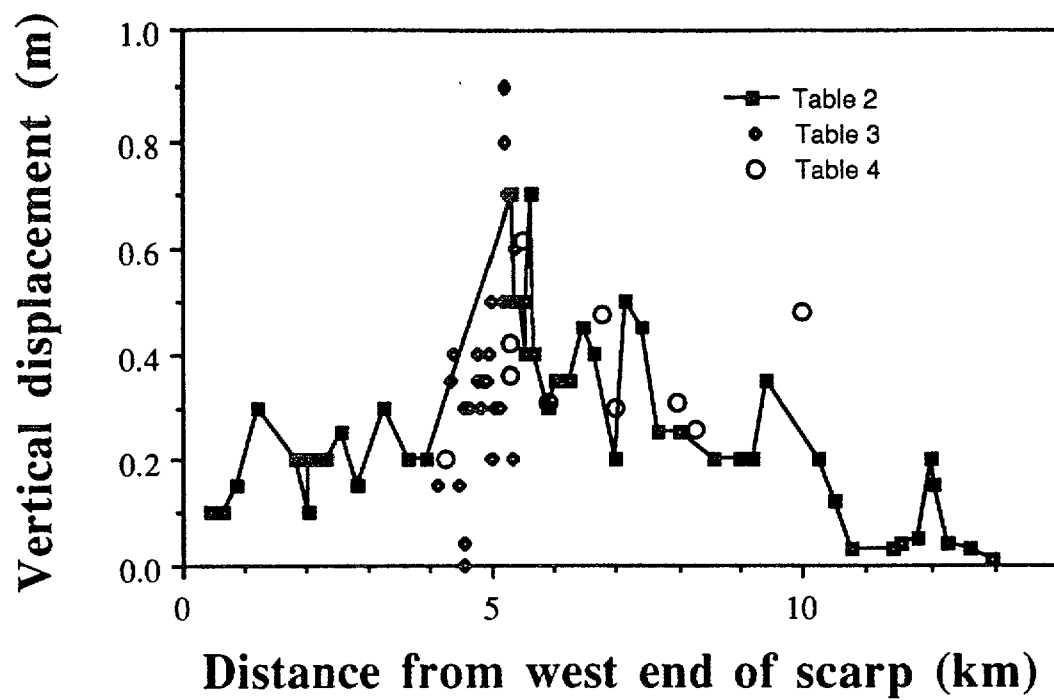
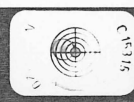


Figure 2

GN

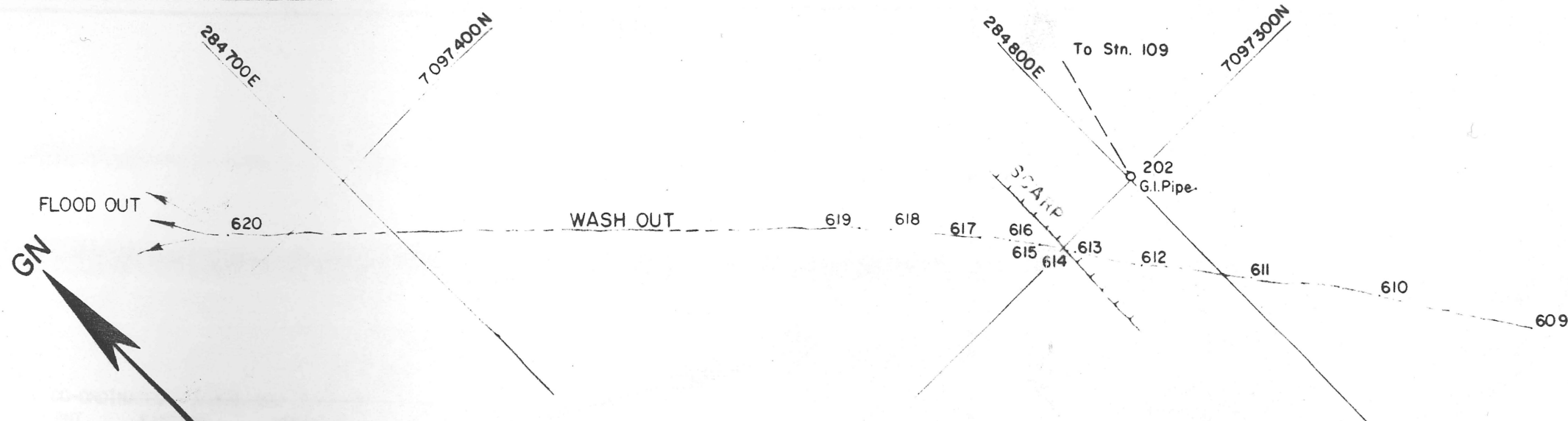


3444

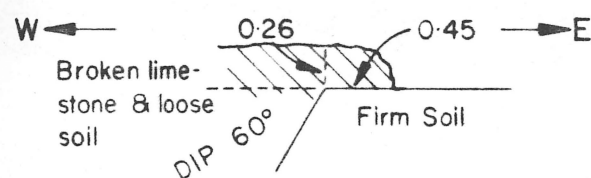
0-0 7

WIDE FIELD OF VIEW

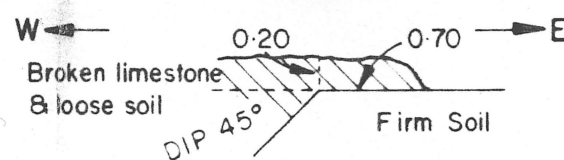
WIDE FIELD OF VIEW



CROSS SECTION OF SCARP
NEAR STN. 202



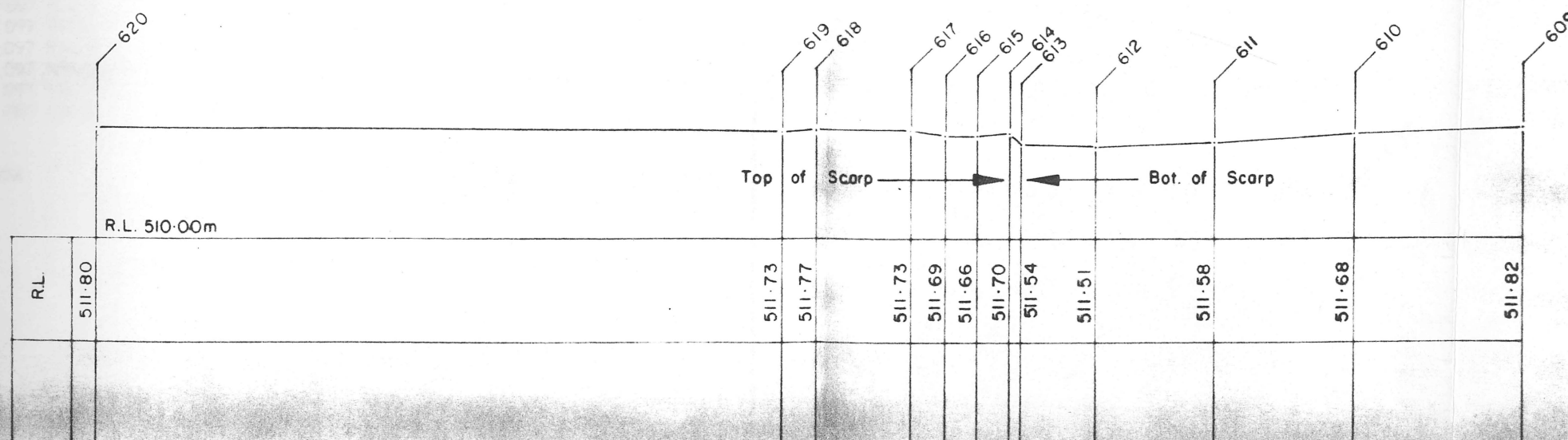
CROSS SECTION OF SCARP
NEAR STN. 108



CO-ORDINATES - A.M.G. (66) Zone 53

PNT.	EASTING	NORTHING
202	284 800.5	7 097 300.5
609	284 832.4	7 097 230.1
610	284 817.1	7 097 253.6
611	284 803.2	7 097 272.3
612	284 790.6	7 097 287.8
613	284 783.9	7 097 297.7
614	284 783.0	7 097 298.9
615	284 780.1	7 097 303.4
616	284 776.9	7 097 307.6
617	284 773.2	7 097 311.8
618	284 763.1	7 097 323.9
619	284 759.3	7 097 328.3
620	284 678.7	7 097 407.6

ASSOCIATED PLANS -
Escarpment Plan - B1/2555A
Survey Plan - B1/2555



HORIZONTAL SCALE 1:1000
0 10 20 30 40 50 Metres

VERTICAL SCALE 1:100

MARRYAT CREEK EARTHQUAKE ESCARPMENT SURVEY

DEPARTMENT OF RESOURCES AND ENERGY - B.M.R.

