NTGS 1973-2

NORTHERN TERRITORY GEOLOGICAL SURVEY REPORT G.S. 345

A1-45
MBR/72/10

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# INVESTIGATION

# of

# KULGERA (AREA 4) RAILWAY BALLAST SITE

# MINING RESERVE NO. 342

by

J. Morlock

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## 1. SUMMARY

The Kulgera Area has been investigated, and in particular, proposed Quarry Site 1A has received detailed attention.

Reserves of dolerite within Quarry Site 1A are estimated at between 270,000 cubic yards (207,000 cubic metres) and 318,000 cubic yards (243,000 cubic metres).

## 2. INTRODUCTION

The Kulgera Ballast Site Areas have been included in Mining Reserve Number 342 which lies within the Kulgera 1:250,000 Sheet SF 53-5, and is approximately bounded by grid references 656797, 669797, 656787 and 669787. The area is about 158 miles south-south-west from Alice Springs and commences three miles from the Kulgera Township (plate 1). The area is covered by the following aerial photographs (taken in 1950): Kulgera Run 13; numbers 5205, 5206, 5207.

The area is reached by first travelling south along the Stuart Highway for 169 miles from Alice Springs to Kulgera. At Kulgera, the Finke Road is followed for about four miles. At this point, the southern boundary of the area is reached (Plate 1).

A few miles of the Stuart Highway are sealed near Alice Springs. The remainder of the Stuart Highway and the Finke Road are unsealed and sometimes impassable during wet weather.

There is an airstrip at Kulgera.

In general, the Kulgera Area consists of a flat, alluvium covered plain containing some low scrub and stunted trees, many of which are dead. In addition, there are a few low rounded granitic hills and a few, somewhat more angular hills consisting of granitic gneisses overlain by dolerite.

The alluvium, which grades into weathered granitic gneisses, provides firm support and this, combined with the flat nature of the terrain among the hills, enables easy access during dry weather to 2-wheel-drive vehicles.

## 3. GEOLOGY

### Regional Geology

The Kulgera Area may be divided into two regions. The western region, occupying about one-fifth of the total area, consists largely of medium to coarse-grained, highly weathered granitic rock which form a complex of low, rounded hills. The remainder of the Kulgera Area consists of alluvium surrounding isolated low hills of granitic, and dolerite-capped granitic rocks.

The most widespread rock type in the Kulgera Area is granite-adamellite gneiss. This gneiss is medium to fine grained with an average biotite content of about 10%. The foliation generally dips towards the west. Structurally, the rock is quite weak due to the weathering of feldspar to clay and planes of weakness caused by the biotite. The gneiss is unsuitable for ballast.

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Small amounts of amphibolite and quartz diorite gneiss are present in diamond drill cores. These rocks are also unsuitable for ballast due to the weathering and the foliation.

A coarse-grained pegmatitic granite outcrops extensively in the western region. It has also been intersected in several of the drill holes. This rock is mechanically weak due to the weathering of the feldspar, and is unsuitable as ballast. However, it is stronger than the granite-adamellite gneiss.

Dolerite occurs as gently-dipping sills which cut across all other rocks. The sills strike north-east and dip to the south-east in the south. In the north, the sills strike north-west and dip to the north-east. The dolerite is medium-grained, non-gneissic and shows very little evidence of fracturing. In outcrop, the dolerite sills are up to four yards thick and have dips from $10^{\circ}$ - $15^{\circ}$. The dolerite would be an excellent source of ballast.

Granite-adamellite gneiss occurs beneath the sills, protected from weathering to some extent by the overlying dolerite. The dolerite outcrops are surrounded by alluvium which overlies granite-adamellite gneiss.

The regional geology is shown on Plate 2. A summary of rock types is given in Appendix I.

## Detailed Geology

### Site 1B

One dolerite sill with a thickness of 9-12 feet outcrops at this site (Plate 2). Surface dip is approximately $13^{\circ}$ to the south-east. A diamond drill hole (D.D.H.2) was sited 150 feet from the outcrop, and dolerite was intersected from down hole depths 32-65 feet. Subsurface dip of the sill was measured at 12 degrees and the true thickness was calculated at 30-35 feet.

The dolerite at Site 1B has excellent potential as a source of ballast.

### Site 2

There are two dolerite sills at this site (Plate 2). The south-eastern sill was tested in D.D.H.3 which was sited 100 feet from the outcrop. Dolerite was intersected at 49-66 feet (downhole depths). Subsurface dip of the sill was measured at 26 degrees and the true thickness was calculated at 15 feet.

The north-western sill was tested in D.D.H.4, drilled 150 feet from the outcrop. Dolerite was intersected at 35-57½ feet (downhole depths). The subsurface dip was measured at 13 degrees, and true thickness was calculated at 20 feet. This site does not have the potential of Sites 1A and 1B.

### Site 3

There are at least three sills at this site (plate 2). The south-eastern sill was intersected in D.D.H.5 from 29½ to 62 feet. Dip of the sill is 18 degrees, and the true thickness is 30 feet.

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The north-western sills were intersected in D.D.H.6 at 1-12 feet and 67½-88 feet. A fair quantity of dolerite is present at this site. However, it is a relatively complex area and considerable investigation would be required to estimate reserves.

Site 4

One major sill, with a minor sill immediately to the south, outcrops at this site. Dip is about 10° to the south-east. At the south-west end of the major sill, thickness is about 9 feet, but this decreases to 3-6 feet to the north-east. This site is the least promising of the four.

4. SITE 1A

Geology and Structure

The dolerite at Site 1A consists of a single sill which varies in dip from 10-12° in outcrop to about 5° beneath the surface. The subsurface thickness of the dolerite sheet is 18 feet. In outcrop, the thickness decreases to 9-12 feet at the north-western edge. The structure of the area, as indicated by surface mapping and diamond drilling, is shown in the geological sections on Plate 4.

The dolerite sill has been intruded into granite-adamellite gneiss.

Calculation of Dolerite Reserves

As shown in Plate 5, the area has been divided into several zones, which are described in detail under their respective headings. These zones (1-3) cover a single dolerite outcrop and its subsurface extension. Adjacent outcrops have not been evaluated, since a large number of diamond drill holes would have been necessary.

Zone 1 includes the subsurface extension of the outcrop. As this area has been well explored by diamond drilling it is possible to make an accurate estimate of contained reserves. The zone covers an area of about 31,000 square yards. Using an average dolerite thickness of six yards, reserves from this zone are calculated at approximately 186,000 cubic yards.

Insufficient drilling was available to test zone 2 (outcrop area). However, the thickness of dolerite in the outcrop appears to be six yards at the south-eastern edge and three to four yards at the north-western edge. A probable average thickness is about five yards. In addition, a large amount of dolerite is present as scree at the base of the outcrop. The zone covers an area of about 21,000 square yards. Using an average thickness of four yards (conservative figure) the reserves of dolerite are estimated to be 84,000 cubic yards.

Zone 3 includes the two border areas. No drilling was allocated for these areas. It is likely that dolerite is present and that its thickness is approximately six yards. The area contained is approximately 8,000 square yards. Assuming a six yard thickness, the estimated reserve is 48,000 cubic yards.

