DEPARTMENT OF NATIONAL RESOURCES

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

Record 1978/84

GOOGONG PIPELINE ACT AND NSW: GEOLOGICAL MAPPING OF EXCAVATIONS DURING CONSTRUCTION, 1977-78

by

G.A.M. Henderson

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SUMMARY

The Googong pipeline supplies water from Googong Dam to Canberra and Queanbeyan. The pipeline was buried in a trench excavated through Ordovician and Silurian sedimentary and igneous formations, and Tertiary to Recent superficial deposits. Mapping of the rock units in the trench has provided useful information that will contribute towards a better understanding of the local geology.

Excavation conditions as predicted in 1975-76 were accurate for much of the route of the pipeline trench. Water seeping into the trench in a few places excavated after prolonged dry weather was less than it might otherwise have been.

INTRODUCTION

The Googong Pipeline (Fig. 1) carries water from the Googong Dam water treatment plant, 6 km southeast of Queanbeyan (NSW), to the Campbell Reservoir on the flank of Mount Ainslie, in Canberra (ACT); the entire 22.5 km pipeline is buried. The pipeline was laid between December 1976 and April 1978, and geological mapping of the excavations was carried out as work progressed.

Before the pipeline was laid the route was investigated by the Bureau of Mineral Resources at the request of the Department of Construction (DC).(1) The assessment consisted of field inspections of the entire route and seismic refraction surveys at 38 selected locations (Bennett & Polak, 1975; Furstner, 1976).