AUSTRALIAN SURVEY OFFICE
DEPARTMENT OF LOCAL GOVERNMENT AND
ADMINISTRATIVE SERVICES-SOUTH AUSTRALIA

SCALE AS ABOVE METRES

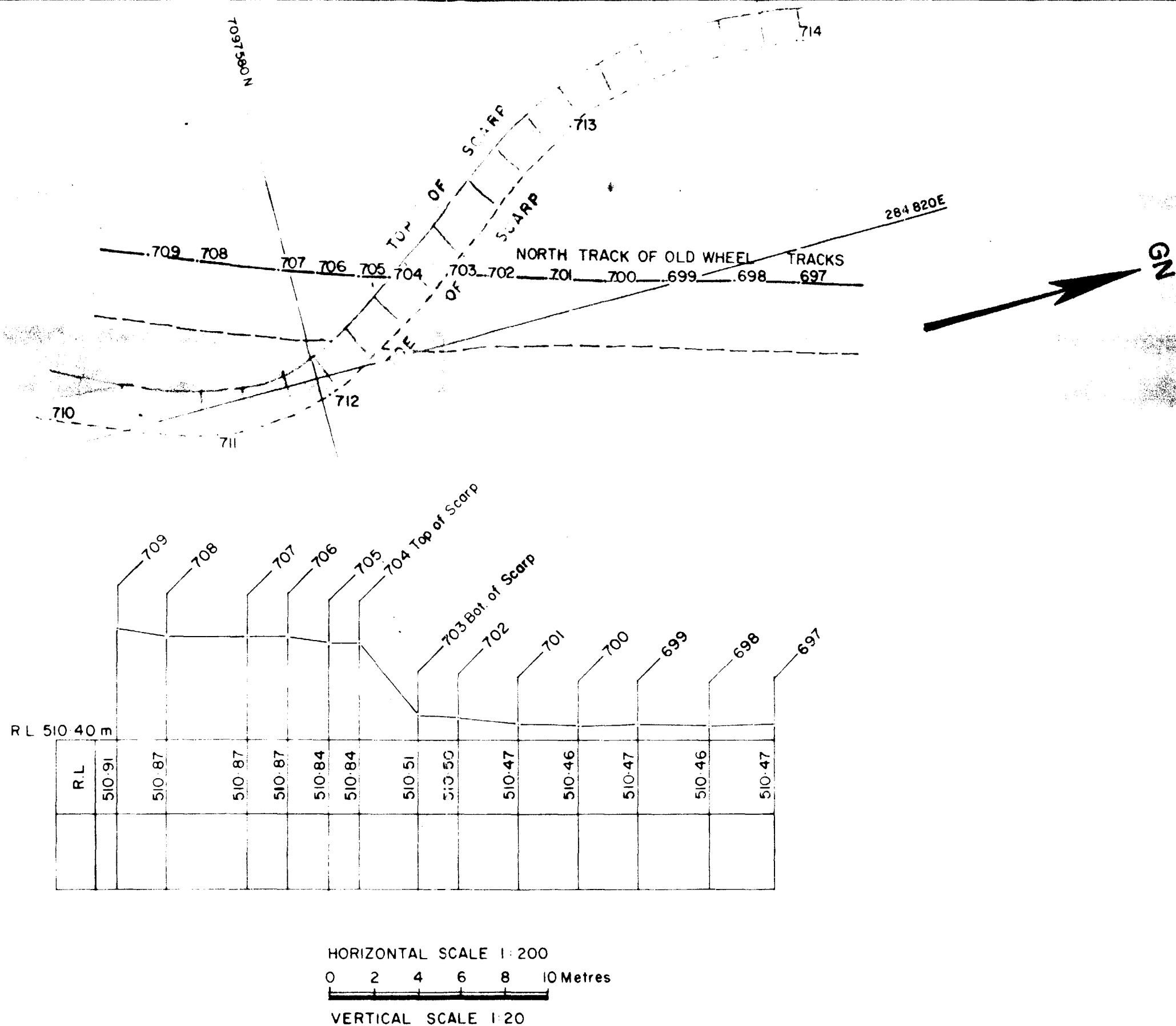
A3/2555C SHEET
2 OF 10

J2138		F.W.T.	APR '86	F1453/14-		C75/66-	M.J.J.	F.W.T.	R.L.L.	I
JOB No.	SEARCH	SURVEY	DATE	FIELD BK.	LEVEL BK.	CALC BK.	DRAWN	CHKD.	PASSED	ISSUE

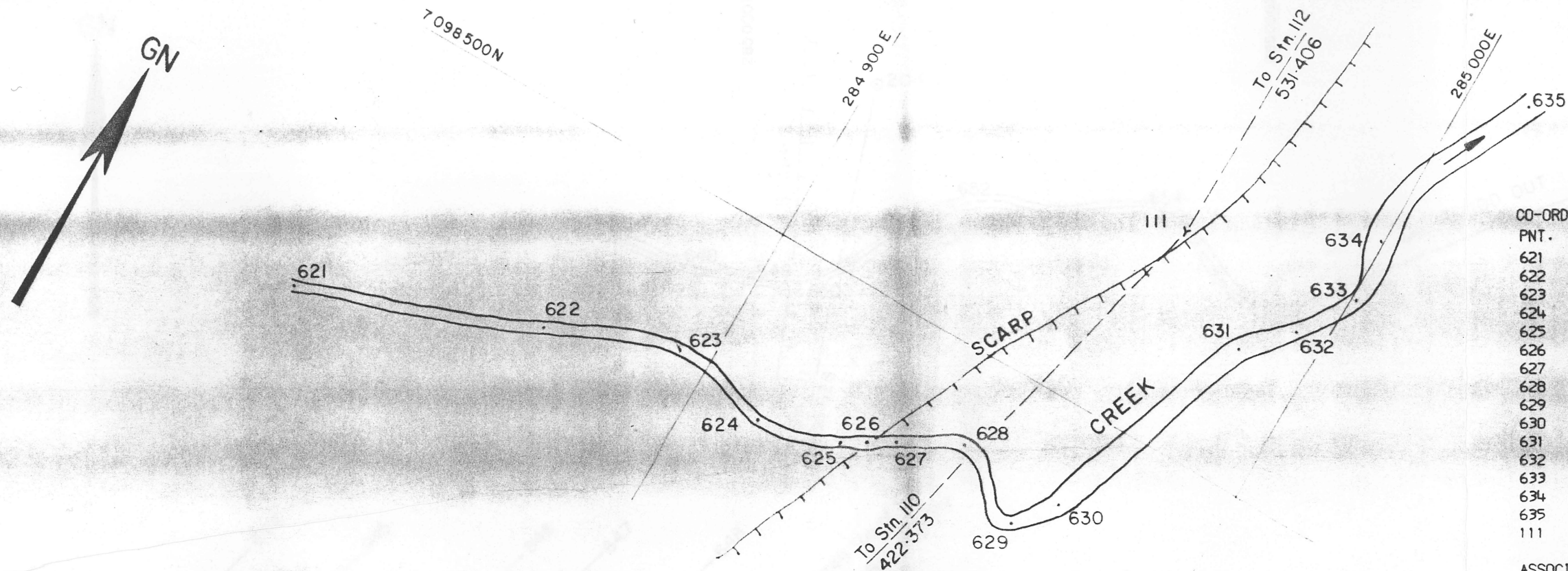
CO-ORDINATES - A.M.G. (66) Zone 59

PNT.	EASTING	NORTHING
697	284 821.6	7 097 602.5
698	284 820.7	7 097 599.6
699	284 819.8	7 097 596.5
700	284 819.2	7 097 594.0
701	284 818.4	7 097 591.4
702	284 817.5	7 097 588.7
703	284 816.9	7 097 587.0
704	284 816.4	7 097 584.4
705	284 816.0	7 097 583.0
706	284 815.4	7 097 581.3
707	284 814.8	7 097 579.5
708	284 813.4	7 097 576.0
709	284 812.5	7 097 573.9
710	284 818.7	7 097 567.6
711	284 821.4	7 097 574.9
712	284 820.9	7 097 580.4
713	284 811.9	7 097 594.3
714	284 810.8	7 097 605.3