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Reserves in Zones 1 and 2 total approximately 270,000 cubic yards. This is a conservative estimate and is regarded as the minimum available reserve.

With the inclusion of Zone 3, the reserve totals 318,000 cubic yards of dolerite. This total is taken as the maximum available reserve.

In addition, there are small outcrops and scree nearby from which dolerite may be obtained.

## 5. CONCLUSIONS AND RECOMMENDATIONS

Site 1A is recommended as the most suitable for the initial supply of railway ballast from the Kulgera area. The site was chosen for the following reasons:

(a) The outcrop is relatively high; at its highest point, it rises some 50 feet above the surrounding plain. There is a considerable quantity of exposed dolerite.

(b) The structure, consisting of one dolerite sill, is simple compared to that of Site 3. This allows a fairly comprehensive exploration program while remaining within the drilling quota.

(c) The dolerite sill, while only six yards thick, appears to be consistent over a width of at least 700 feet and a down-dip length of at least 350 feet.

(d) The dolerite is accessible. According to drill hole data, the subsurface dip is only about 5°. Thus, at a distance of 350 feet down-dip from the outcrop, the dolerite lies only 30 feet beneath the surface. Above the dolerite there is about 15-20 feet of alluvium, grading into highly weathered granite-adamellite gneiss. At Site 2, although the dolerite is about ten yards thick, it has a subsurface dip of 13 degrees.

(e) Access is easy. A road or railway spur could be constructed from the proposed railway line with little difficulty as the intervening countryside is flat and firm.

Minimum dolerite reserves have been calculated at 270,000 cubic yards (207,000 cubic metres) and maximum reserves at 318,000 cubic yards (243,000 cubic metres).

## 6. REFERENCE

Stewart, A.J., 1967 Kulgera, Northern Territory - 1:250,000 Geological Series. Bur. Min. Resour. Aust. Explan. Notes SG/53-5.

## APPENDIX 1

## ROCK DESCRIPTIONS

(Based on hand-specimen examination only)

DOLERITE:

Very fine grained at contacts, varying to coarse-grained; dark greenish-grey; very little fracturing and no gneissosity.

Estimated Composition:

| | |
|---|---|
| pyroxene plus minor amphiboles | 50% |
| olivine | 20% |
| plagioclase | 15% |
| magnetite | 10% |
| pyrite | 1% |
| others | 4% |

This rock should provide excellent ballast material.

GRANITE:

Course grained; pink; pegmatitic; mechanically weak due to coarse grain size.

Estimated Composition:

| | |
|---|---|
| orthoclase | 45% |
| plagioclase | 5% |
| quartz | 20% |
| biotite | 15% |
| hornblende | 7% |
| tourmaline | 3% |
| magnetite | 1% |
| others | 4% |

GRANITE GNEISS:

Medium to medium-fine grained; pink; mechanically weak due to biotite alignment.

Estimated Composition:

| | |
|---|---|
| orthoclase | 25% |
| plagioclase | 10% |
| quartz | 25% |
| biotite | 15% |
| hornblende | 15% |
| others including trace of sulphide | 10% |

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AMPHIBOLITE GNEISS:

Fine grained; dark grey; mechanically weak due to biotite alignment.

Estimated Composition:

| | |
|---|---|
| amphiboles including hornblende | 40% |
| biotite | 20% |
| quartz | 15% |
| magnetite | 10% |
| cordierite | 10% |
| others including trace of sulphide | 5% |

ADAMELLITE GNEISS:

Medium-fine grained; light grey; mechanically weak.

Estimated Composition:

| | |
|---|---|
| quartz | 40% |
| plagioclase | 35% |
| orthoclase | 10% |
| biotite | 5% |
| magnetite | 5% |
| others | 5% |

QUARTZ DIORITE GNEISS:

Fine grained; dark grey; mechanically weak due to biotite alignment.

Estimated Composition:

| | |
|---|---|
| pyroxenes plus amphiboles | 30% |
| quartz (generally iron-stained) | 30% |
| biotite | 20% |
| magnetite | 10% |
| others | 10% |

It appears that the oldest rock type in the area is an alkali granite which contains minor intrusions of intermediate to basic igneous rocks. After the above-mentioned rocks were transformed into gneisses, coarse grained pegmatitic granite was introduced parallel to the gneissosity. The youngest igneous event was the intrusion of dolerite which cuts across the gneissosity of the older rocks.

APPENDIX 11

LOGS FOR DIAMOND DRILL HOLES

Note (1) All holes are vertical.
(2) Angles are given relative to core axis.

| Depth | Core Recovered | Remarks |
|---|---|---|
| D.D.H. 1 | | |
| 0' - 6' | 0' | Alluvium |
| 6' - 24½' | 18½' | Dolerite: Medium-grained except for very fine-grained zones at contacts. Rare sulfide specks. |
| 24½' - 34½' | 10' | Weathered Granite Gneiss: Medium-grained. Pink. Gneissosity approx. 55°. |
| 34½' - 36' | 1½' | Granite: Pink. Coarse-grained. Contacts 55 - 60°. |
| 36' - 52½' | 16½' | Adamellite Gneiss: Minor bands of coarse grained granite parallel to gneissosity at 55 - 60°. |
| 52½' - 64½' | 12' | Granite Gneiss: Contains bands of coarse-grained granite and adamellite gneiss. Gneissosity approx. 60°. |
| 64½' - 69½' | 5' | Granite: Coarse grained, pink. Contains adamellite gneiss bands at 55 - 60°. |
| 69½' - 75' | 5½' | Granite Gneiss: Contains bands of adamellite gneiss parallel to gneissosity at 60°. |
| 75' - 85' | 10' | Granite: Coarse grained, pink. |
| 85' - 100' | 15' | Adamellite Gneiss: Gneissosity approx 60°. |
| 100' - -- | -- | END OF HOLE. |

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| Depth | Core Recovered | Remarks |
|---|---|---|
| D.D.H. 2 | | |
| 0' - 32' | 28' | Weathered Granite Gneiss: Feldspars altered to clay. Highly fractured. Shear zones at 14' - 16' and 23' - 25'. |
| 32' - 65' | 33' | Dolerite: Rare random silica-filled fractures. Contacts at 75°. |
| 65' - 84' | 19' | Granite Gneiss: Gneissosity approx 60°. Medium-fine grained. |
| 84' - -- | -- | END OF HOLE. |
| D.D.H. 3 | | |
| 0' - 29½' | 16' | Granite Gneiss: Highly weathered. Minor bands of coarse grained granite. Gneissosity 55 - 60°. Many small shear zones. |
| 29½' - 49' | 19½' | Quartz Diorite Gneiss: Contains numerous bands of very-fine grained dolerite at 70 - 75°, parallel to contacts and gneissosity. |
| 49' - 66' | 17' | Dolerite: Contacts 75 - 80°. Very fine grained at contacts, varying to coarse-grained within rock unit. |
| 66' - 85' | 19' | Amphibolite Gneiss: Gneissosity 65 - 70°. From 66' - 72' contains bands of coarse grained granite gneiss. |
| 85' - 88' | 3' | Granite Gneiss: Medium grained. Pink. Contains bands of coarse-grained granite. Gneissosity approx 60°. |
| 88' - -- | -- | END OF HOLE. |

