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GEOLOGICAL INVESTIGATION OF THE PROPOSED MINJ-WAHGI RIVER ROADWAY, NEW GUINEA, 1967.

by

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Record No. 1967/143

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SUMMARY

A geological investigation of the proposed route of the Minj-Wahgi River Roadway was carried out in April, 1967. The investigation included an examination of a possible alignment along the south side of the Wahgi River and a six-mile alternative section on the north side of the river at the eastern end of the route.

All sections investigated traverse extensive alluvial terrace deposits of clay, silt, sand, and gravel located within the Wahgi River Valley. The alluvial terrace deposits are stable but are overlain by 2 - 10 feet of black, silty and clayey soil which tends to be swampy; where the soil has accumulated on side-slopes, in gullies, and at the base of the terrace escarpments, it is unstable.

It is concluded that construction of either the southern or the northern alternative route is geologically feasible although it is considered that the northern alternative route may be more difficult and more expensive owing to the need for additional bridge sites at unfavourable locations.

It is recommended that all embankments in alluvial terrace deposits be cut nearly vertical and that all soil and slopewash material be removed from fill areas located on side-slopes, in gullies, and at the base of terrace escarpments, prior to construction. Culverts should be designed to allow flood waters to be cleared as quickly as possible.

It is also recommended that an investigation should be carried out to determine the feasibility of by-passing the heavy earthwork sections located within the first five miles of the alignment. A possible route, which crosses the Minj River near the confluence of the Minj and Wahgi Rivers, is suggested.

INTRODUCTION

The proposed re- alignment of the Minj-Wahgi River Roadway forms a further part of the programme of upgrading the Highlands Highway connecting the New Guinea centres of Lae and Mount Hagen (Plate 1). West of Chuave the existing route of the highway approaches Mount Hagen along the northern side of the Wahgi River Valley. It is now planned that the highway leave Mount Hagen on the southern side of the valley, pass through Minj and cross the Wahgi River about 19 miles east of Minj before rejoining the existing alignment about 5 miles east of Kerowagi.

At the request of the Director, Department of Public Works, Port Moresby, an investigation to determine the geological feasibility of the proposed route between Minj and the Wahgi River (Plate 2) was carried out in April, 1967.

The investigation included an examination of the route along the south side of the river and also a six-mile long alternative route east of chainage 12 Mile + 1200 feet on the north side of the river. Particular attention was paid to the areas referred to on Plate 2 as localities A, B, C, D, E and F which were regarded by the designing civil engineers as having the most unfavourable geological conditions of the whole route.

REGIONAL GEOLOGY

The proposed alignment along the south side of the Wahgi River, and the alternative route on the north side of the river, both traverse extensive Recent alluvial terrace deposits of clay, silt, sand, and gravel located within the Wahgi River Valley. The settlement of Minj and the access road east of Minj on the southern side of the valley are located on the highest terrace, which is separated from the valley floor by two or more terraces at successively lower levels.

All the terraces have been dissected by the numerous streams which flow north and south into the Wahgi River from the uplifted margins of the valley, leaving a series of elongated, flat-topped ridges.

On the south side of the valley the terrace deposits overlie shale, conglomerate, and tuff of the Lower Cretaceous Kondaku Tuffs (Rickwood, 1955) which dip from 10 to 25 degrees north. On the north side of the valley the gravels rest on shale of the Upper Cretaceous Chim Group (Rickwood, 1955).

ENGINEERING GEOLOGY

The alluvial terrace deposits preserved in the Wahgi River Valley consist of a moderately compacted and poorly sorted conglomeration of clay, silt, sand and gravel. Crude horizontal bedding can be recognised in several places and numerous flat-lying beds of silt and sand occur at irregular intervals within the sequence. The gravel components vary from point to point in both shape and size: the maximum size noted was 8 inches and the most common size is about 1½ inches. The terraces are everywhere overlain by 2-10 feet of black, silty and clayey soil which is often swampy.

The proposed alignment is described in sections divided according to chainage, commencing from the settlement of Minj. All chainages listed refer to drawing numbers 1 to 7, Minj - Wahgi River Road, prepared by Messrs. M.G. Bull & Collier, Consultant Civil Engineers, Port Moresby. Engineering works referred to, such as cut, fill and embankment, are those proposed by the investigating engineers, as shown in drawings 1-7.