ASSOCIATED PLANS -
Escarpment Plan - B1/2555A
Survey Plan - B1/2555



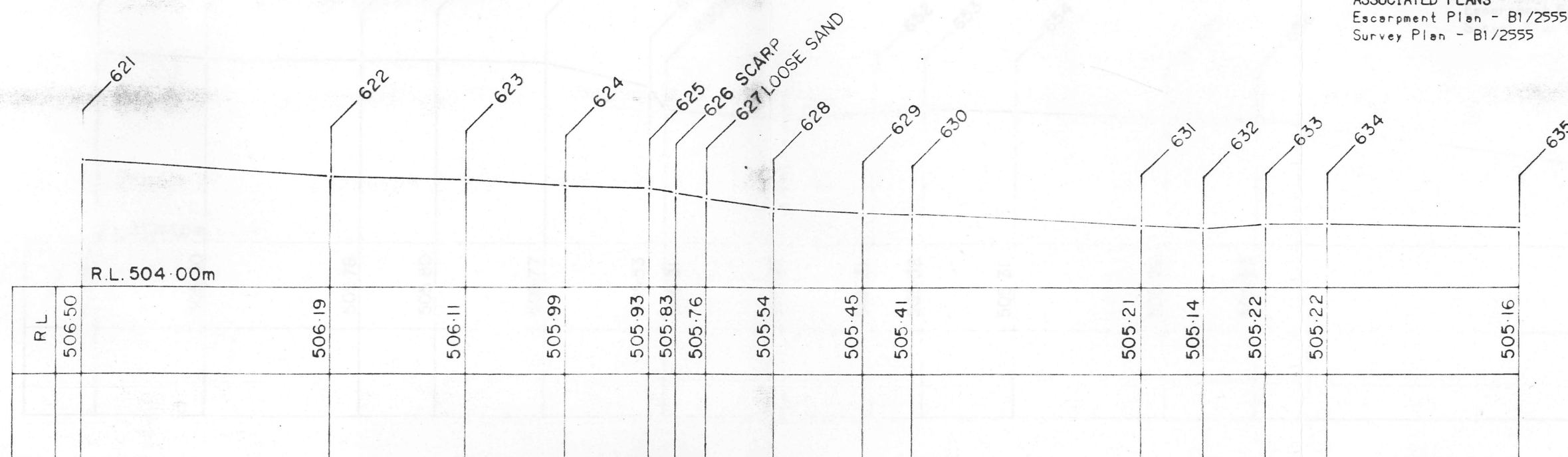
										MARRYAT CREEK EARTHQUAKE ESCARPMENT SURVEY		AUSTRALIAN SURVEY OFFICE DEPARTMENT OF LOCAL GOVERNMENT AND ADMINISTRATIVE SERVICES-SOUTH AUSTRALIA		
												SCALE AS ABOVE METRES		
J2138		FWT	APR '86	FI453/14-		C75/66-	M.J.J.	FWT	R.L.L.	I	DEPARTMENT OF RESOURCES AND ENERGY - B.M.R.		A3/2555C	SHEET 3 OF 10
JOB No.	SEARCH	SURVEY	DATE	FIELD BK.	LEVEL BK.	CALC BK.	DRAWN	CHKD.	PASSED	ISSUE				



CO-ORDINATES - A.M.G. (66) Zone 53

PNT.	EASTING	NORTHING
621	284 823.2	7 098 444.4
622	284 869.1	7 098 461.7
623	284 893.7	7 098 471.1
624	284 913.2	7 098 466.9
625	284 929.4	7 098 470.9
626	284 933.5	7 098 473.6
627	284 938.2	7 098 476.6
628	284 950.2	7 098 482.7
629	284 965.3	7 098 474.1
630	284 971.2	7 098 481.5
631	284 986.1	7 098 524.5
632	284 994.4	7 098 533.0
633	285 000.7	7 098 543.6
634	284 999.2	7 098 555.7
635	285 011.3	7 098 592.0
111	284 966.2	7 098 538.8

ASSOCIATED PLANS -
 Escarpment Plan - B1/2555A
 Survey Plan - B1/2555



HORIZONTAL SCALE 1:1000
 0 10 20 30 40 50 Metres

VERTICAL SCALE 1:100

MARRYAT CREEK EARTHQUAKE ESCARPMENT SURVEY

DEPARTMENT OF RESOURCES AND ENERGY - B.M.R.

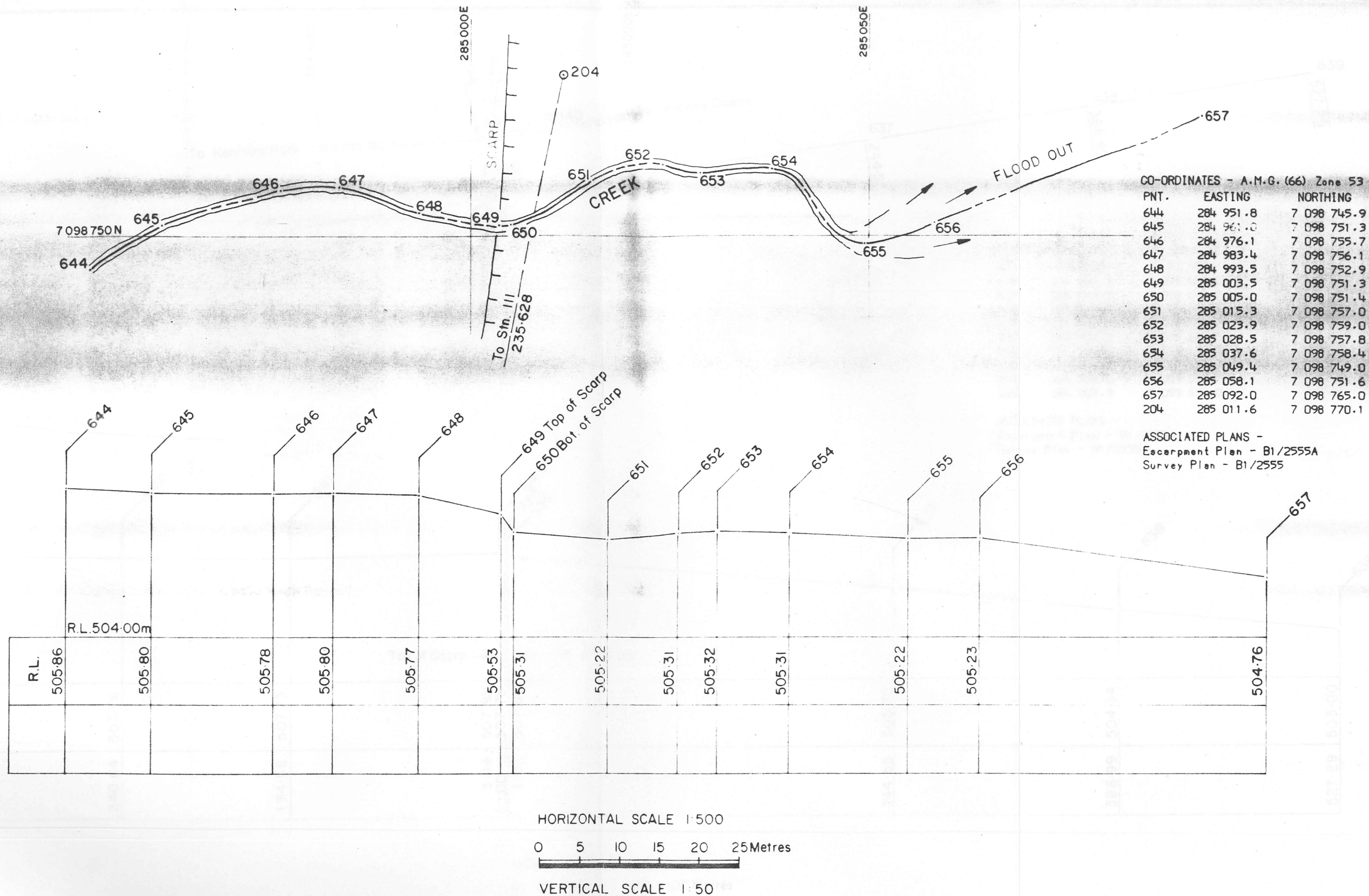
AUSTRALIAN SURVEY OFFICE
 DEPARTMENT OF LOCAL GOVERNMENT AND
 ADMINISTRATIVE SERVICES-SOUTH AUSTRALIA

SCALE AS ABOVE METRES

A3/2555C SHEET
 4 OF 10

J2138		FWT.	APR '86	FI453/14-		C75/66-	M.J.J.	FWT.	R.L.L.	I
JOB No.	SEARCH	SURVEY	DATE	FIELD BK.	LEVEL BK.	CALC BK.	DRAWN	CHKD.	PASSED	ISSUE

GN



J2138		F.W.T.	APR'86	FI453/14-		C75/66-	M.J.J.	F.W.T.	R.L.L.	I
JOB No.	SEARCH	SURVEY	DATE	FIELD BK.	LEVEL BK.	CALC BK.	DRAWN	CHKD.	PASSED	ISSUE

MARRYAT CREEK EARTHQUAKE ESCARPMENT SURVEY

DEPARTMENT OF RESOURCES AND ENERGY - B.M.R.