...../3

| Depth | Core Recovered | Remarks |
|---|---|---|
| D.D.H. 4 | | |
| 0' - 24' | 10' | Granite Gneiss: Weathered. Gneissosity approximately 57°. |
| 24' - 25' | 1' | Dolerite: Very fine to fine grained. Contacts 75 - 80°. |
| 25' - 35' | 6' | Granite Gneiss: As for 0' - 24'. |
| 35' - 57½' | 21' | Dolerite: Medium grained to very fine grained at contacts. Contacts sharp, at approximately 80°. |
| 57½' - 90' | 32' | Granite Gneiss: Contains bands of coarse grained granite and adamellite. Gneissosity 55 - 60°. |
| 90' - -- | -- | END OF HOLE. |
| D.D.H. 5 | | |
| 0' - 24½' | 17' | Granite Gneiss: Medium-grained. Pink. Gneissosity approx 70°. |
| 24½' - 29½' | 5' | Granite: Coarse-grained. Pink. Angle of contact with granite gneiss variable. |
| 29½' - 62' | 32½' | Dolerite: Very- fine-grained at contacts varying to medium-grained. Contacts approx. 80°. |
| 62' - 65½' | 3½' | Granite: Pink, coarse-grained. Lower contact approx. 75°. |
| 65½' - 88' | 22½' | Granite and Adamellite Gneisses: Alternating bands. Rare pyrrhotite stringers at 81'. Gneissosity approx. 70°. |
| 90' - -- | -- | END OF HOLE |

...../4

| Depth | Core Recovered | Remarks |
|---|---|---|
| **D.D.H. 6** | | |
| 0' - 1' | 4" | Alluvium: Weathered Granite. |
| 1' - 12' | 3½' | Dolerite: Fine to medium grained. Rock is broken but fresh. |
| 12' - 59½' | 30' | Granite Gneiss: Medium grained, pink. Gneissosity varies from 70 - 90°. |
| 59½' - 61' | 1½' | Amphibolite Gneiss: Upper contact 60°, lower contact 80°. Gneissosity parallel to contacts, varies from 60 - 80°. |
| 61' - 67½' | 6½' | Granite Gneiss: Pink. Medium grained. Gneissosity 80 - 85°. |
| 67½' - 88' | 20½' | Dolerite: Very fine grained at contacts varying to coarse grained. Contacts approx. 83°. |
| 88' - 97' | 9' | Granite Gneiss: Pink. Medium grained. Gneissosity approx. 83°. |
| 97' - -- | -- | END OF HOLE. |
| **D.D.H. 7** | | |
| 0' - 7' | 1' | Alluvium: Highly Weathered Granitic Rock. |
| 7' - 10' | 1' | Weathered Granite Gneiss: Medium-fine grained. Pink. Highly friable.. |
| 10' - 28' | 18' | Dolerite: Fine grained at contacts; grades to medium grained. Contacts broken but approx. at right-angles to core axis.<br>13' - 14' : Fracturing at approx 30°. |
| 28' - 44' | 11½' | Granite Gneiss: Grading into adamellite gneiss, fine to medium-fine grained. Gneissosity approx. 50°. Weak, friable very broken. |
| 44' - -- | --- | END OF HOLE. |

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| Depth | Core Recovered | Remarks |
|---|---|---|
| D.D.H. 8 | | |
| 0' - 14' | 1' | Alluvium: Highly Weathered Granitic Rock. |
| 14' - 33½' | 19' | Dolerite: Medium grained. Broken contacts.<br>Fracturing:<br>15½' - 16½'<br>28' - 29'<br>31' - 32'<br>33' - 33½'<br>Fractures at approx. right angles to core and calcite-healed. |
| 33½' - 50' | 6' | Granite-Adamellite Gneiss: Gradational (on % orthoclase visible) but grain size is constant; medium-fine grained. The rock is weak, friable and somewhat weathered. Gneissosity is at 60 - 65°. |
| 50' - -- | -- | END OF HOLE. |
| D.D.H. 9 | | |
| 0' - 10½' | 1½' | Alluvium: Highly Weathered Granitic Rock. |
| 10½' - 12' | ½' | Granite Gneiss: Pink. Medium grained. Invaded at random angles by coarse-grained granite. Gneissosity is at 30°. |
| 12' - 32' | 18' | Dolerite: Upper contact is approx. 40°. Lower contact broken. Very fine grained at contacts grading to medium grained. |
| 32' - 46' | 13' | Granite-Adamellite Gneiss: Medium-fine grained. Variable pink to light grey. Structurally weak, friable. Approx. 10 - 15% biotite in bands. Gneissosity 50 - 55°. Partially weathered. |
| 46' - -- | --- | END OF HOLE. |

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| Depth | Core Recovered | Remarks |
|---|---|---|
| D.D.H. 10. | | |
| 0' - 14' | less than 1' | Alluvium: Highly Weathered Granitic Rock. |
| 14' - 26½' | 10' | Granite-Adamellite Gneiss: Medium-fine grained. Structurally weak due to partial weathering and approx. 10% biotite. Gneissosity 50 - 55°. |
| 26½' - 43' | 15½' | Dolerite: Fine grained at contacts grading to medium grained. Upper contact approx 90°. |
| 43' - 53' | 10' | Granite-Adamellite Gneiss: As for 14' - 26½'. Gneissosity is approx. 55°. |
| 53' - -- | -- | END OF HOLE. |
| D.D.H. 11. | | |
| 0' - 10' | less than 1' | Alluvium: Highly Weathered Granitic Rock. |
| 10' - 34' | 21' | Granite-Adamellite Gneiss: Gradational between pink and light grey. Medium-fine grained. Approx. 10% biotite. Structurally weak, somewhat weathered, friable. Gneissosity 50 - 55°. |
| 34' - 51½' | 17½' | Dolerite: Fine grained at contacts grading to medium-fine grained. Contacts approx. 90°. |
| 51½' - 55' | 3½' | Granite Gneiss-Granite: Pink granite gneiss. Medium-fine grained and as described under 10' - 34' except for colour. Also partly invaded by coarse-grained granite. Structurally weak. Gneissosity 50 - 55°. |
| 55' - -- | -- | END OF HOLE. |

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| Depth | Core Recovered | Remarks |
|---|---|---|
| **D.D.H. 12.** | | |
| 0' - 19' | 2½' | Alluvium: Highly Weathered Granitic Rock. |
| 19' - 26' | 4' | Granite-Adamellite Gneiss: Variable from pink to light grey. Structurally weak. Medium-fine grained. Somewhat weathered. Gneissosity 50-55°. |
| 26' - 44½' | 18' | Dolerite: Medium to medium-fine grained except fine grained at contacts which are approx. 90°. |
| 44½' - 50' | 5½' | Granite-Adamellite Gneiss: As for 19' - 26'. Also somewhat invaded by coarse grained granite. Gneissosity approx. 55°. |
| 50' - -- | --- | END OF HOLE. |
| **D.D.H. 13** | | |
| 0' - 14' | 2½' | Alluvium: Highly Weathered Granitic Rock. |
| 14' - 19½' | 5' | Weathered Granite Gneiss: Pink in un-weathered areas. Extensively invaded by coarse grained granite. Weak structurally. |
| 19½' - 40½' | 2' | Dolerite: Contacts approx 85 - 90° Medium-fine grained. |
| 40½' - 42½' | 2' | Granite Gneiss: As for 14' - 19½' but only minor weathering. |
| 42½' - -- | -- | END OF HOLE. |