ROUTE ALONG SOUTH SIDE OF VALLEY

Chainage	Description
00 to 340 feet	Start of average 6½% downgrade to the Minj River crossing. Cut into, and embankment on, clay, silt, sand and gravel overlain by up to 5 feet of silty and clayey overburden. The outside of the pavement is in loose slide debris consisting of clayey soil mixed with sand and gravel.

Chainage	Description
340 ft to 800 ft	Fill would be on slide debris derived from a terrace level above the alignment. The debris consists of black clayey and silty soil, mixed with sand and gravel, and overlies an alluvial terrace.
800 ft to 1000 ft	Cut. The embankment and pavement are in completely weathered sandstone and 3 - 5 feet of silty, clayey and pebbly overburden.
1000 ft to 1430 ft	Fill would be on swampy, silty and clayey soil about 6 - 8 feet thick, overlying an alluvial terrace.
1430 ft to 2500 ft	Cut. Embankments and pavement would be in completely weathered sandstone, overlain by 6 - 8 feet of silty and clayey overburden mixed with sand and gravel derived from terrace level above alignment.
2500 ft to 2560 ft	Minj River crossing. Moderately to completely weathered sandstone is exposed in the river banks and fresh sandstone, strike 280° magnetic dip 25° north, is exposed in the river bed.
2560 ft to 2980 ft	Commencement of an average 8½% upgrade to a terrace flat on east side of the Minj River. Cut would be in highly to completely weathered sandstone, and colluvial clay, silt, sand, and gravel derived from a vertically-cliffed terrace above the alignment. The colluvium infills a natural drainage depression.
2980 ft to 3200 ft	Fill would be over clay, silt, sand and gravel, derived from a vertically-cliffed terrace above the alignment, which infills a natural drainage depression.
3200 ft to 3250 ft	Cut would be through nose of spur consisting of terrace clay, silt, sand, and gravel.
3250 ft to 3870 ft	Fill would be on slide material deposited over the face of an escarpment between two terrace levels. The slide material consists of swampy, silty and clayey soil, mixed with sand and gravel, and is derived from the terrace above the alignment.
3870 ft to 1 mile (1 M + 00 ft)	Box-cut would be through face of a terrace escarpment consisting of clay, silt, sand and gravel, overlain by 2-4 feet of red, clayey soil.
1 M + 00 ft to 3 M + 600 ft	Flat grade along terrace flats with minor fills across small gullies. The terrace deposits are overlain by an unknown depth of red, clayey soil: possibly up to 10 feet deep.
3 M + 600 ft to 3 M + 1070 ft	Cut. Start of an average 9½% downgrade leading from the highest terrace level down a deep gully and along the side of a terraced ridge to the floor of the Wahgi River Valley. The cut would be through the face of a terrace escarpment which consists of clay, silt, sand and gravel, overlain by 4-5 feet of red-brown soil.

Chainage	Description
3M + 1070 ft to 3M + 1400 ft	Fill on loose, swampy material at the head of the gully. The slide material consists of black, silty and clayey soil, and sand and gravel, washed down from the escarpment above and behind the alignment.
3M + 1400 ft to 3M + 2300 ft	Cut and fill along the side of a terraced ridge with a side-slope of 30-40 degrees on the right hand side of alignment. The embankment would be on clay, silt, sand, and gravels and the fill on loose, silty and clayey soil which overlies the terrace deposits.
3M + 2300 ft to 3M + 3000 ft	Fill with a slight cut through a low ridge of clay, silt, sand, and gravel between 3M + 2700 feet and 3M + 2820 feet. The fill is planned to carry the alignment from the right hand to left hand side of the gully and would be on swampy, black, silty and clayey soil situated in the natural drainage depression. The black soil is possibly about 12 feet deep.
3M + 3000 ft to 3M + 3300 ft	Box-cut through a side spur of a terraced ridge. The cut would be in clay, silt, sand, and gravel overlain by 3-4 feet of red-brown soil.
3M + 3300 ft to 3M + 3850 ft	Fill across an alluvial terrace. The terrace deposits consist of clay, silt, sand, and gravel overlain by swampy, black, clayey and silty soil about 3-5 feet deep.
3M + 3850 ft to 3M + 4630 ft	Box-cut through a broad spur consisting of clay silt, sand and gravel overlain by 3-5 feet of brown-black swampy soil and slopewash.
3M + 4630 ft to 3M + 5000 ft	Fill would be over an alluvial terrace and stream flat. Up to 10 feet of black silty soil, with admixed sand and gravel, overlies the terrace clay, silt, sand, and gravel.
3M + 5000 ft to 4M + 7500 ft	Cut leading from preceding fill area through the side of a terraced ridge to an open stream flat along the floor of the Wahgi River Valley. The start of the cut marks the end of the average 9½% downgrade section and commences a transition to the flat grades which predominate along the floor of the Wahgi River Valley. The maximum proposed cut is at 3M + 5100 feet along a side slope which steepens from about 35 degrees near the top to about 65 degrees at the base. The embankments and pavement would be in terrace clay, silt, sand, and gravel overlain by a shallow layer of black, silty and clayey soil and sandy slopewash.