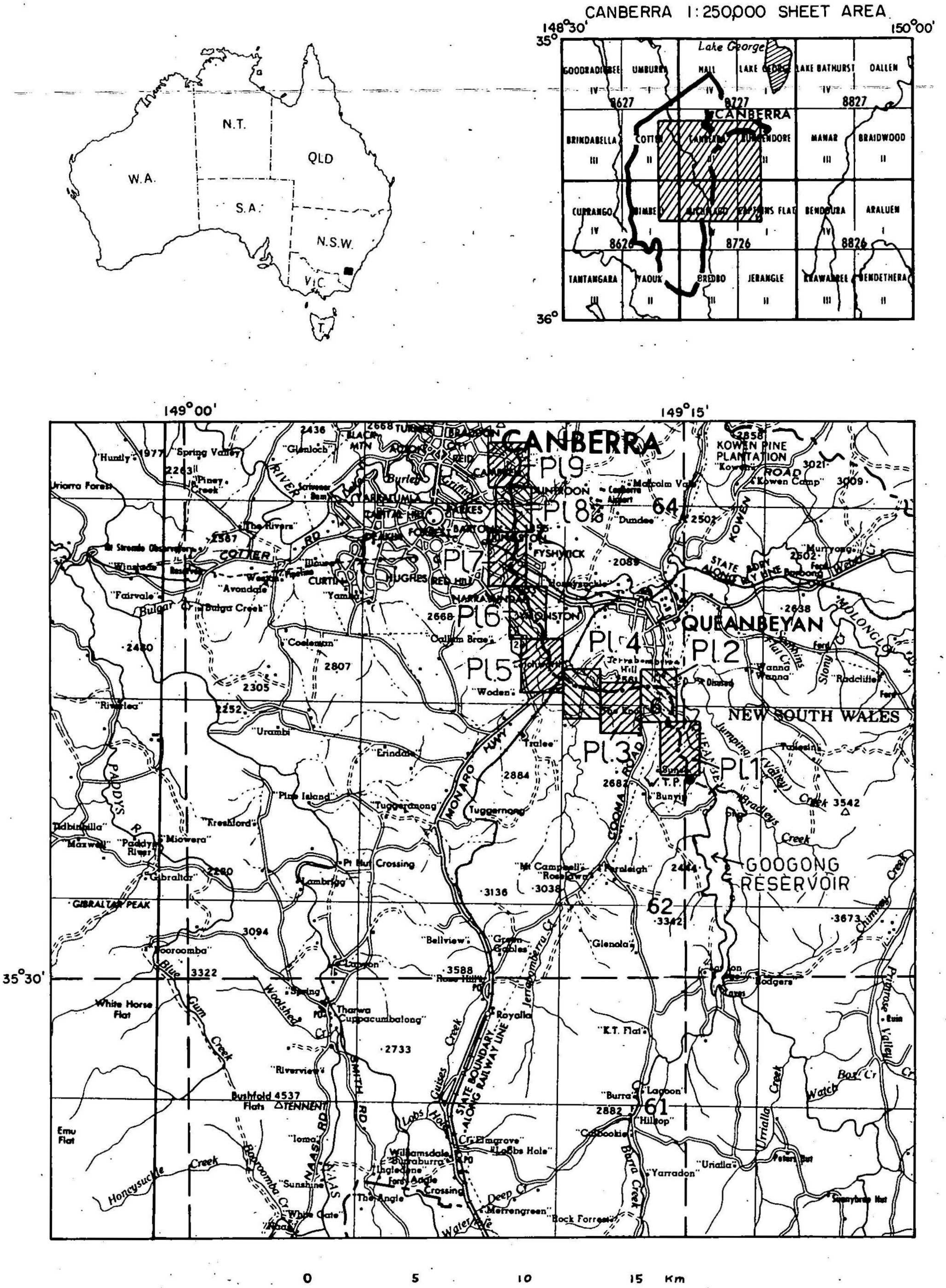
GEOLOGY

Rocks ranging in age from Ordovician to late Silurian, and superficial deposits of Tertiary? to Recent age, were exposed during excavation of the pipeline trench (see Plates 1-9). These notes are restricted mainly to observations and discussion of features revealed in the pipeline trench. A limited amount of outcrop mapping adjacent to the pipeline was also done concurrently, mainly in the area of Ordovician rocks south of Jerrabomberra Hill. A general account of the geology of the Canberra area is contained in the Canberra and Queanbeyan 1:50 000 special geological map and explanatory notes (Henderson, in prep.).

Pipeline chainages shown in Plates 1-9 are in kilometres from the treatment plant, and accord with those in DC drawings CD74/566 and CD71/79B11; along the ACT section of the route, chainages differ slightly from those in the investigation reports. Rock types or superficial deposits indicated along the pipeline route are those observed at the bottom of the excavated trench; e.g., where alluvium overlies shale, shale, not alluvium, is shown.

GOOGONG PIPELINE LOCATION MAP

Fig.1



ORDOVICIAN

Pittman Formation (Pls. 2 and 3)

Sandstone, shale, and chert of the Pittman Formation were well exposed for several hundred metres immediately west of Barracks Creek; farther west the trench was excavated within colluvium in most places. A short section of Ordovician sandstone was also mapped east of Barracks Creek at about chainage 4.70 km. Outcrop mapping on the slopes adjacent to the pipeline indicates a useful marker bed of chert; however it could not be established with certainty that all chert outcrops are at the one stratigraphic level. The sandstone at the eastern end of the Ordovician exposures contained more mica and feldspar than those to the west and could be more accurately described as a greywacke.

The trench exposures revealed complex structure with extremely variable strike and dip of bedding, and, in a few places, small folds plunge steeply and shallowly to the north and south. Progressive steepening and reversal of dip direction is inferred between chainages 6.10 and 6.30 km, implying overturned bedding, but no downward facing sedimentary structures were observed. Small faults were evident at several places in the trench. The structural style is consistent with that described to the east by Stauffer & Rickard (1966). No evidence was found in the trench near Barracks Creek for the thrust fault which is shown on Stauffer and Rickard's map as forming the boundary between the Pittman Formation and the Barrack Creek Adamellite at about chainage 5.05 km; the contact was intrusive.

Acton Shale Member (Pl. 3)

A short exposure length of siliceous shale at chainage 6.80 km was readily identifiable as Acton Shale Member. A northwesterly dip and northerly plunge indicates that the exposures of other Ordovician rocks to the south and east are probably all older than the Acton Shale. The Acton Shale has previously been mapped trending north along the eastern slopes of Jerrabomberra Hill (Phillips, 1956), which is a few hundred metres north of the pipeline at about chainage 6.5 km.

MIDDLE TO LATE SILURIAN

Canberra Group? (Pl. 8)

A section of about 140 m of fresh green-grey mudstone was exposed in the trench beside Dairy Flat Road near chainage 18 km. Opik (1958) mapped an outcrop of Mahon Formation (Fairbairn Group) in this area. However, the mudstone exposed in the trench was similar to the exposure of the Riverside Formation (Canberra Group) at Woolshed Creek. Fossils common to both the Riverside Formation and Fairbairn Group were recovered from the mudstone. They included the brachiopods Atrypa and Howellella?, the trilobite Encrinurus and other indeterminate fragments (D.L. Strusz, pers. comm.).

Fairbairn Group (Pls. 6 and 7)

Sedimentary rocks of the Mahon Formation (Fairbairn Group) were exposed along two sections between chainages 13.09 and 14.07 km (Pl. 6). Poorly bedded shale, in part tuffaceous, was exposed along the southern of these two sections. To the north of chainage 13.5 km most of the section to the first exposure of the Narrabundah Ashstone at chainage 14.66 km is covered by alluvium. However, a short length of slightly weathered calcareous sandstone and siltstone was exposed near chainage 14.00 km. The sandstone at one point is thinly bedded and contains small-scale slump structures in silty laminations.

Siltstone of the Fairbairn Group (Molonglo River Formation?) was exposed underlying alluvium along Canberra Avenue, and underlying the Fyshwick Gravel north of the Ipswich Street railway bridge (Pl. 7). The siltstone along Canberra Avenue overlies the Narrabundah Ashstone and is purple near the base.