AUSTRALIAN SURVEY OFFICE
DEPARTMENT OF LOCAL GOVERNMENT AND
ADMINISTRATIVE SERVICES-SOUTH AUSTRALIA

SCALE AS ABOVE

METRES

A3/2555C

SHEET
5 OF 10

GN

284600E

284800E

285000E

7099600 N

To Kenmore Park

ROAD To Victory Downs

643

388.66

642

240.64

641

134.56

640

220

636

637

244.55

638

386.99

639

527.29

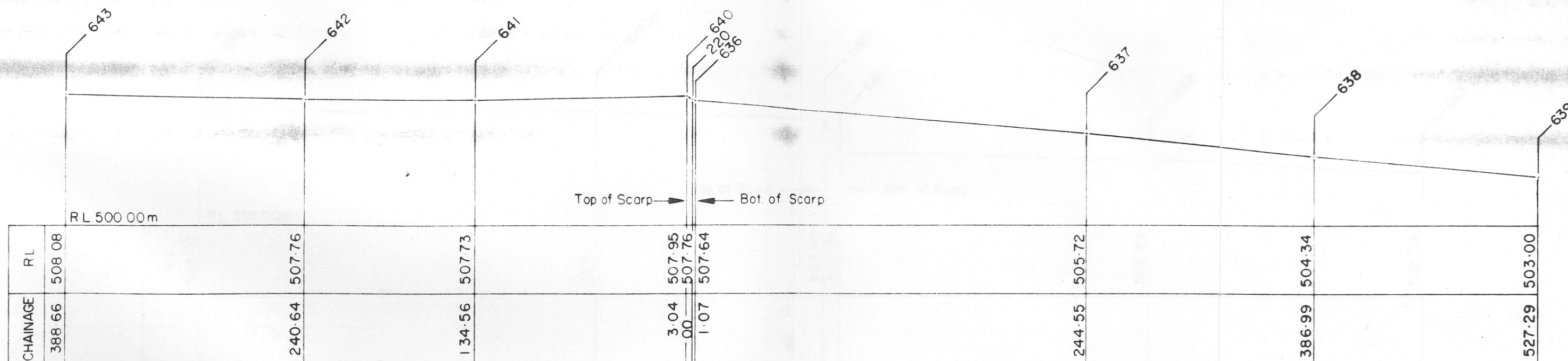
CO-ORDINATES - A.M.G. (66) Zone 53

PNT.	EASTING	NORTHING
636	284 908.3	7 099 612.2
637	285 149.3	7 099 647.3
638	285 290.3	7 099 667.9
639	285 429.1	7 099 688.2
640	284 904.3	7 099 611.6
641	284 774.1	7 099 592.6
642	284 669.1	7 099 577.3
643	284 522.6	7 099 555.9
220	284 907.3	7 099 612.0

ASSOCIATED PLANS -

Escarpment Plan - B1/2555A

Survey Plan - B1/2555



HORIZONTAL SCALE 1:2500

0 20 40 60 80 100 Metres

VERTICAL SCALE 1:250

MARRYAT CREEK

EARTHQUAKE ESCARPMENT SURVEY

DEPARTMENT OF RESOURCES AND ENERGY - B.M.R.

AUSTRALIAN SURVEY OFFICE

DEPARTMENT OF LOCAL GOVERNMENT AND
ADMINISTRATIVE SERVICES-SOUTH AUSTRALIA

SCALE AS ABOVE

METRES

A3/2555C

SHEET
6 OF 10

J 2138		F.W.T.	APR. '86	FI453/14-		C75/66-	M.J.J.	F.W.T.	R.L.L.	I
JOB No.	SEARCH	SURVEY	DATE	FIELD BK.	LEVEL BK.	CALC BK.	DRAWN	CHKD.	PASSED	ISSUE

GN

658.

284 600 E

To Stn. 117

116/659

SCARP

284 700 E

661

660

CREEK (Sandy Bed - Main channel approx. 10m wide)

662

7 099 900 N

663

To

Stn. 115

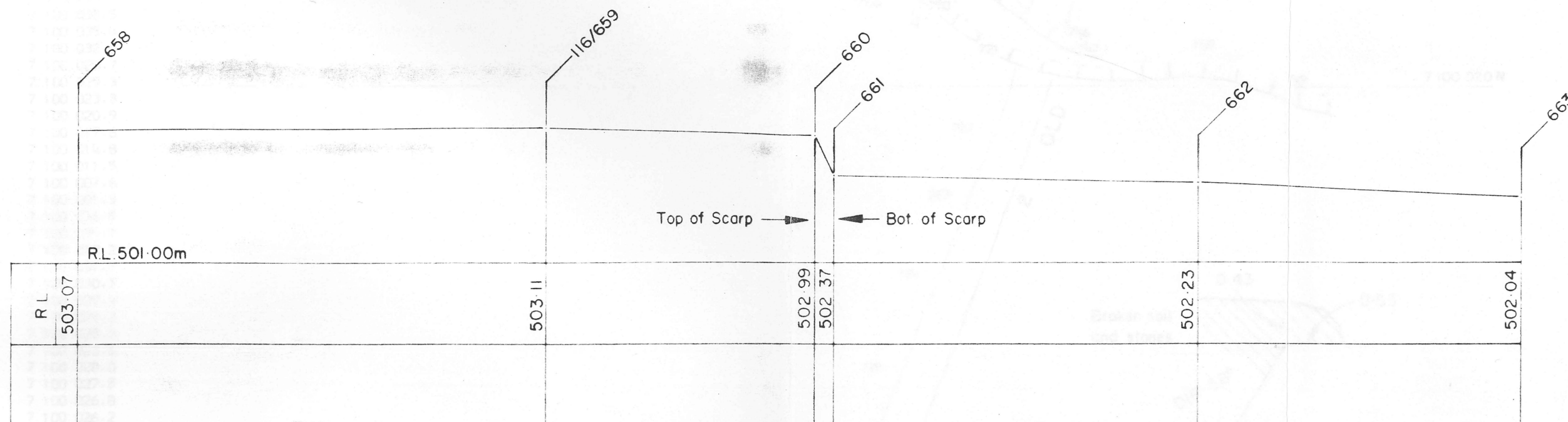
CO-ORDINATES - A.M.G. (66) Zone 53

PNT.	EASTING	NORTHING
658	284 568.4	7 099 905.2
659	284 639.0	7 099 927.1
660	284 681.1	7 099 922.0
661	284 683.8	7 099 921.6
662	284 739.3	7 099 907.2
663	284 787.5	7 099 890.0
116	284 639.0	7 099 927.1

ASSOCIATED PLANS -

Escarpment Plan - B1/2555A

Survey Plan - B1/2555



HORIZONTAL SCALE 1:750

0 10 20 30 40 Metres

VERTICAL SCALE 1:75

MARRYAT CREEK EARTHQUAKE ESCARPMENT SURVEY

DEPARTMENT OF RESOURCES AND ENERGY - B.M.R.