Chainage	Description
4M + 7500 ft to 9M + 1700 ft	In this section the alignment crosses, with flat grade, alluvial terraces along the floor of the Wahgi River Valley. The terraces consist of clay, silt, sand, and gravel overlain by 4-6 feet of swampy, black, silty and clayey soil. Moderate fill areas are located across gullies cut into the terraces by small streams which drain into the Wahgi River. The sides of the gullies are covered with shallow deposits of slide material consisting generally of black, silty and clayey soil, mixed with sand and gravel derived from the terraces bordering the gullies.
9M + 1700 ft to 9M + 1980 ft	Proposed box-cut through the face of the escarpment of an alluvial terrace marks the start of an average 8% downgrade to a stream crossing between 9M + 2650 feet and 9M + 2750 feet. The embankments and pavement would be in clay, silt, sand and gravel, overlain by slide material consisting of black silty and clayey soil mixed with sand and gravel.
9M + 1980 ft to 9M + 2650 ft	Fill on alluvial terrace with a small cut through the terrace between 9M + 2450 ft and 9M + 2650 ft for the approach to the stream crossing. The terrace consists of clay, silt, sand, and gravel, overlain by 4-6 feet of black, clayey and silty soil mixed with sandy slopewash derived from the terrace level above the alignment.
9M + 2650 ft to 9M + 2750 ft	Stream crossing.
9M + 2750 ft to 9M + 3700 ft	Cut marking the start of an average 6½% upgrade to the top of a terraced ridge at 9M + 5000 feet. The proposed cut is initially through the face of an escarpment consisting of clay, silt, sand, and gravel then through an alluvial terrace covered with slide debris of silt, sand, and gravel. The slide material was derived from a slump in the face of a terrace escarpment, above the alignment, which was subsequently eroded.
9M + 4280 ft to 10M + 730 ft	Cut through the face of a terrace escarpment to the top of the terraced ridge at 9M + 500 feet, and shallow cut descending at about a 9% grade over successive terrace levels to alluvial stream flats which commence at about 10M + 730 feet. The alluvial terraces consist of clay, silt, sand, and gravel, overlain by 4-6 feet of black, silty and clayey soil.

Chainage	Description
10M + 730 ft to 13M + 1280 ft	In this section the alignment again traverses, with predominantly flat grade, alluvial terraces along the floor of the Wahgi River Valley. As before, the terrace consists of clay, silt, sand, and gravel overlain by 4-6 feet of swampy, black silty and clayey soil. Moderate fill areas are located across gullies cut into the terraces by small streams which drain into the Wahgi River Valley. The sides of the gullies are covered with shallow deposits of slide material consisting of black, silty and clayey soil mixed with sand and gravel derived from the surrounding terraces.
13M + 1280 ft to 13M + 5150 ft	Predominantly cuts with flat grades across alluvial terraces alongside the Wahgi River; deep cuts through spurs of clay, silt, sand, and gravel between 13M + 2750 feet and 13M + 3000 feet, and 13M + 3450 feet to 13M + 3750 feet. The indigenous people in the locality report that the area between 13M + 2000 feet and 13M + 2750 feet is liable to shallow flooding during the wet season. The country above and to the right hand side of the alignment rises steeply for about 400 feet to high-level terraced ridges. The escarpment consists of clay, silt, sand, and gravel; except for minor slopewash, it shows no sign of instability.
13M + 5150 ft to 14M + 460 ft	Fill would be across low-level terraces consisting of clay, silt, sand, and gravel alongside the Wahgi River. The indigenous people report that the terraces are subject to flooding in the wet season. As in the previous section, the ground above and to the right hand side of the alignment rises steeply for about 400 feet, but is stable.
14M + 460 ft to 14M + 4100 ft	The section commences with a proposed cut through a spur of terrace clay, silt, sand, and gravel. Beyond 14M + 1130 feet the alignment continues with a predominantly flat grade requiring moderate cut and fill. It crosses an alluvial terrace surfaced by loose debris of black silty and clayey soil mixed with sand and gravel: the debris is from a terrace which stands 250-300 feet above, and to the right hand side of, the alignment. The debris has accumulated as a result of normal weathering, and there is no indication that the escarpment above the alignment is unstable.
14M + 4100 ft to 14M + 4470 ft	Cut through a spur of a terraced ridge which consists of clay, silt, sand, and gravel overlain by 2-4 feet of silty and sandy slopewash. The alignment crosses two small landslides which have taken place within the sand and gravel in the face of the spur. The