Narrabundah Ashstone (Pls. 6 and 7)

The main exposure of the Narrabundah Ashstone along the pipeline trench was between chainages 14.66 and 15.58 km. The rock is blocky-jointed and hard, and, in places, bedding is obscure. Bedding becomes increasingly obvious south of chainage 15.0 km, where a few thin beds of medium-grained tuff form part of the sequence. The bedding attitudes between chainage 14.66

and 15.0 km indicate a syncline plunging about 12° ENE. Opik (1958) regard the Narrabundah Ashstone as the final eruptive stage of the Ainslie Volcanics, unconformable on the Silurian sedimentary rocks, and probably of early Devonian age. However, the contact relations observed along Canberra Avenue (see Fairbairn Group, above), and the plunge direction of the syncline mentioned above, which is towards outcrops of the Mahon Formation, do not support this view. It appears more likely that the ashstone is within, or underlies, the Fairbairn Group. The exposure of Narrabundah Ashstone near the intersection of Canberra Avenue and Ipswich Street showed large and irregular variations of dip and strike, possibly indicating the proximity of a major fault.

Ainslie Volcanics (Pls. 8 and 9)

Rocks belonging to the upper part of the Ainslie Volcanics were exposed between Duntroon (Pl. 8) and Campbell Reservoir (Pl. 9). Two main rock types were revealed: one has been mapped as quartz andesite, although most exposures were too weathered for its composition to be reliably determined; the other is a white rhyolite which corresponds with Opik's Mount Pleasant Porphyry. The rhyolite between chainage 20.5 and 20.6 km contains the mineral damourite, a green chromium mica. The contact between the rhyolite and quartz andesite was probably exposed under Northcott Drive but, being under a main road, the trench was dug and backfilled again before it could be mapped. This was unfortunate as the contact could have provided further evidence that the rhyolite overlies the quartz andesite as now inferred from rhyolite outliers elsewhere. This differs from Opik's interpretation of the rhyolite as an inlier of Silurian porphyry in an Early Devonian volcanic sequence (Ainslie Volcanics).

The Ainslie Volcanics were not exposed in the pipeline trench south of Fyshwick, owing to a thick cover of alluvium.

Colinton Volcanics (Pl. 1)

Much of the pipeline section between the water treatment plant and Wickerslack Lane was excavated in dacite of the Colinton Volcanics and in associated sedimentary rocks. Two main dacite rock types were mapped: one a strongly foliated almost schistose variety; the other an almost massive type. Foliation in the dacite, and interbeds of shale up to about 3 m thick,

dip steeply to the southeast. Bedding and foliation are essentially parallel where the shale lenses occur. Isoclinal folding overturned to the northwest is suspected in the volcanics but cannot be established. Repetition of the massive dacite by one of the northeast-trending faults is indicated.

A thick shale formation, much of which is metamorphosed to phyllite or slate, occurs between about chainages 1.9 and 2.2 km. This shale is part of the shale and limestone marker unit which defines a pronounced strike swing around the southern and eastern side of the Barrack Creek Adamellite (see Stauffer, 1967). The shale, which dips southeast under the dacite, probably correlates with the shale and limestone which dips west under the same dacite south of Googong Dam (Goldsmith & Evans, in prep.).

A distinctive dacite of gneissic appearance was exposed over a length of a few metres at chainage 1.16 km. The texture is the result of segregation of lenses of pale and dark constituents; the resultant banding is parallel to the foliation in the adjacent dacite.

LATE SILURIAN

Mount Painter Porphyry (Pl. 5)

Brown highly to extremely weathered dacite was exposed beneath alluvium between chainages 11.5 and 12.0 km. The area including this section of the pipeline has previously been mapped as Mount Painter Porphyry from outcrops nearby, and the weathered rock exposed in the trench appeared to be typical of the porphyry as it has been observed in its weathered state in excavations elsewhere.

Yarralumla Formation (Pl. 5)

Banded reworked purple tuff was exposed at chainage 11.4 km. The tuff dips south under the Mugga Mugga Porphyry and this relationship indicates that it represents the topmost part of the Yarralumla Formation (see Henderson, in prep.). The relation between the tuff and the Mount Painter Porphyry to the north was obscured by alluvium.

Mugga Mugga Porphyry (Pls. 4 and 5)

Rhyodacite mapped as Mugga Mugga Porphyry was exposed along a 3 km section that straddles the ACT-NSW border. Unweathered rock, where exposed in the trench, was dark grey or purple. Where the pipeline crosses Tharwa Road, a bed of fossiliferous tuffaceous shale - containing the brachiopod Atrypa, a linguloid brachiopod, and a gastropod (D.L. Strusz, pers. comm) - indicates that the porphyry consists of at least two separate volcanic flows dipping south-southeast to south-southwest. Banded purple tuff overlying the topmost flow was exposed from chainage 8.5-8.6 km.

The origin, whether intrusive or extrusive, of some of the acid porphyries around Canberra including the Mugga Mugga Porphyry has been the subject of contention (see Henderson, in prep.). Apparently discordant contacts between the Mugga Mugga Porphyry and the bed of fossiliferous tuffaceous shale are exposed beside Tharwq Road, and were also exposed in the pipeline trench. Slight contact metamorphism of the overlying sediments, together with the apparently discord contacts, appear to indicate that the underlying porphyry is intrusive. Exposures with similar characteristics have been seen between acid porphyries and sedimentary rocks elsewhere in the Canberra area, but most of these porphyries, including the Mugga Mugga Porphyry, show microscopic features indicative of volcanic rocks. Four alternative explanations can be offered to explain the conflicting evidence illustrated by the pipeline exposure.