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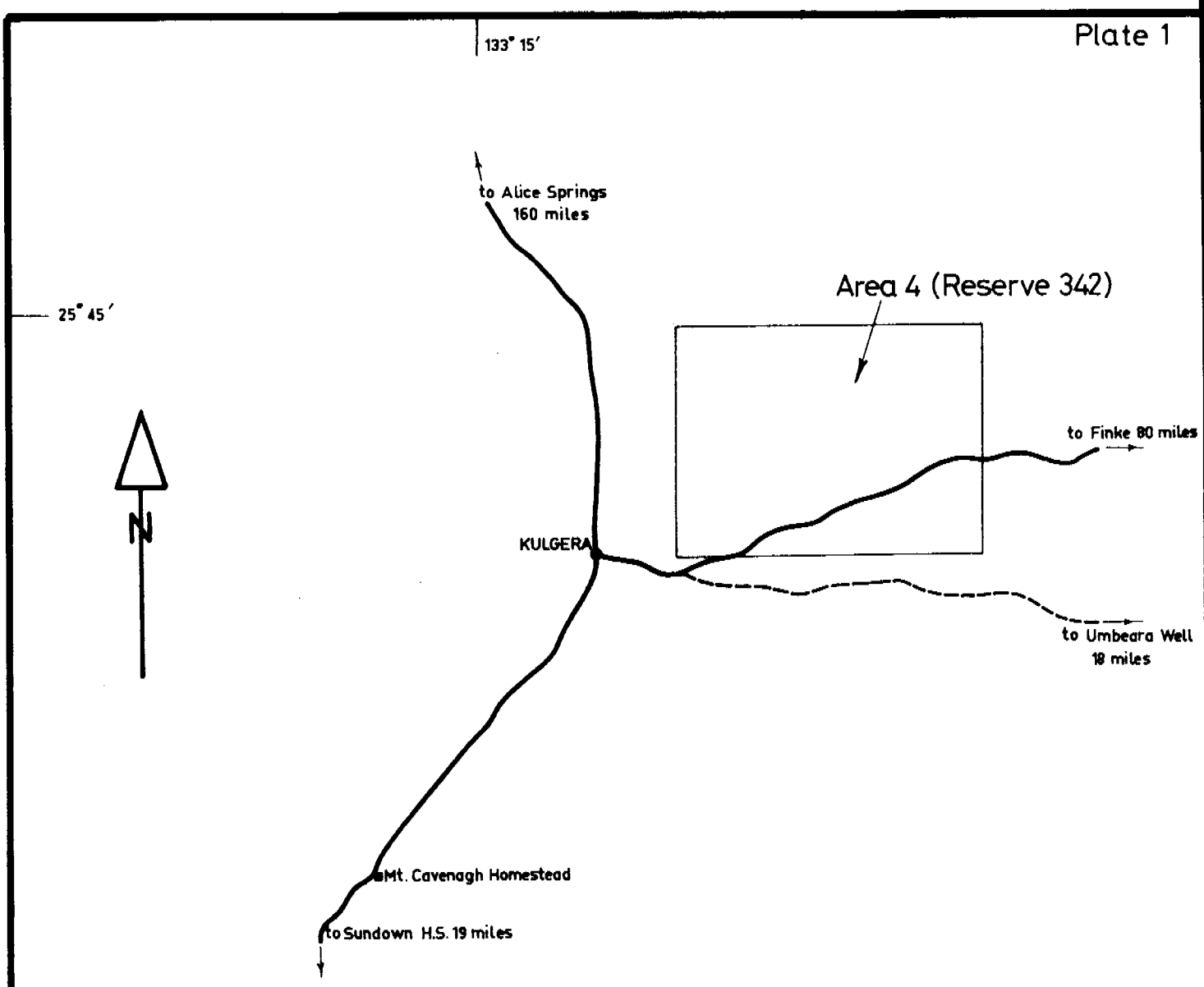
| Depth | Core Recovered | Remarks |
|---|---|---|
| D.D.H. 14. | | |
| 0' - 14' | 1' | Alluvium: Highly Weathered Granitic Rock. |
| 14' - 19' | 1½' | Highly Weathered Granite Gneiss. |
| 19' - 38' | 18½' | Dolerite: Medium-fine grained. Contacts 85 - 90°. |
| 38' - 46' | 7½' | Granite Gneiss-Granite: Mixture of granite gneiss, medium-fine grained and coarse grained granite (both pink). Gneissosity 60 - 70°. |
| 46' - -- | -- | END OF HOLE. |

Plate 1




# KULGERA (AREA FOUR)
# LOCALITY MAP

Scale 1:250,000

5 0 5 10

REFERENCE

Unsealed road

Vehicle track

Compiled by N.T. Geological Survey (Reference N° G.S. 345)
Drawn by Mines Branch Drafting Office, Darwin, April, 1973