Chainage	Description
	landslide action was initiated by small-scale slumping within the terrace deposits and has been aggravated by erosion during periods of heavy rain.
14M + 4470 ft to 15M + 260 ft	Fill would be on an alluvial terrace consisting of clay, silt, sand, and gravel overlain by 4-6 feet of silty and clayey soil.
15M + 360 ft to 16M + 4700 ft	In this section the alignment traverses, with generally flat gradient, alluvial terraces along the floor of the Wahgi River Valley. The terraces consist of clay, silt, sand, and gravel overlain by 4-6 feet of swampy, black, silty and clayey soil and slopewash. Moderate fills are located across gullies cut into the terrace by small streams which drain into the Wahgi River. The indigenous people in the area report that the section between about 15M + 4500 feet and 16M + 1000 feet is subject to shallow flooding during the wet season.
16M + 4700 ft to 17M + 3000 ft	Except for a gully fill between 17M and 17M + 320 feet this section would be in cut along a 40-45 degree side slope forming the escarpment of a terrace which is about 180 feet above river level. The embankment and pavement would be formed in clay, silt, sand, and gravel which are overlain by 2-3 feet of silty and sandy soil and slopewash. The escarpment is stable and shows no sign of landslide activity.
17M + 3000 ft to 17M + 4000 ft	Stream crossing. The approaches to the probable bridge site are located in terrace clay, silt, sand, and gravel. The terrace level stands about 25 feet above river level.
17M + 4000 ft to 17M + 5000 ft	Both cut and fill are planned for this section. The roadway would be formed on extensive deposits of scree debris beneath a near-vertical terrace escarpment to the right hand side of the alignment. The terrace above the escarpment, of clay, silt, sand, and gravel, has been undercut by the Wahgi River. The resultant slumping has formed the cliffed escarpment and deposited the alluvial debris, which is composed of silt, sand and gravel, at the base of the slope. The thickness of the scree deposit is estimated at about 20-30 feet.
17M + 5000 ft to 18M + 150 ft	Cut through a spur of an alluvial terrace. Both the embankment and the pavement would be formed in clay, silt, sand and gravel which has 2-4 feet of silty and sandy soil and slopewash overlying it.

Chainage	Description
18M + 150 ft to 18M + 550 ft	Fill over a gully on a 25-35 degree sideslope on the upper section of a terrace escarpment. The gully is filled with up to 10 feet of swampy, black silty and sandy soil and slopewash.
18M + 550 ft to 18M + 3250 ft END.	The remainder of the alignment traverses, with flat grade, alluvial terraces of clay, silt, sand, and gravel with 3-5 feet of black, silty and clayey soil on top.

A suitable bridge site to carry the alignment across the Wahgi River can be located anywhere between the end of the section and the existing swing bridge situated about one mile beyond the peg at chainage 18M + 3250 feet. The river is contained within a steep-sided gorge in which tuff, conglomerate and sandstone (strike 315° magnetic dip 10° east) are overlain by up to 80 feet of alluvial terrace deposits.