1. The porphyry is entirely intrusive.
2. A thin intrusive sill of similar composition to, and indistinguishable from, the porphyry has been emplaced between the top of a volcanic porphyry and the overlying sedimentary rocks.
3. Unconsolidated reworked, or non-welded, porous tuff at the top of the volcanic flow has been mobilised, as a result of deep burial, and favourable conditions of temperature and pore water pressure, to form a slurry which has worked its way up to higher levels in the sequence. The slurry would not have been a magma but would have been hot enough to cause slight metamorphism of the sedimentary rocks with which it came in contact.

4. Sedimentary material has been rafted up during extrusion of a volcanic flow.

Explanation 3 is favoured provided such a process is theoretically possible.

INTRUSIVES OF LATE SILURIAN? AGE

Barrack Creek Adamellite (Pls. 1 and 2)

Most of the pipeline section from south of Wickerslack Lane to Barracks Creek was excavated in Barrack Creek Adamellite; the rock was generally weathered to a coarse brown crumbly material except along a few short sections. Fresh rock was excavated at only three places; aplite veins and dykes exposed in several places were less weathered that the surrounding coarser rock.

The intrusive contact of fresh pale grey adamellite with Ordovician sedimentary rocks was exposed over a short length immediately west of chainage 5.0 km. Greenish adamellite of uneven texture and containing pink feldspar was exposed near chainage 3.5 km. The rock gave the appearance of being a hybrid of adamellite and dacite of the Colinton Volcanics. Greenish adamellite of coarse even texture was exposed at chainage 2.4 km. A small offshoot of the adamellite intrudes foliated dacite (Colinton Volcanics) at chainage 1.67 km.

Googong Adamellite (Pl. 1)

The southern end of the pipeline trench was excavated in the Googong Adamellite (formerly Googong Granite). Much of the rock was fresh coarse grey adamellite with a greenish tinge owing to partial alteration of plagioclase to epidote. In some places the rock contained large pink feldspar megacrysts. The contact with the massive dacite (Colinton Volcanics) to the north was not clearly exposed in the trench owing to weathering.

Basic dykes and other minor intrusives

A weathered dolerite dyke several metres wide was intersected in the trench at chainage 5.17 km (Pl. 2). Fresh outcrops of the dolerite were also mapped a short distance west of the trench exposure. Another weathered

dolerite dyke was intersected at chainage 3.9 km (Pl. 2).

A weathered coarse-grained acid igneous rock ('granite') in intrusive contact with shale of the Fairbairn Group was exposed at chainage 13.2 km (Pl. 6). The proximity of volcanic rocks (Ainslie Volcanics) to this exposure indicates that the 'granite' could represent another exposure of the type at Tharwa Road which has been discussed above.

TERTIARY?

Fyshwick Gravel (Pl. 7)

The Fyshwick Gravel was well exposed where the pipeline trench crossed the main deposit at Fyshwick. The gravel consisted of well-rounded, almost exclusively quartz pebbles in a white to yellow-brown coarse sandy matrix. In places the underlying highly to extremely weathered clayey siltstone of the Fairbairn Group was exposed beneath the gravel. A channel filling of gravel in rock was exposed at chainage 16.8 km. The gravel slumped during excavation in places between chainages 16.5 and 16.7 km, particularly where it was resting on bedrock surfaces sloping steeply towards the trench. Opik (1958), who proposed a Permian age for the gravel, regarded slump folding of the gravel as being the result of an overriding ice sheet. However, the base of the gravel in the trench tended to reflect the present day contours in the land surface, indicating that slumping could have been from higher to lower levels; the gravel could have slumped when meanders of Jerrabomberra Creek and the Molonglo River undercut the gravel terraces.

QUATERNARY

Aeolian Sand

Fine red-brown aeolian sand was exposed at Duntroon (Pl. 8) where much of it was more than 3 m thick. Similar sand was also exposed overlying the mudstone beside Dairy Flat Road at chainage 18.0 km, and for some distance to the south (Pls. 7 and 8).

Colluvium

A considerable length of the pipeline trench south of Jerrabomberra Hill (Pls. 3 and 4) was excavated in colluvium derived from the steep slopes

to the north and south of the pipeline. The colluvium covers rock on the crest of the saddle at chainage 6.25 km, and indicates that the position of the saddle has been moved progressively westwards by downcutting at the head of the steep watercourse on the eastern side.

Colluvium derived from Mount Ainslie covers much of the area north of Fairbairn Avenue (Pl. 9).

Alluvium

The main areas excavated in alluvium were along Jerrabomberra Creek (Pl. 6) and across Dairy Flat (Pl. 8). Two terrace levels were crossed in the alluvium along Jerrabomberra Creek between chainages 12.00 and 13.09 km, with a 2-3 m difference in elevation. The lower terrace was between chainages 12.2 and 12.7 km, and the excavated material consisted of black organic clay. On the higher terrace immediately to the north, layers of mottled white and brown clay up to 1 m thick overlie sandy clay which is possibly residual extremely weathered volcanic rock (Ainslie Volcanics). None of the alluvium across Dairy Falt was mapped in detail but much of it consisted of black organic silt and clay. Coarse alluvial sand was mapped underlying the fine aeolian sand at the main entrance to Duntroon at Morshead Drive.