G73/21E

Plate 2

to Finke 72 miles

N

Site 4

Site 3

Site 2

Site 1

B

A

to Kulgera
3¼ miles

# KULGERA AREA GEOLOGICAL MAP

Scale

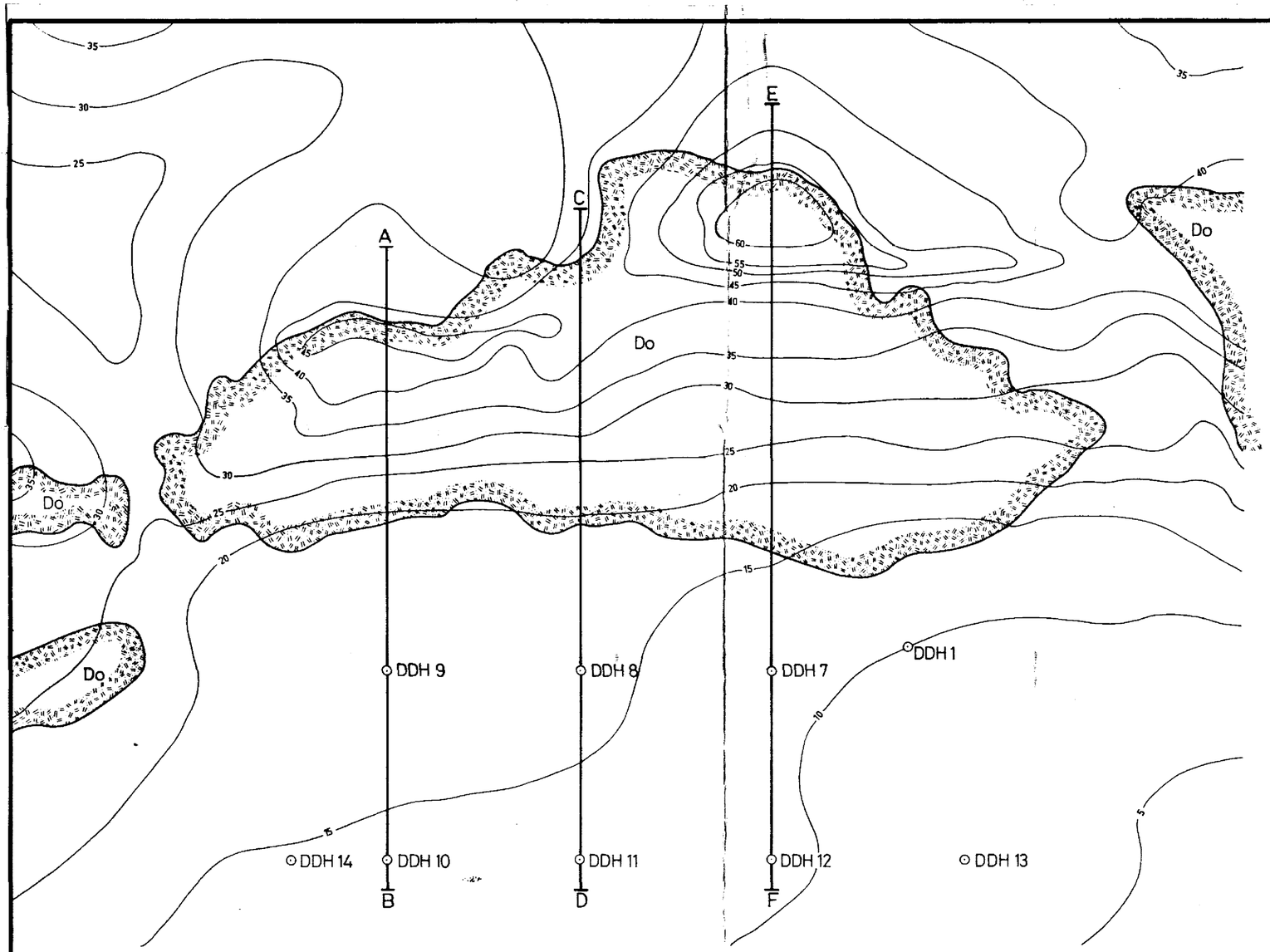
0 0·1 0·2 0·3 0·4 0·5 1 mile

REFERENCE

- Dolerite
- Granite, gneiss
- Strike and dip of rock units
- Site 3 — Proposed quarry site
- Diamond Drill Hole collar position
- River bed
- Track

Compiled by the Geological Survey (Reference No GS 345)
Drawn by Lands Branch Drafting Office Darwin March 1973

G73/22C




# KULGERA AREA
# SITE 1A
# GEOLOGY AND TOPOGRAPHY

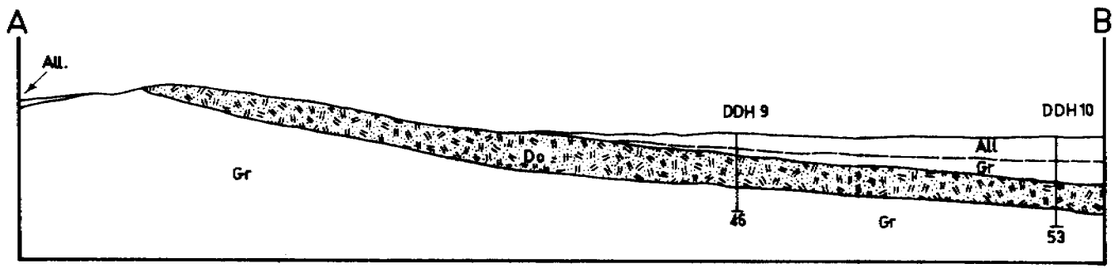
Scale 1:1200

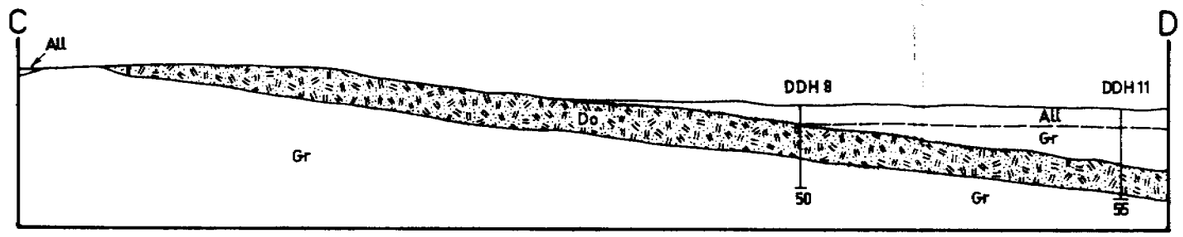
100 0 100 200 300 feet

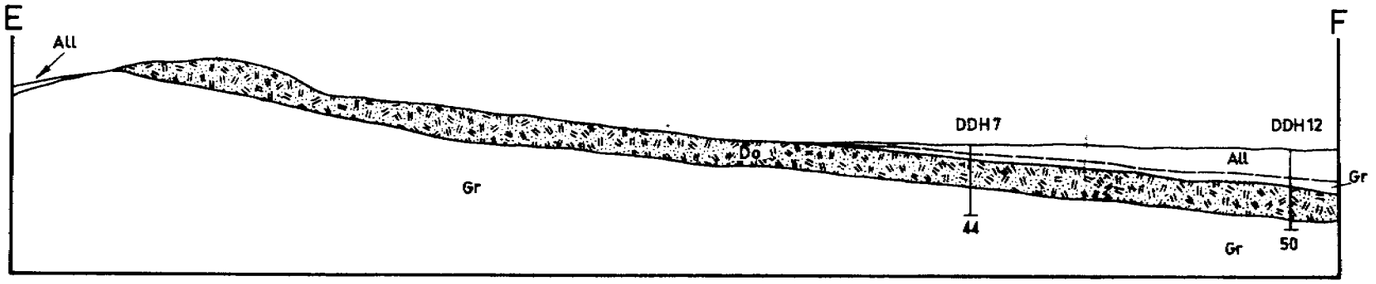
Reference

- Alluvium cover over granite-gneiss
- Do — Dolerite
- DDH 6 ⊙ — Diamond drill hole site
- Outcrop boundary
- 20 — Topographic contour in feet; DDH 1 assigned arbitrary elevation of +10 feet
- C — D — Geological section.

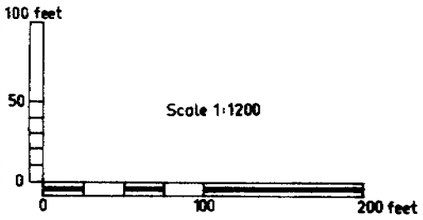
Compiled by N.T. Geological Survey (Reference N° GS.345)
Drawn by Mines Branch Drafting Office Darwin April, 1973.