ALTERNATIVE ROUTE

12M + 1150 ft to 13M + 3400 ft	Shallow cut and fill are planned to cross alluvial terraces which consist of clay, silt, sand, and gravel overlain by 3-6 feet of black, silty and clayey soil. This section includes the crossing of the Wahgi and Gar Rivers. At the Wahgi bridge site the river flows in a straight section and is contained within high alluvial terraces. The Gar is a shallow shingle-bedded river with braided channels, and the main stream is likely to change position without warning during periods of peak flow.
13M + 3400 ft to 13M + 4200 ft	Cut through the face of a terrace escarpment. The terrace consists of clay, silt, sand, and gravel overlain by 4-6 feet of black silty and clayey soil and slopewash.
13M + 4200 ft to 14M + 00 ft	Fill would be over 4-6 feet of swampy, black silty and clayey soil resting on an alluvial terrace. The terrace has a slope of 10-15 degrees towards a deep gully on the right hand side of the alignment.
14M to 14M + 1150 ft	Cut in an alluvial terrace which consists of clay, silt, sand, and gravel overlain by 4-6 feet of silty and clayey soil and slopewash.
14M + 1150 ft to 14M + 1360 ft	Fill would be across a natural drainage depression containing swampy, black, silty and clayey soil and slopewash.
14M + 1360 ft to 14M + 1720 ft	Box-cut is planned through a spur of an alluvial terrace. The terrace consists of clay, silt, sand, and gravel, overlain by 2-4 feet of black, silty soil and slopewash.

14M + 1720 ft to 14M + 2100 ft	Fill across a deep gully incised into alluvial terraces. The sides of the gully are heavily forested and are covered by 2-4 feet of silty and sandy soil and slopewash resting on stable terrace clay, silt, sand, and gravel.
14M + 2100 ft to 15M + 400 ft	Shallow cut and fill would be in alluvial terraces consisting of clay, silt, sand, and gravel overlain by 3-5 feet of black, silty and clayey soil.
15M + 400 ft to 15M + 950 ft	Fill across a broad, shallow gully incised in the alluvial terraces. The sides of the gully are covered with 2-3 feet of silty and sandy soil and slopewash resting on stable clay, silt, sand, and gravel.
15M + 950 ft to END, about 19.5M	In this section the alignment traverses, generally with a flat grade, alluvial terraces of clay, silt, sand, and gravel overlain by 4-6 feet of swampy, black, silty and clayey soil. There is a small stream at about 16M + 300 feet, and a larger, shallow, shingle-bedded stream with braided channels at about 16M + 2200 feet in both of which the main streams are likely to change course without warning in periods of peak flow. The section terminates at a steep-sided, deep stream gully at about 19.6 miles.

CONCLUSIONS

As a result of the investigation of the proposed Minj-Wahgi River roadway it is concluded that:-

1. Geologically the proposed route along the southern side of the river, and also the alternative rout on the northern side of the river beyond chainage 12M + 1200 feet, are suitable for the construction of a roadway.

2. A high proportion of the proposed alignment has a flat grade and would require slight to moderate cut and fill through or over alluvial terrace deposits.

3. Most of the cuts are directly through, or angled across, the faces of terrace escarpments few of which have a vertical fall of more than 40 feet; all the escarpments are considered to be stable. Extensive cuts along escarpments with a vertical fall of more than 40 feet are limited to localities A, B, and E. In these places the greatest vertical height above the alignment is less than 200 feet and the escarpments bound flat-topped terraced ridges.

4. The alluvial terrace deposits are stable; they consist of a moderately-compacted, poorly-sorted mixture of clay, silt, sand, and gravel with irregular lenses and beds of silt and sand. Terrace escarpments and embankments formed in existing road or stream sections stand as near-vertical slopes with little sign of deterioration except where they have been subjected to erosion by running water. Water erosion, however,

washes out the fine material from the deposit and leads to slump collapse of the embankment.

5. The black silty and clayey soil overlying the alluvial terrace deposits tends to be swampy, and adequate drainage facilities will be required to keep the alignment free from water. The deposits are not thick, averaging about 4-6 feet, and formation of the alignment by direct filling and compaction should be adequate.

6. Stability problems will be encountered where the alignment crosses black silty and clayey soil and slopewash which has accumualted on side slopes, in gullies, and at the base of terrace escarpments. Unless the soil and slopewash is removed and the alignment founded on stable terrace deposits, basefailure on the downslope side of the fill can be expected.

7. Areas where most difficulties in construction can be expected are:

(a) 2560 feet to 3200 feet. The alignment requires cut and fill to provide satisfactory grades. It crosses extensive deposits of clay, silt, sand, and gravel which slumped off the vertical face of a terrace escarpment to the right-hand side of the alignment and accumulated in a large, natural drainage depression. Before the road is formed the debris will have to be cleared out of the depression and adequate drainage channels provided.

(b) 3250 feet to 3870 feet. In this section the road will have to be built up; the alignment crosses extensive deposits of black silty and clayey soil and slopewash which have accumulated at the base of a near-vertical terrace escarpment. Before the fill is placed, the soil and slopewash material will have to be removed so that the road can be founded on stable terrace deposits.