EXCAVATION CONDITIONS

ROCK AND OVERBURDEN CHARACTERISTICS

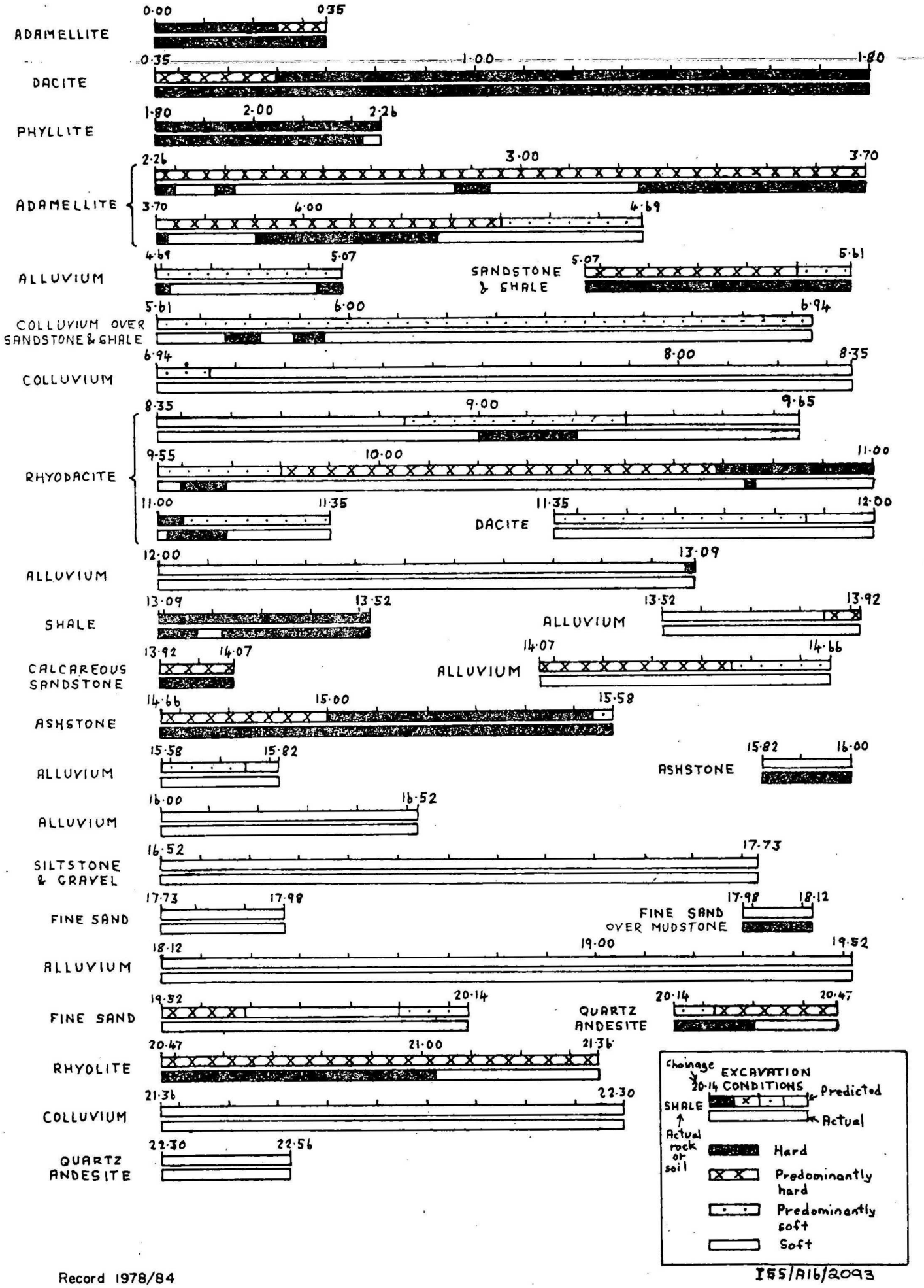
Furstner (1976) divided the pipeline route into sections according to predicted rock and overburden characteristics from the surface to the designed depth of the trench. The four categories he defined were:

1. SOFT GROUND, consisting of unconsolidated sediments such as topsoil, alluvium, colluvium, etc., or highly to extremely weathered bedrock; seismic velocities generally less than 1200 m/sec; generally possible to excavate by backhoe without the use of explosives.
2. HARD GROUND, consisting of fresh to moderately weathered bedrock with less than 1 m overburden; seismic velocities generally more than 1200 m/sec; material not rippable by a backhoe and requiring blasting.

Fig. 2

GOOGONG PIPELINE

PREDICTED AND ACTUAL EXCAVATION CONDITIONS



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3. PREDOMINANTLY SOFT GROUND, consisting of more than 50% soft ground.
4. PREDOMINANTLY HARD GROUND, consisting of more than 50% hard ground.