# KULGERA AREA
# SITE 1A
# GEOLOGICAL SECTIONS AB, CD, EF




## Reference

All — **Alluvium, gradational into lightly weathered granite-adamellite gneiss.**

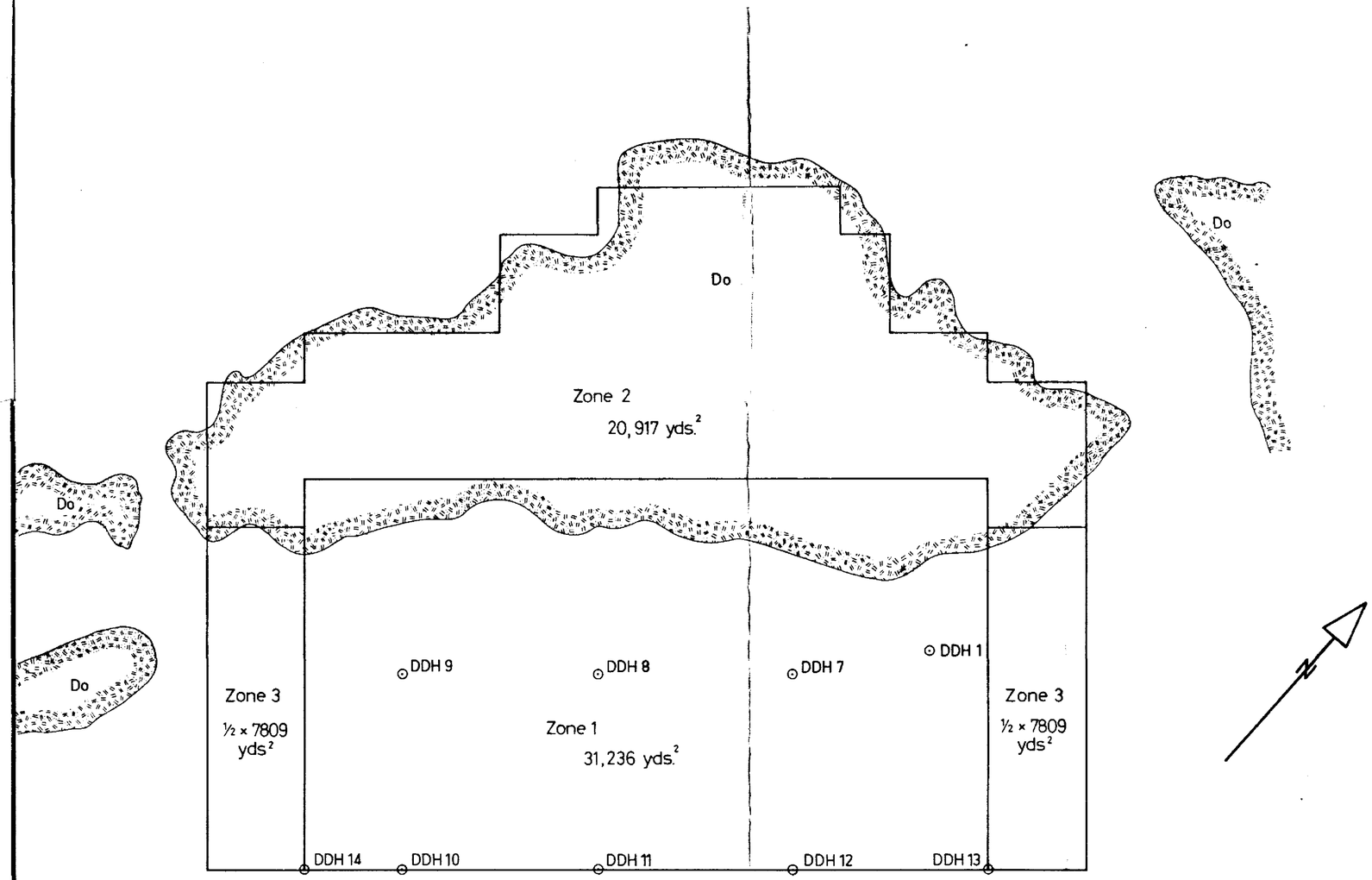
Gr — Granite-adamellite gneiss: weathered, structurally weak.

Do — Dolerite: medium grained. Structurally tough with very few fractures.

gradational / sharp } Geological boundary

DDH 12 / 50 — Diamond drill hole, indicating depth drilled in feet.

Compiled by N.T. Geological Survey (Reference No. G.S. 345)
Drawn by Mines Branch Draughting Office, Darwin, April, 1973




# KULGERA AREA
# SITE 1A, DOLERITE RESERVES

Scale 1:1200

100 0 100 200 300 feet

Reference

Do — Dolerite

——— Outcrop boundary

⊙DDH12 — Diamond drill hole location

Compiled by N.T. Geological Survey (Reference N° G-S 345)
Drawn by Mines Branch Drafting Office, Darwin, April, 1973

NORTHERN TERRITORY GEOLOGICAL SURVEY REPORT G.S. 345

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# INVESTIGATION

# of

# KULGERA (AREA 4) RAILWAY BALLAST SITE

# MINING RESERVE NO. 342

by

J. Morlock

## 1. SUMMARY

The Kulgera Area has been investigated, and in particular, proposed Quarry Site 1A has received detailed attention.

Reserves of dolerite within Quarry Site 1A are estimated at between 270,000 cubic yards (207,000 cubic metres) and 318,000 cubic yards (243,000 cubic metres).

## 2. INTRODUCTION

The Kulgera Ballast Site Areas have been included in Mining Reserve Number 342 which lies within the Kulgera 1:250,000 Sheet SF 53-5, and is approximately bounded by grid references 656797, 669797, 656787 and 669787. The area is about 158 miles south-south-west from Alice Springs and commences three miles from the Kulgera Township (plate 1). The area is covered by the following aerial photographs (taken in 1950): Kulgera Run 13; numbers 5205, 5206, 5207.

The area is reached by first travelling south along the Stuart Highway for 169 miles from Alice Springs to Kulgera. At Kulgera, the Finke Road is followed for about four miles. At this point, the southern boundary of the area is reached (Plate 1).

A few miles of the Stuart Highway are sealed near Alice Springs. The remainder of the Stuart Highway and the Finke Road are unsealed and sometimes impassable during wet weather.

There is an airstrip at Kulgera.

In general, the Kulgera Area consists of a flat, alluvium covered plain containing some low scrub and stunted trees, many of which are dead. In addition, there are a few low rounded granitic hills and a few, somewhat more angular hills consisting of granitic gneisses overlain by dolerite.

The alluvium, which grades into weathered granitic gneisses, provides firm support and this, combined with the flat nature of the terrain among the hills, enables easy access during dry weather to 2-wheel-drive vehicles.

## 3. GEOLOGY

### Regional Geology

The Kulgera Area may be divided into two regions. The western region, occupying about one-fifth of the total area, consists largely of medium to coarse-grained, highly weathered granitic rock which form a complex of low, rounded hills. The remainder of the Kulgera Area consists of alluvium surrounding isolated low hills of granitic, and dolerite-capped granitic rocks.

The most widespread rock type in the Kulgera Area is granite-adamellite gneiss. This gneiss is medium to fine grained with an average biotite content of about 10%. The foliation generally dips towards the west. Structurally, the rock is quite weak due to the weathering of feldspar to clay and planes of weakness caused by the biotite. The gneiss is unsuitable for ballast.

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Small amounts of amphibolite and quartz diorite gneiss are present in diamond drill cores. These rocks are also unsuitable for ballast due to the weathering and the foliation.