(c) 3M + 600 feet to 4M + 7500 feet. Between these chainages the alignment traverses a deep gully incised into an alluvial terrace; cut and fill are required along and below the face of the escarpment of a high terraced ridge. The section has an average downgrade of $9\frac{1}{2}\%$ and takes the proposed road from the highest terrace level to the floor of the Wahgi River Valley. Construction of a stable road in this section is feasible but will require extensive earthworks including the removal of soil and slopewash on terraced areas and extensive benching of all embankments cut along side slopes. The additional earthwork required may increase the total excavation allowed for in the provisional design by as much as 50%.

(d) 9M + 2750 feet to 10^{M} + 730 feet. In this section there is both cut and fill on an average $6\frac{1}{2}\%$ upgrade across scree deposits of clay, silt, sand and gravel. The scree formed by slumping of the face of a terrace escarpment above, and to the left-hand side of, the alignment. The scree deposits will have to be removed and the road founded on the stable terrace deposits underneath the scree.

(e) 14M + 4101 feet to 14M + 4470 feet. The line of the road crosses two slumps in the face of a spur of terrace clay, silt, sand, and gravel. Removal of the slumped material, and benching out of that part of the slip exposed above the alignment, will be necessary.

(f) 16M + 4700 feet to 17M + 3000 feet. Here a road cut is proposed along the face of a terrace escarpment which drops away at about 45 degrees into the Wahgi River. To ensure that the road is stable it will be necessary to bench the embankments and provide some form of protection against river erosion - probably rock-filled baskets - for the river-side of the road.

(g) 17M + 3000 feet to 17M + 4000 feet. Bridge site. The approaches and foundations for the bridge consist of terrace clay, silt, sand, and gravels and the abutments must be piled.

(h) 17M + 4000 feet to 17M + 5000 feet. Cut in, and fill on, clay, silt, sand, and gravel scree from the face of a terrace escarpment to the right-hand side of the alignment is proposed. The scree will have to be removed and the road founded on stable terrace deposits. It will also be necessary to provide protection for the outside of the road against river erosion.

(i) Alternative Route: The Gar River and the stream located at about 16M + 300 feet are shallow, shingle-bedded rivers with braided channels which are liable to change course without warning during periods of peak flow. As such they provide difficult sites for the construction of a permanent bridge crossing.

(j) Alternative Route 14M + 1720 feet to 14M + 2100 feet. This section involves the construction of a 70-foot fill across a deep, steep-sided gully which may be expected to carry a high volume of water in the wet season. It is considered that a large fill in such a situation may prove to be impracticable and that the alternative of bridging should be considered.

RECOMMENDATIONS

It is recommended that:-

1. All embankments in alluvial terrace clay, silt, sand, and gravel should be cut nearly vertical; a suggested gradient is $\frac{1}{4}$:1. In the Minj-Wahgi Valley area all escarpments and embankments cut in alluvial terraces by roads and streams stand with little sign of instability at slopes steeper than 45 degrees. Exposed embankments with slopes flatter than 45 degrees are extremely susceptible to erosion by running water which washes out the fine material and leads to slumping of the embankment.

2. Embankments should have a maximum vertical height which from field observations should be about 40 to 50 feet. The validity of this figure should be verified by materials tests if possible.

3. Where fills are to be located on side slopes, particularly in gullies and at the base of terrace escarpments, all soil and slopewash material should be removed and stable terrace clay, silt, sand, and gravel exposed before the fill is placed. Soil and slopewash material should not be used as fill.

4. All culverts in fill areas should be so designed that storm run-off and flood waters can be cleared as quickly as possible. If water is permitted to dam up to more than half the height of the fill, over-saturation of fill material, which would initiate failure of the roadway, could take place.