Figure 2 shows a diagrammatic comparison between predicted and actual rock and overburden conditions. Plates 1-9 show also soil and weathering profiles at representative localities. Actual conditions are divided into only two categories, hard and soft, depending on whether blasting was necessary or not, as assessed from the excavated material.

Along much of the route, actual excavation conditions were predicted accurately, but in places, the predicted conditions were at variance with the actual conditions. For instance much of the Barrack Creek Adamellite (chainage 2.26 to 4.69 km) and Mugga Mugga Porphyry (rhyodacite, chainage 8.35 to 11.35 km) were more easily excavated than predicted. Both rock types weather in a very irregular manner, making it difficult to predict the state of weathering at depth at a particular place, or to choose reliable representative sites for seismic refraction traverses.

GROUNDWATER

Groundwater seeped into the excavations at some places along the sections excavated in colluvium and in low-lying areas of alluvium. Some of the potentially more serious seepage areas, for instance in part of the colluvium south of Jerrabomberra Hill (Pls. 3 and 4), were excavated after an abnormally dry season and the seepages were less than they might otherwise have been.

CONCLUSIONS

1. Additions to the geological knowledge of the Canberra area as a result of the pipeline excavations include:

   (a) a revised stratigraphic position for the Narrabundah Ashstone within or underlying the Fairbairn Group, and
   (b) additional observations of rock contacts relevant to the problem of intrusive versus extrusive porphyries.

2. Reasonably reliable predictions of excavation conditions are possible with limited seismic refraction and geological knowledge

in the Canberra area, but predictions are difficult for some types of igneous rock which may show little relation between weathering profiles and surface features.

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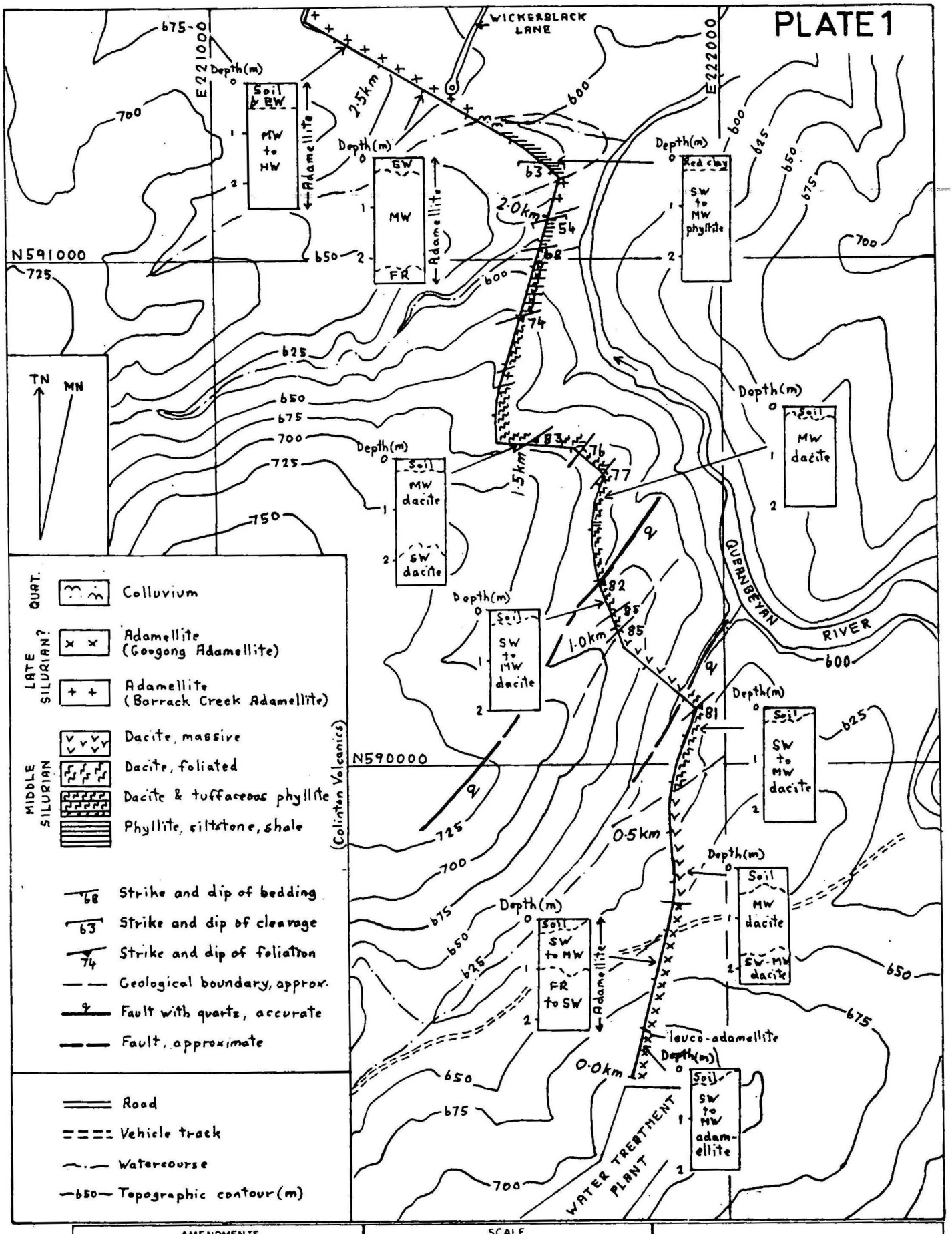
PLATE 1