AUSTRALIAN SURVEY OFFICE

DEPARTMENT OF LOCAL GOVERNMENT AND
ADMINISTRATIVE SERVICES-SOUTH AUSTRALIA

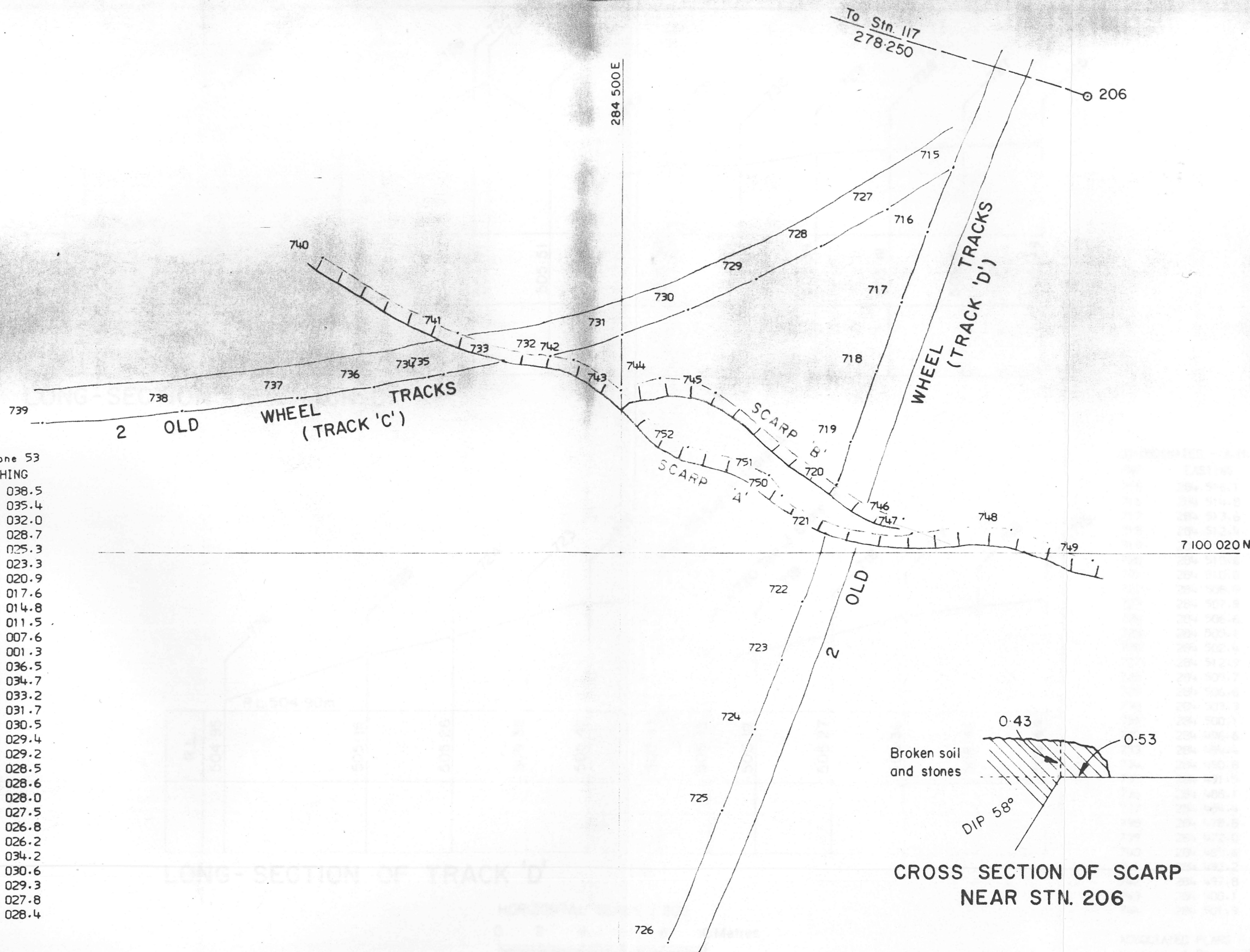
SCALE AS SHOWN

METRES

A3/2555C

SHEET
7 OF 10

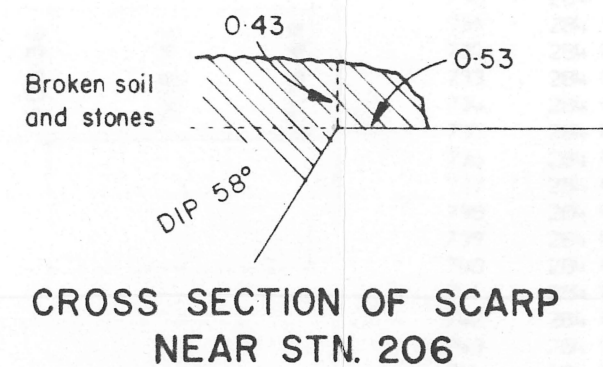
J2138		FWT.	APR '86	F1453/14-		75/66-	M.J.J.	FWT	R.L.L	I
JOB No.	SEARCH	SURVEY	DATE	FIELD BK.	LEVEL BK.	CALC BK.	DRAWN	CHKD.	PASSED	ISSUE



CO-ORDINATES - A.M.G. (66) Zone 53

PNT.	EASTING	NORTHING
715	284 516.1	7 100 038.5
716	284 514.8	7 100 035.4
717	284 513.6	7 100 032.0
718	284 512.4	7 100 028.7
719	284 511.2	7 100 025.3
720	284 510.6	7 100 023.3
721	284 510.0	7 100 020.9
722	284 508.9	7 100 017.6
723	284 507.9	7 100 014.8
724	284 506.6	7 100 011.5
725	284 505.1	7 100 007.6
726	284 502.4	7 100 001.3
727	284 512.9	7 100 036.5
728	284 509.7	7 100 034.7
729	284 506.6	7 100 033.2
730	284 503.3	7 100 031.7
731	284 500.1	7 100 030.5
732	284 496.6	7 100 029.4
733	284 494.4	7 100 029.2
734	284 490.8	7 100 028.5
735	284 491.5	7 100 028.6
736	284 488.1	7 100 028.0
737	284 484.4	7 100 027.5
738	284 478.8	7 100 026.8
739	284 472.0	7 100 026.2
740	284 485.6	7 100 034.2
741	284 492.2	7 100 030.6
742	284 497.8	7 100 029.3
743	284 500.1	7 100 027.8
744	284 501.9	7 100 028.4

ASSOCIATED PLANS -
Escarpment Plan - B1/2555A
Survey Plan - B1/2555



FOR LONG-SECTIONS OF TRACKS VIDE A3/2555 Sheet 9

MARRYAT CREEK EARTHQUAKE ESCARPMENT SURVEY

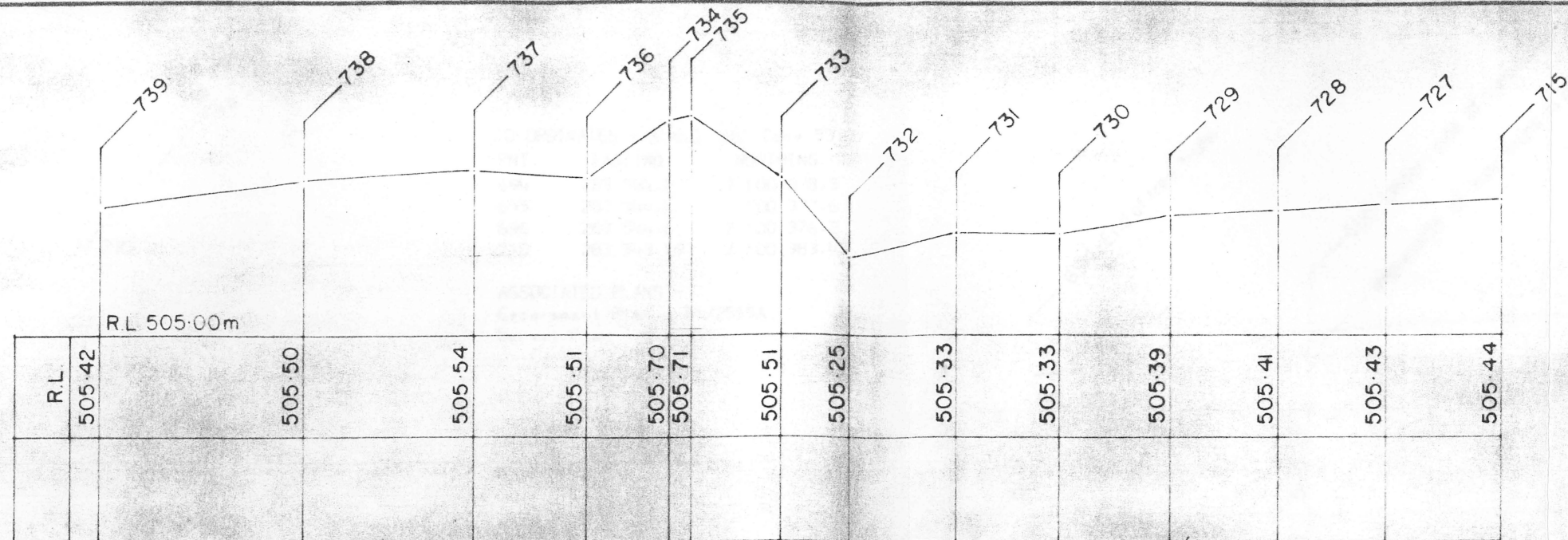
DEPARTMENT OF RESOURCES AND ENERGY - B.M.R.