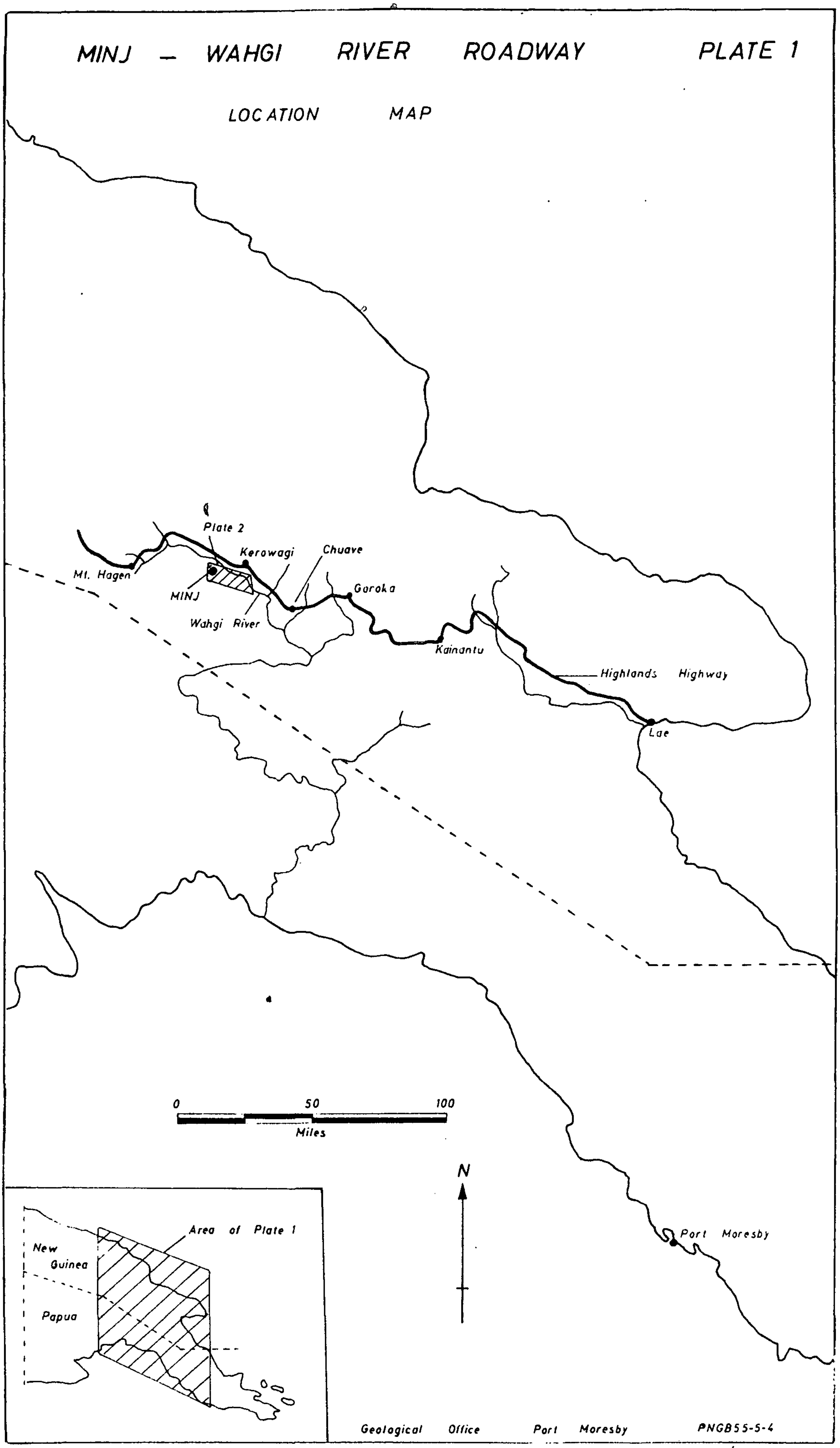
5. All reports by indigenous people living in the low-lying areas, adjacent to the proposed route, that the route is subject to flooding should be checked for reliability before the final design is prepared.

6. The route on the southern side of the Wahgi River should be followed in preference to the alternative route beyond chainage 12M + 1200 on the northern side of the river. Both routes are suitable for development but the alternative includes two, and possibly four, extra bridges, two of which are across rivers where it will be difficult to obtain satisfactory bridge sites. In addition the alternative route terminates in a steep sided, deep gully which will have to be negotiated before the link with the section from the Wahgi River to Kerowagi can be completed.

7. Investigation should be carried out to determine the feasibility of by-passing the section of the alignment between Minj and about chainage 5 mile. A suggested route for investigation runs north-east from Minj, crosses the Minj River about $\frac{3}{4}$ mile above its confluence with the Wahgi River and then along the low-lying alluvial terraces on the southern side of the Wahgi River Valley as far as chainage 5 mile. Such a route would have a predominantly flat grade with shallow cut and fill across terrace clay, silt, sand, and gravel overlain by about 4-6 feet of black, silty and clayey soil and would avoid the difficult, heavy earthwork sections in localities A and B. It may also decrease the overall cost of the project, provided a suitable site for the Minj River bridge can be located.