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A2	Water treatment plant added 5/7/78	G.A.M.H.	
A3			
A4			
A5			

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Base map/survey A.C.T. 1:10,000 SERIES SHEET 216.588 & DEPT. CONSTR. DRAWING CD71/79 B11

Geology by G. A. M. Henderson

Compiled and checked G.A.M.H. Project geologist

Checked and approved Senior geologist

E.G. WILSON Supervising geologist

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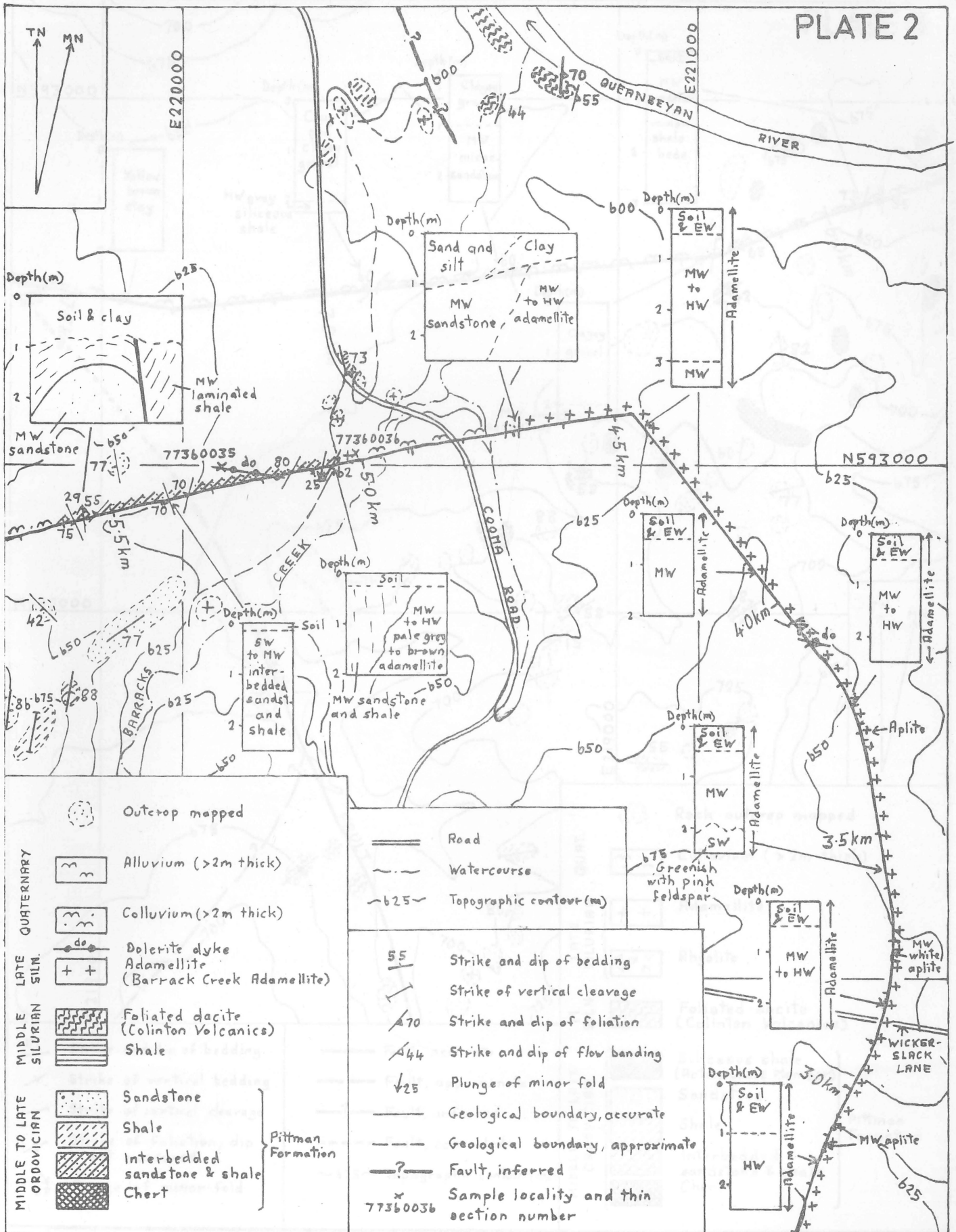
CANBERRA, A.C.T.