AUSTRALIAN SURVEY OFFICE
DEPARTMENT OF LOCAL GOVERNMENT AND
ADMINISTRATIVE SERVICES-SOUTH AUSTRALIA

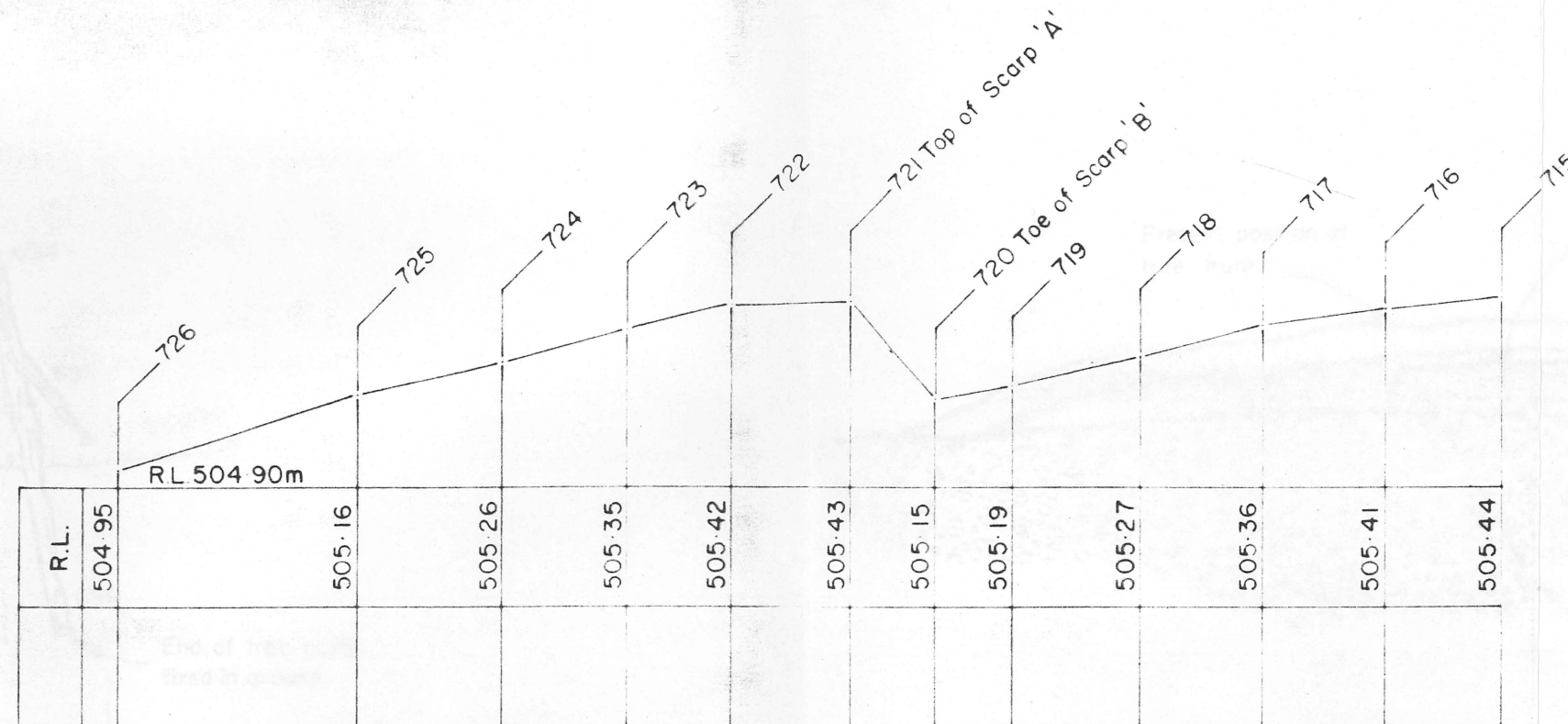
SCALE 1:200
0 2 4 6 8 10 METRES

A3/2555C SHEET
8 OF 10

J2138		F.W.T.	APR '86	F1453/14-		C75/66	M.J.J.	F.W.T.	R.L.L.	I
JOB No.	SEARCH	SURVEY	DATE	FIELD BK.	LEVEL BK.	CALC BK.	DRAWN	CHKD.	PASSED	ISSUE



LONG-SECTION OF TRACK 'C'



LONG-SECTION OF TRACK 'D'

HORIZONTAL SCALE 1:200
 0 2 4 6 8 10 Metres
 VERTICAL SCALE 1:20

CO-ORDINATES - A.M.G. (66) Zone 53

PNT.	EASTING	NORTHING
715	284 516.1	7 100 038.5
716	284 514.8	7 100 035.4
717	284 513.6	7 100 032.0
718	284 512.4	7 100 028.7
719	284 511.2	7 100 025.3
720	284 510.6	7 100 023.3
721	284 510.0	7 100 020.9
722	284 508.9	7 100 017.6
723	284 507.9	7 100 014.8
724	284 506.6	7 100 011.5
725	284 505.1	7 100 007.6
726	284 502.4	7 100 001.3
727	284 512.9	7 100 036.5
728	284 509.7	7 100 034.7
729	284 506.6	7 100 033.2
730	284 503.3	7 100 031.7
731	284 500.1	7 100 030.5
732	284 496.6	7 100 029.4
733	284 494.4	7 100 029.2
734	284 490.8	7 100 028.5
735	284 491.5	7 100 028.6
736	284 488.1	7 100 028.0
737	284 484.4	7 100 027.5
738	284 478.8	7 100 026.8
739	284 472.0	7 100 026.2
740	284 485.6	7 100 034.2
741	284 492.2	7 100 030.6
742	284 497.8	7 100 029.3
743	284 500.1	7 100 027.8
744	284 501.9	7 100 028.4

ASSOCIATED PLANS -
 Escarpment Plan - B1/2555A
 Survey Plan - B1/2555

FOR PLAN OF TRACKS VIDE A3/2555C Sheet 8

MARRYAT CREEK EARTHQUAKE ESCARPMENT SURVEY

DEPARTMENT OF RESOURCES AND ENERGY - B.M.R.

AUSTRALIAN SURVEY OFFICE
 DEPARTMENT OF LOCAL GOVERNMENT AND
 ADMINISTRATIVE SERVICES-SOUTH AUSTRALIA

SCALE AS ABOVE METRES

A3/2555C SHEET
 9 OF 10

J2138		F.W.T.	APR '86	FI453/14-		C75/66-	M.J.J.	F.W.T.	R.L.L.	I
JOB No.	SEARCH	SURVEY	DATE	FIELD BK.	LEVEL BK.	CALC BK.	DRAWN	CHKD.	PASSED	ISSUE



To Str. 118
 74 232
 283 545 E

ASSOCIATED PLANS -
Escarpment Plan - B1/2555A
Survey Plan - B1/2555

7100 380 N

End of tree trunk fixed
in ground

Impression of tree
trunk in ground —

Apparent position of
tree trunk before
earthquake _____

End of tree trunk
fixed in ground

SCALE - 1:50

694-End of tree trunk

695 Under-side of tree trunk

Impression of tree trunk in ground

696-End of tree trunk

Assumed level of tree trunk before earthquake

R.L. 508-00

R.L. 508-00

ASSUMED PRE-QUAKE	PRESENT
R.L.	R.L.
508.12	508.12

508.18	508.26
--------	--------

508.15	508.34
--------	--------

Present position of
tree trunk —

Assumed position of tree trunk and
ground level before earthquake

— FAULT LINE

HORIZONTAL & VERTICAL SCALE - 1:20

0 0.2 0.4 0.6 0.8 1.0 Metres

J2138		F.W.T.	APR'86	FI453/14-		C75/66-	M.J.J.	F.W.T.	R.L.L.	I
JOB No.	SEARCH	SURVEY	DATE	FIELD BK.	LEVEL BK.	CALC BK.	DRAWN	CHKD.	PASSED	ISSUE

MARRYAT CREEK EARTHQUAKE ESCARPMENT SURVEY

DEPARTMENT OF RESOURCES AND ENERGY - B.M.R.