A coarse-grained pegmatitic granite outcrops extensively in the western region. It has also been intersected in several of the drill holes. This rock is mechanically weak due to the weathering of the feldspar, and is unsuitable as ballast. However, it is stronger than the granite-adamellite gneiss.

Dolerite occurs as gently-dipping sills which cut across all other rocks. The sills strike north-east and dip to the south-east in the south. In the north, the sills strike north-west and dip to the north-east. The dolerite is medium-grained, non-gneissic and shows very little evidence of fracturing. In outcrop, the dolerite sills are up to four yards thick and have dips from $10^{\circ}$ - $15^{\circ}$. The dolerite would be an excellent source of ballast.

Granite-adamellite gneiss occurs beneath the sills, protected from weathering to some extent by the overlying dolerite. The dolerite outcrops are surrounded by alluvium which overlies granite-adamellite gneiss.

The regional geology is shown on Plate 2. A summary of rock types is given in Appendix I.

## Detailed Geology

### Site 1B

One dolerite sill with a thickness of 9-12 feet outcrops at this site (Plate 2). Surface dip is approximately $13^{\circ}$ to the south-east. A diamond drill hole (D.D.H.2) was sited 150 feet from the outcrop, and dolerite was intersected from down hole depths 32-65 feet. Subsurface dip of the sill was measured at 12 degrees and the true thickness was calculated at 30-35 feet.

The dolerite at Site 1B has excellent potential as a source of ballast.

### Site 2

There are two dolerite sills at this site (Plate 2). The south-eastern sill was tested in D.D.H.3 which was sited 100 feet from the outcrop. Dolerite was intersected at 49-66 feet (downhole depths). Subsurface dip of the sill was measured at 26 degrees and the true thickness was calculated at 15 feet.

The north-western sill was tested in D.D.H.4, drilled 150 feet from the outcrop. Dolerite was intersected at 35-57½ feet (downhole depths). The subsurface dip was measured at 13 degrees, and true thickness was calculated at 20 feet. This site does not have the potential of Sites 1A and 1B.

### Site 3

There are at least three sills at this site (plate 2). The south-eastern sill was intersected in D.D.H.5 from 29½ to 62 feet. Dip of the sill is 18 degrees, and the true thickness is 30 feet.

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The north-western sills were intersected in D.D.H.6 at 1-12 feet and 67½-88 feet. A fair quantity of dolerite is present at this site. However, it is a relatively complex area and considerable investigation would be required to estimate reserves.

Site 4

One major sill, with a minor sill immediately to the south, outcrops at this site. Dip is about 10° to the south-east. At the south-west end of the major sill, thickness is about 9 feet, but this decreases to 3-6 feet to the north-east. This site is the least promising of the four.

## 4. SITE 1A

### Geology and Structure

The dolerite at Site 1A consists of a single sill which varies in dip from 10-12° in outcrop to about 5° beneath the surface. The subsurface thickness of the dolerite sheet is 18 feet. In outcrop, the thickness decreases to 9-12 feet at the north-western edge. The structure of the area, as indicated by surface mapping and diamond drilling, is shown in the geological sections on Plate 4.

The dolerite sill has been intruded into granite-adamellite gneiss.

### Calculation of Dolerite Reserves

As shown in Plate 5, the area has been divided into several zones, which are described in detail under their respective headings. These zones (1-3) cover a single dolerite outcrop and its subsurface extension. Adjacent outcrops have not been evaluated, since a large number of diamond drill holes would have been necessary.

Zone 1 includes the subsurface extension of the outcrop. As this area has been well explored by diamond drilling it is possible to make an accurate estimate of contained reserves. The zone covers an area of about 31,000 square yards. Using an average dolerite thickness of six yards, reserves from this zone are calculated at approximately 186,000 cubic yards.

Insufficient drilling was available to test zone 2 (outcrop area). However, the thickness of dolerite in the outcrop appears to be six yards at the south-eastern edge and three to four yards at the north-western edge. A probable average thickness is about five yards. In addition, a large amount of dolerite is present as scree at the base of the outcrop. The zone covers an area of about 21,000 square yards. Using an average thickness of four yards (conservative figure) the reserves of dolerite are estimated to be 84,000 cubic yards.

Zone 3 includes the two border areas. No drilling was allocated for these areas. It is likely that dolerite is present and that its thickness is approximately six yards. The area contained is approximately 8,000 square yards. Assuming a six yard thickness, the estimated reserve is 48,000 cubic yards.

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Reserves in Zones 1 and 2 total approximately 270,000 cubic yards. This is a conservative estimate and is regarded as the minimum available reserve.

With the inclusion of Zone 3, the reserve totals 318,000 cubic yards of dolerite. This total is taken as the maximum available reserve.

In addition, there are small outcrops and scree nearby from which dolerite may be obtained.

## 5. CONCLUSIONS AND RECOMMENDATIONS

Site 1A is recommended as the most suitable for the initial supply of railway ballast from the Kulgera area. The site was chosen for the following reasons:

(a) The outcrop is relatively high; at its highest point, it rises some 50 feet above the surrounding plain. There is a considerable quantity of exposed dolerite.

(b) The structure, consisting of one dolerite sill, is simple compared to that of Site 3. This allows a fairly comprehensive exploration program while remaining within the drilling quota.

(c) The dolerite sill, while only six yards thick, appears to be consistent over a width of at least 700 feet and a down-dip length of at least 350 feet.

(d) The dolerite is accessible. According to drill hole data, the subsurface dip is only about $5^{\circ}$. Thus, at a distance of 350 feet down-dip from the outcrop, the dolerite lies only 30 feet beneath the surface. Above the dolerite there is about 15-20 feet of alluvium, grading into highly weathered granite-adamellite gneiss. At Site 2, although the dolerite is about ten yards thick, it has a subsurface dip of 13 degrees.

(e) Access is easy: A road or railway spur could be constructed from the proposed railway line with little difficulty as the intervening countryside is flat and firm.

Minimum dolerite reserves have been calculated at 270,000 cubic yards (207,000 cubic metres) and maximum reserves at 318,000 cubic yards (243,000 cubic metres).

## 6. REFERENCE

Stewart, A.J., 1967 Kulgera, Northern Territory - 1:250,000 Geological Series. Bur. Min. Resour. Aust. Explan. Notes SG/53-5.

## APPENDIX 1

## ROCK DESCRIPTIONS

(Based on hand-specimen examination only)

DOLERITE:

Very fine grained at contacts, varying to coarse-grained; dark greenish-grey; very little fracturing and no gneissosity.

Estimated Composition:

| | |
|---|---|
| pyroxene plus minor amphiboles | 50% |
| olivine | 20% |
| plagioclase | 15% |
| magnetite | 10% |
| pyrite | 1% |
| others | 4% |

This rock should provide excellent ballast material.

GRANITE:

Course grained; pink; pegmatitic; mechanically weak due to coarse grain size.

Estimated Composition:

| | |
|---|---|
| orthoclase | 45% |
| plagioclase | 5% |
| quartz | 20% |
| biotite | 15% |
| hornblende | 7% |
| tourmaline | 3% |
| magnetite | 1% |
| others | 4% |

GRANITE GNEISS:

Medium to medium-fine grained; pink; mechanically weak due to biotite alignment.