REFERENCE

Rickwood, F.K., 1955 - The Geology of the Western Highlands of New Guinea. J. Geol. Soc. Aust., 2, 63-82



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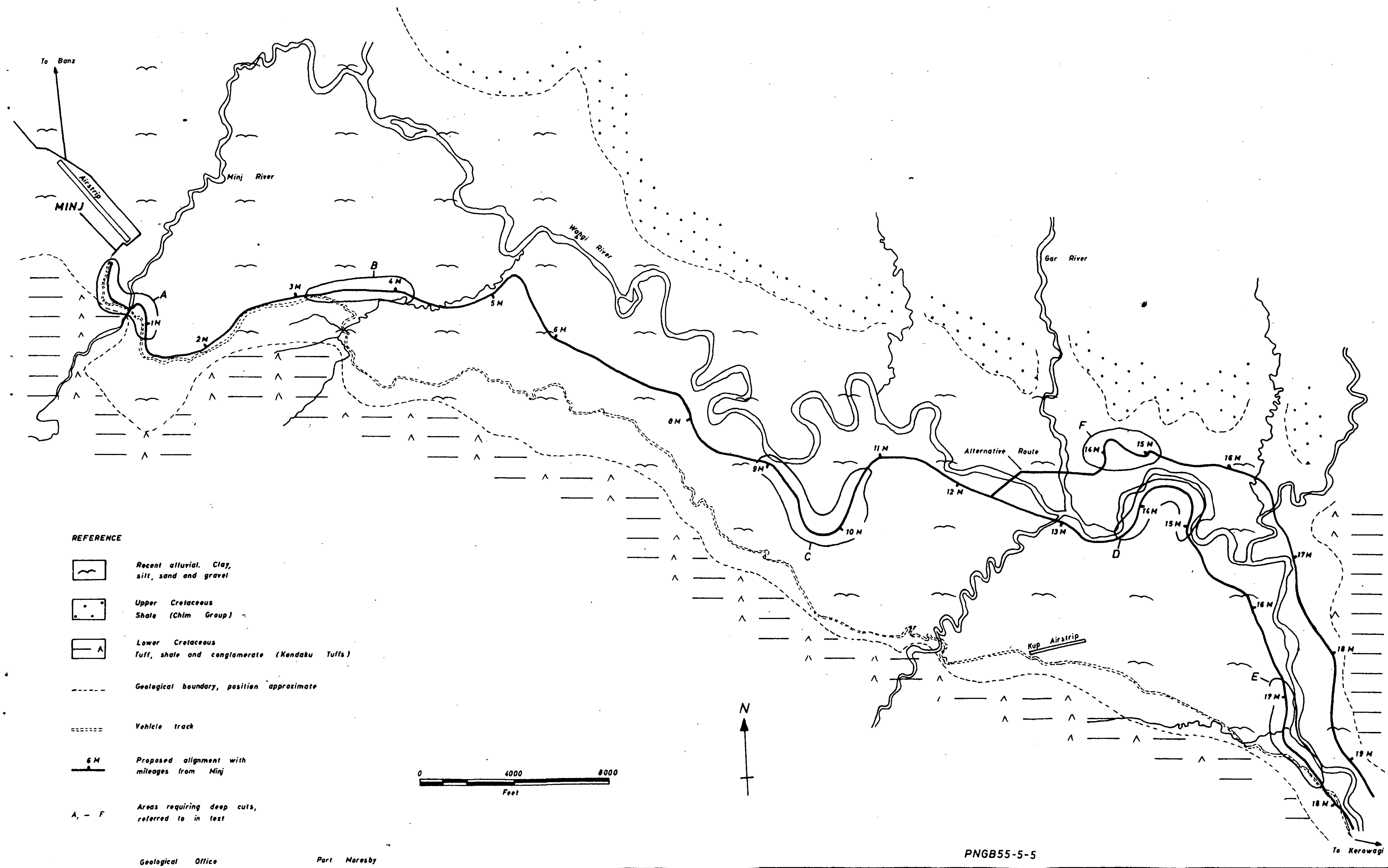
MINJ — WAHGI RIVER ROADWAY

PLATE 2

GEOLOGICAL MAP SHOWING PROPOSED ALIGNMENT



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