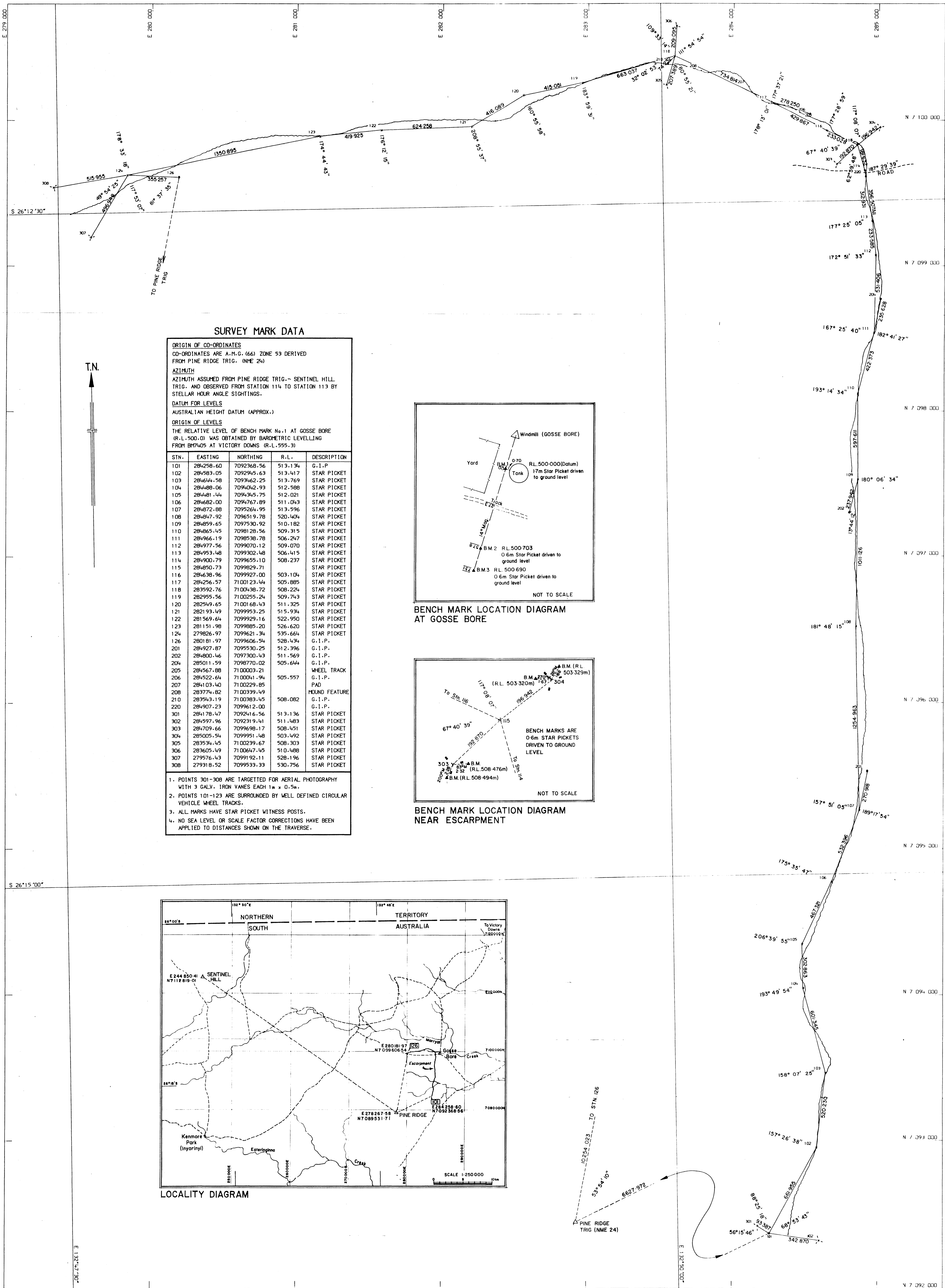
AUSTRALIAN SURVEY OFFICE
DEPARTMENT OF LOCAL GOVERNMENT AND
ADMINISTRATIVE SERVICES-SOUTH AUSTRALIA

SCALE 1:50

0 0.5 1 1.5 2 2.5 METRES



A3/2555C SHEET
10 OF 10



SURVEY MARK DATA

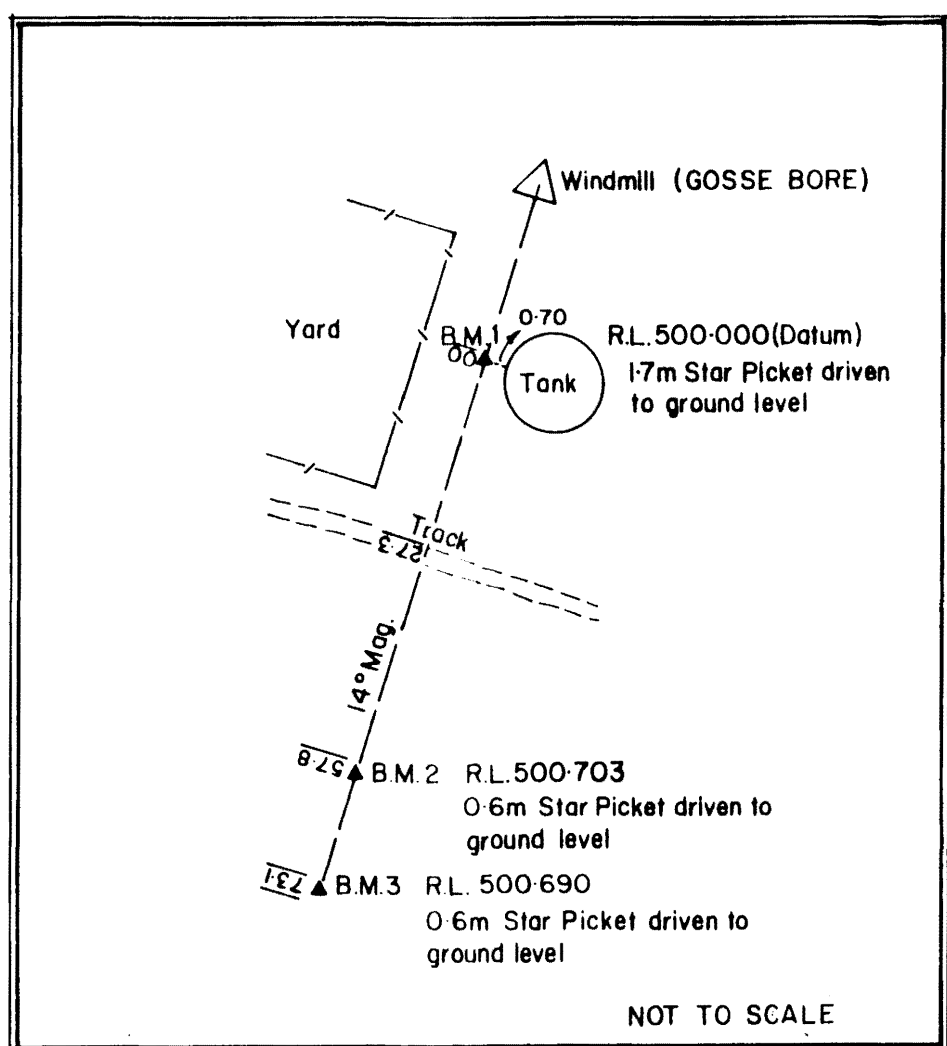
ORIGIN OF CO-ORDINATES				
CO-ORDINATES ARE A.M.G. (66) ZONE 53 DERIVED FROM PINE RIDGE TRIG. (NME 24)				
AZIMUTH				
AZIMUTH ASSUMED FROM PINE RIDGE TRIG. - SENTINEL HILL TRIG. AND OBSERVED FROM STATION 114 TO STATION 113 BY STELLAR HOUR ANGLE SIGHTINGS.				
DATUM FOR LEVELS				
AUSTRALIAN HEIGHT DATUM (APPROX.)				
ORIGIN OF LEVELS				
THE RELATIVE LEVEL OF BENCH MARK No.1 AT GOSSE BORE (R.L. 500.0) WAS OBTAINED BY BAROMETRIC LEVELLING FROM BM7405 AT VICTORY DOWNS (R.L. 555.3)				
STN.	EASTING	NORTHING	R.L.	DESCRIPTION
101	284258.60	7092368.56	513.134	G.I.P.
102	284283.05	7092345.63	513.417	STAR PICKET
103	284444.58	7093462.25	513.769	STAR PICKET
104	284488.06	7094042.93	512.588	STAR PICKET
105	284481.44	7094345.75	512.021	STAR PICKET
106	284682.00	7094767.89	511.043	STAR PICKET
107	284872.88	7095264.95	513.596	STAR PICKET
108	284847.92	7096519.78	520.404	STAR PICKET
109	284859.65	7097530.92	510.182	STAR PICKET
110	284865.45	7098128.56	509.315	STAR PICKET
111	284966.19	7098538.78	506.247	STAR PICKET
112	284977.56	7099070.12	509.070	STAR PICKET
113	284953.48	7099302.48	506.415	STAR PICKET
114	284900.79	7099655.10	508.237	STAR PICKET
115	284850.73	7099829.71	508.237	STAR PICKET
116	284638.96	7099927.00	503.104	STAR PICKET
117	284256.57	7100123.44	505.885	STAR PICKET
118	283592.76	7100438.72	508.224	STAR PICKET
119	282955.56	7100255.24	509.743	STAR PICKET
120	282549.65	7100168.43	511.325	STAR PICKET
121	282193.49	7099953.25	515.934	STAR PICKET
122	281569.64	7099929.16	522.950	STAR PICKET
123	281151.98	7099885.20	526.620	STAR PICKET
124	279826.97	7099621.34	535.664	STAR PICKET
126	280181.97	7099606.54	528.434	G.I.P.
201	284927.87	7095530.25	512.396	G.I.P.
202	284800.46	7097300.43	511.569	G.I.P.
204	285011.59	7098770.02	505.644	G.I.P.
205	284567.88	7100003.21	505.557	G.I.P.
206	284522.64	7100041.94	505.557	G.I.P.
207	284103.40	7100229.85	508.082	G.I.P.
208	283774.82	7100339.49	508.082	G.I.P.
210	283543.19	7100383.45	508.082	G.I.P.
220	284907.23	7099612.00	513.136	STAR PICKET
301	284178.47	7092416.56	511.483	STAR PICKET
302	284597.96	7092319.41	508.451	STAR PICKET
303	284709.66	7099698.17	509.402	STAR PICKET
304	285005.34	7099951.48	508.303	STAR PICKET
305	283534.45	7100239.67	510.488	STAR PICKET
306	283605.49	7100647.45	528.196	STAR PICKET
307	279576.43	7099192.11	530.756	STAR PICKET
308	279318.52	7099533.33	530.756	STAR PICKET