Estimated Composition:

| | |
|---|---|
| orthoclase | 25% |
| plagioclase | 10% |
| quartz | 25% |
| biotite | 15% |
| hornblende | 15% |
| others including trace of sulphide | 10% |

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AMPHIBOLITE GNEISS:

Fine grained; dark grey; mechanically weak due to biotite alignment.

Estimated Composition:

| | |
|---|---|
| amphiboles including hornblende | 40% |
| biotite | 20% |
| quartz | 15% |
| magnetite | 10% |
| cordierite | 10% |
| others including trace of sulphide | 5% |

ADAMELLITE GNEISS:

Medium-fine grained; light grey; mechanically weak.

Estimated Composition:

| | |
|---|---|
| quartz | 40% |
| plagioclase | 35% |
| orthoclase | 10% |
| biotite | 5% |
| magnetite | 5% |
| others | 5% |

QUARTZ DIORITE GNEISS:

Fine grained; dark grey; mechanically weak due to biotite alignment.

Estimated Composition:

| | |
|---|---|
| pyroxenes plus amphiboles | 30% |
| quartz (generally iron-stained) | 30% |
| biotite | 20% |
| magnetite | 10% |
| others | 10% |

It appears that the oldest rock type in the area is an alkali granite which contains minor intrusions of intermediate to basic igneous rocks. After the above-mentioned rocks were transformed into gneisses, coarse grained pegmatitic granite was introduced parallel to the gneissosity. The youngest igneous event was the intrusion of dolerite which cuts across the gneissosity of the older rocks.

APPENDIX 11

LOGS FOR DIAMOND DRILL HOLES

Note (1) All holes are vertical.
(2) Angles are given relative to core axis.

| Depth | Core Recovered | Remarks |
|---|---|---|
| D.D.H. 1 | | |
| 0' - 6' | 0' | Alluvium |
| 6' - 24½' | 18½' | Dolerite: Medium-grained except for very fine-grained zones at contacts. Rare sulfide specks. |
| 24½' - 34½' | 10' | Weathered Granite Gneiss: Medium-grained. Pink. Gneissosity approx. 55°. |
| 34½' - 36' | 1½' | Granite: Pink. Coarse-grained. Contacts 55 - 60°. |
| 36' - 52½' | 16½' | Adamellite Gneiss: Minor bands of coarse grained granite parallel to gneissosity at 55 - 60°. |
| 52½' - 64½' | 12' | Granite Gneiss: Contains bands of coarse-grained granite and adamellite gneiss. Gneissosity approx. 60°. |
| 64½' - 69½' | 5' | Granite: Coarse grained, pink. Contains adamellite gneiss bands at 55 - 60°. |
| 69½' - 75' | 5½' | Granite Gneiss: Contains bands of adamellite gneiss parallel to gneissosity at 60°. |
| 75' - 85' | 10' | Granite: Coarse grained, pink. |
| 85' - 100' | 15' | Adamellite Gneiss: Gneissosity approx 60°. |
| 100' - -- | -- | END OF HOLE. |

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| Depth | Core Recovered | Remarks |
|---|---|---|
| D.D.H. 2 | | |
| 0' - 32' | 28' | Weathered Granite Gneiss: Feldspars altered to clay. Highly fractured. Shear zones at 14' - 16' and 23' - 25'. |
| 32' - 65' | 33' | Dolerite: Rare random silica-filled fractures. Contacts at 75°. |
| 65' - 84' | 19' | Granite Gneiss: Gneissosity approx 60°. Medium-fine grained. |
| 84' - -- | -- | END OF HOLE. |
| D.D.H. 3 | | |
| 0' - 29½' | 16' | Granite Gneiss: Highly weathered. Minor bands of coarse grained granite. Gneissosity 55 - 60°. Many small shear zones. |
| 29½' - 49' | 19½' | Quartz Diorite Gneiss: Contains numerous bands of very-fine grained dolerite at 70 - 75°, parallel to contacts and gneissosity. |
| 49' - 66' | 17' | Dolerite: Contacts 75 - 80°. Very fine grained at contacts, varying to coarse-grained within rock unit. |
| 66' - 85' | 19' | Amphibolite Gneiss: Gneissosity 65 - 70°. From 66' - 72' contains bands of coarse grained granite gneiss. |
| 85' - 88' | 3' | Granite Gneiss: Medium grained. Pink. Contains bands of coarse-grained granite. Gneissosity approx 60°. |
| 88' - -- | -- | END OF HOLE. |

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| Depth | Core Recovered | Remarks |
|---|---|---|
| D.D.H. 4 | | |
| 0' - 24' | 10' | Granite Gneiss: Weathered. Gneissosity approximately 57°. |
| 24' - 25' | 1' | Dolerite: Very fine to fine grained. Contacts 75 - 80°. |
| 25' - 35' | 6' | Granite Gneiss: As for 0' - 24'. |
| 35' - 57½' | 21' | Dolerite: Medium grained to very fine grained at contacts. Contacts sharp, at approximately 80°. |
| 57½' - 90' | 32' | Granite Gneiss: Contains bands of coarse-grained granite and adamellite. Gneissosity 55 - 60°. |
| 90' - -- | -- | END OF HOLE. |
| D.D.H. 5 | | |
| 0' - 24½' | 17' | Granite Gneiss: Medium-grained. Pink. Gneissosity approx 70°. |
| 24½' - 29½' | 5' | Granite: Coarse-grained. Pink. Angle of contact with granite gneiss variable. |
| 29½' - 62' | 32½' | Dolerite: Very- fine-grained at contacts varying to medium-grained. Contacts approx. 80°. |
| 62' - 65½' | 3½' | Granite: Pink, coarse-grained. Lower contact approx. 75°. |
| 65½' - 88' | 22½' | Granite and Adamellite Gneisses: Alternating bands. Rare pyrrhotite stringers at 81'. Gneissosity approx. 70°. |
| 90' - -- | -- | END OF HOLE |

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| Depth | Core Recovered | Remarks |
|---|---|---|
| **D.D.H. 6** | | |
| 0' - 1' | 4" | Alluvium: Weathered Granite. |
| 1' - 12' | 3½' | Dolerite: Fine to medium grained. Rock is broken but fresh. |
| 12' - 59½' | 30' | Granite Gneiss: Medium grained, pink. Gneissosity varies from 70 - 90°. |
| 59½' - 61' | 1½' | Amphibolite Gneiss: Upper contact 60°, lower contact 80°. Gneissosity parallel to contacts, varies from 60 - 80°. |
| 61' - 67½' | 6½' | Granite Gneiss: Pink. Medium grained. Gneissosity 80 - 85°. |
| 67½' - 88' | 20½' | Dolerite: Very fine grained at contacts varying to coarse grained. Contacts approx. 83°. |
| 88' - 97' | 9' | Granite Gneiss: Pink. Medium grained. Gneissosity approx. 83°. |
| 97' - -- | -- | END OF HOLE. |
| **D.D.H. 7** | | |
| 0' - 7' | 1' | Alluvium: Highly Weathered Granitic Rock. |
| 7' - 10' | 1' | Weathered Granite Gneiss: Medium-fine grained. Pink. Highly friable.. |