1. POINTS 301-308 ARE TARGETTED FOR AERIAL PHOTOGRAPHY WITH 3 GALV. IRON VANES EACH 1m x 0.5m.

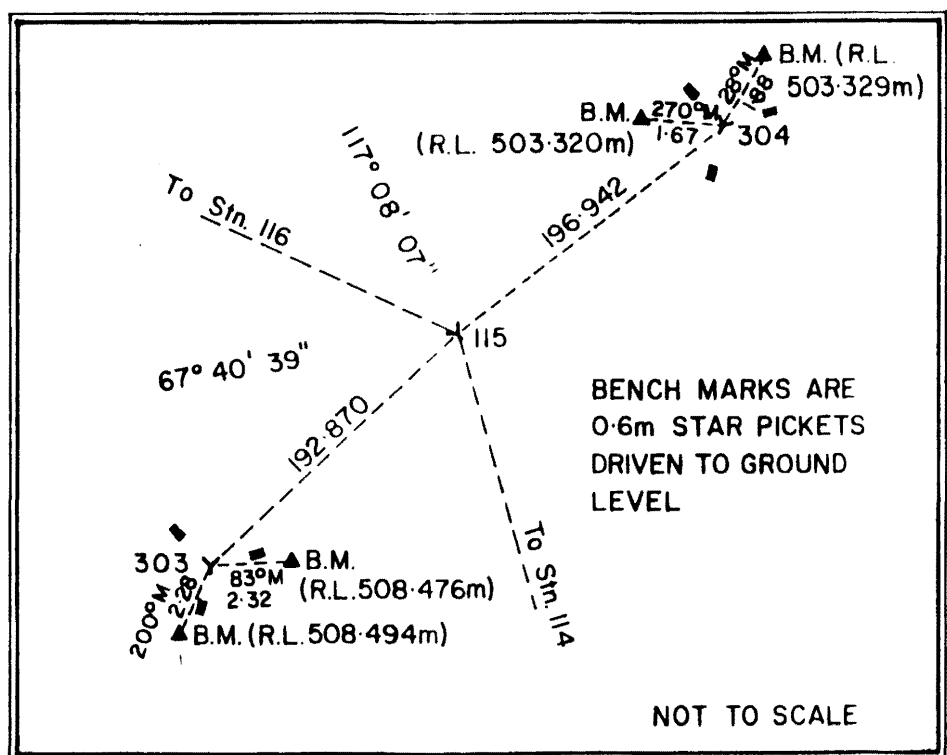
2. POINTS 101-123 ARE SURROUNDED BY WELL DEFINED CIRCULAR VEHICLE WHEEL TRACKS.

3. ALL MARKS HAVE STAR PICKET WITNESS POSTS.

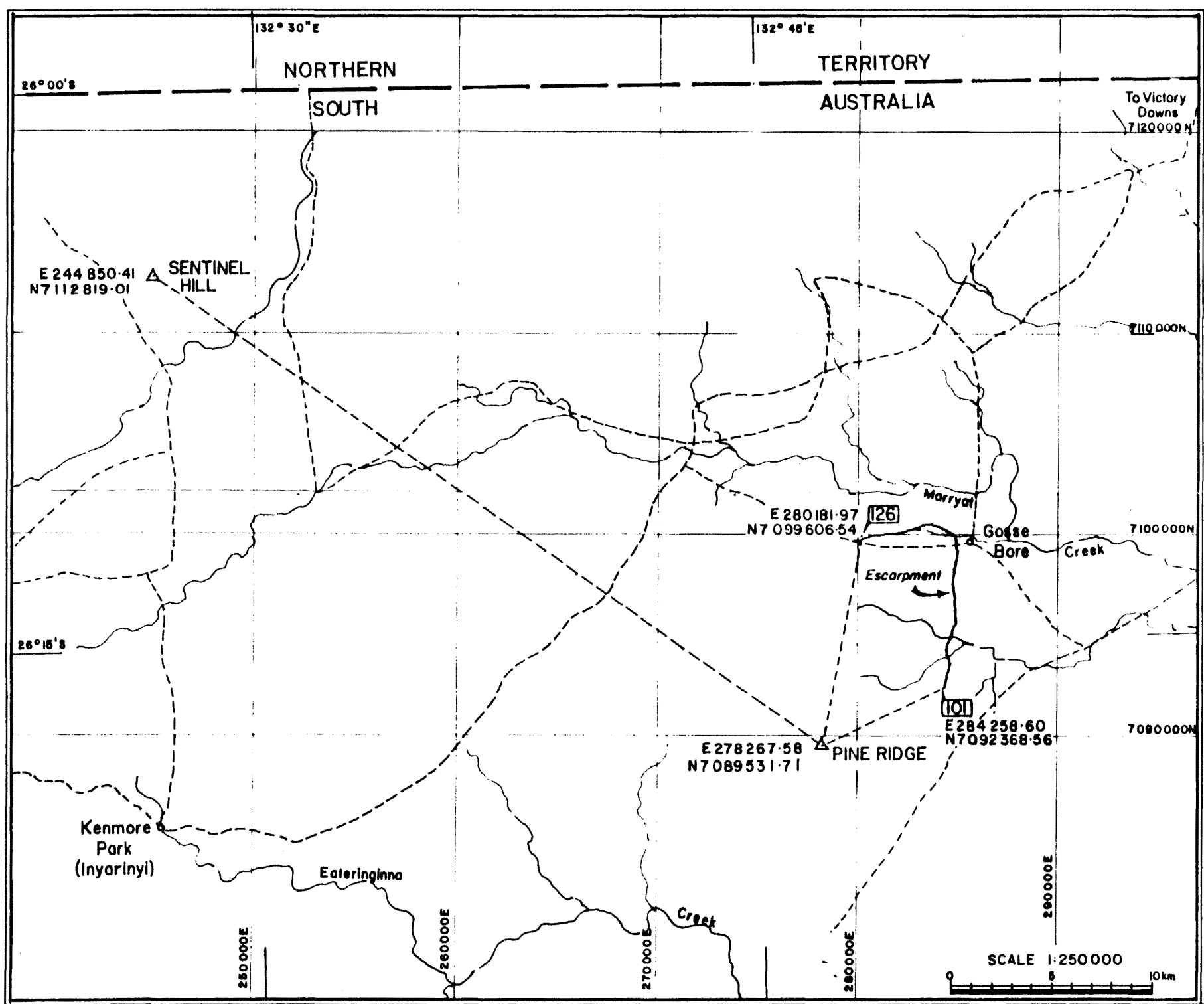
4. NO SEA LEVEL OR SCALE FACTOR CORRECTIONS HAVE BEEN APPLIED TO DISTANCES SHOWN ON THE TRAVERSE.



BENCH MARK LOCATION DIAGRAM AT GOSSE BORE



BENCH MARK LOCATION DIAGRAM NEAR ESCARPMENT



LOCALITY DIAGRAM