TITLE **GOOGONG PIPELINE**

GEOLOGICAL DATA FROM EXCAVATIONS Sheet 1
CHAINAGE 0·00 – 2·70 km

To accompany	Drawn by	Drawing No.
Record 1978/84	C.A.M.H.	I55/A16/2094



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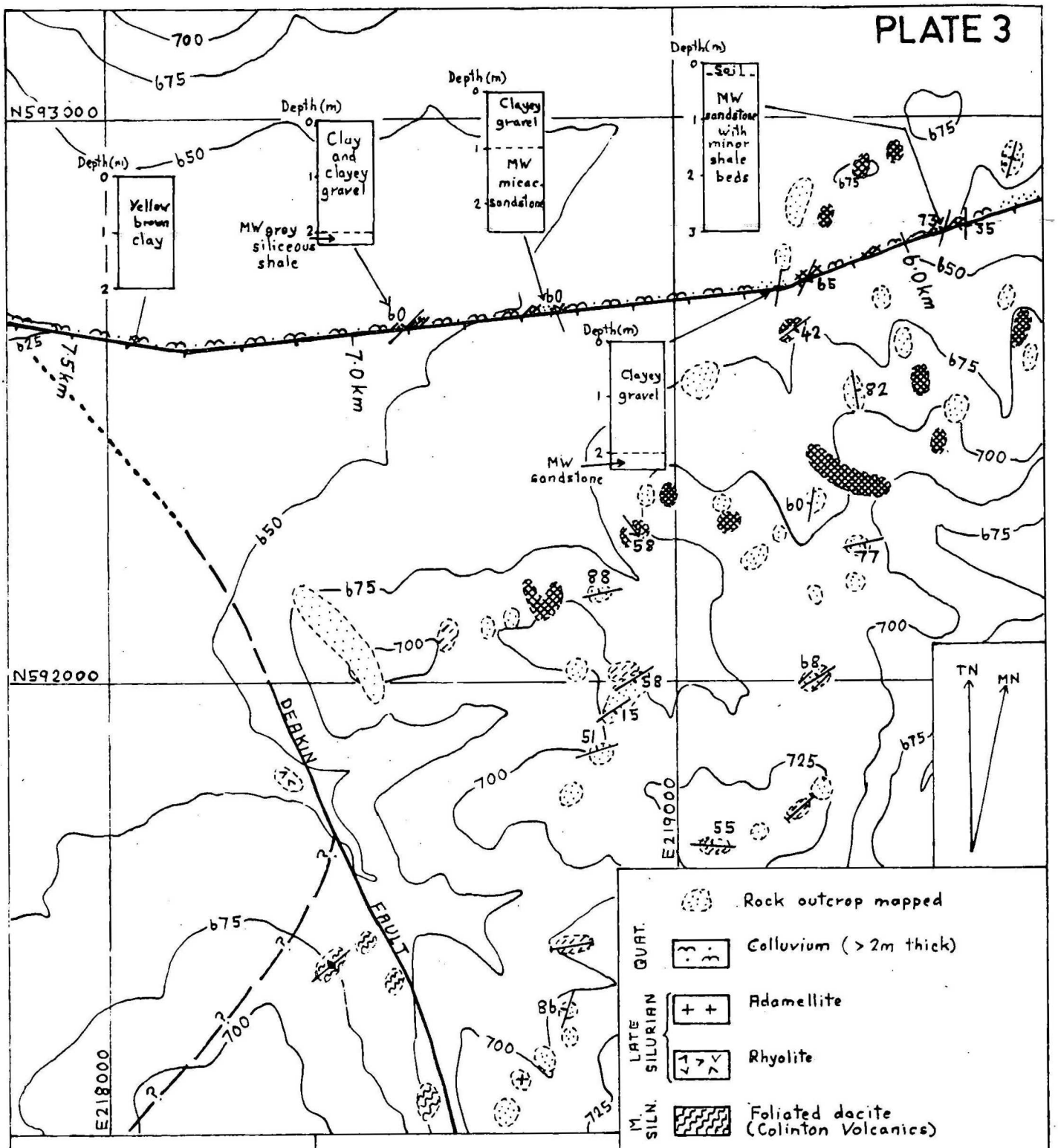
TITLE
GOOGONG PIPELINE
GEOLOGICAL DATA FROM EXCAVATIONS Sheet 2
CHAINAGE 2.70 - 5.74 km

To accompany Record 1976/84

Drawn by G.A.M.H.

Drawing No. 155/A16/2095

PLATE 3



Rock outcrop mapped

QUAT. — Colluvium (> 2m thick)

LATE SILURIAN — Adamellite; Rhyolite

M. SILN. — Foliated dacite (Colinton Volcanics)

MIDDLE TO LATE ORDOVICIAN — Siliceous shale (Acton Shale Member); Sandstone; Shale; Interbedded sandstone & shale; Chert — Pittman Formation

51 Strike and dip of bedding

Strike of vertical bedding

Strike of vertical cleavage

Strike of foliation, dip not measured

58 Plunge of minor fold

Fault, accurate

Fault, approximate

?— Fault, inferred

Fault, concealed

~675~ Topographic contour(m)

AMENDMENTS			
No.	Description	Author	Checked
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A3			
A4			
A5			

SCALE 0 100 200 300 400 500m

Base map/survey & DEPT. CONSTR. A.C.T. 1:10,000 SERIES SHEET 216.588 DRAWING CD71/79811

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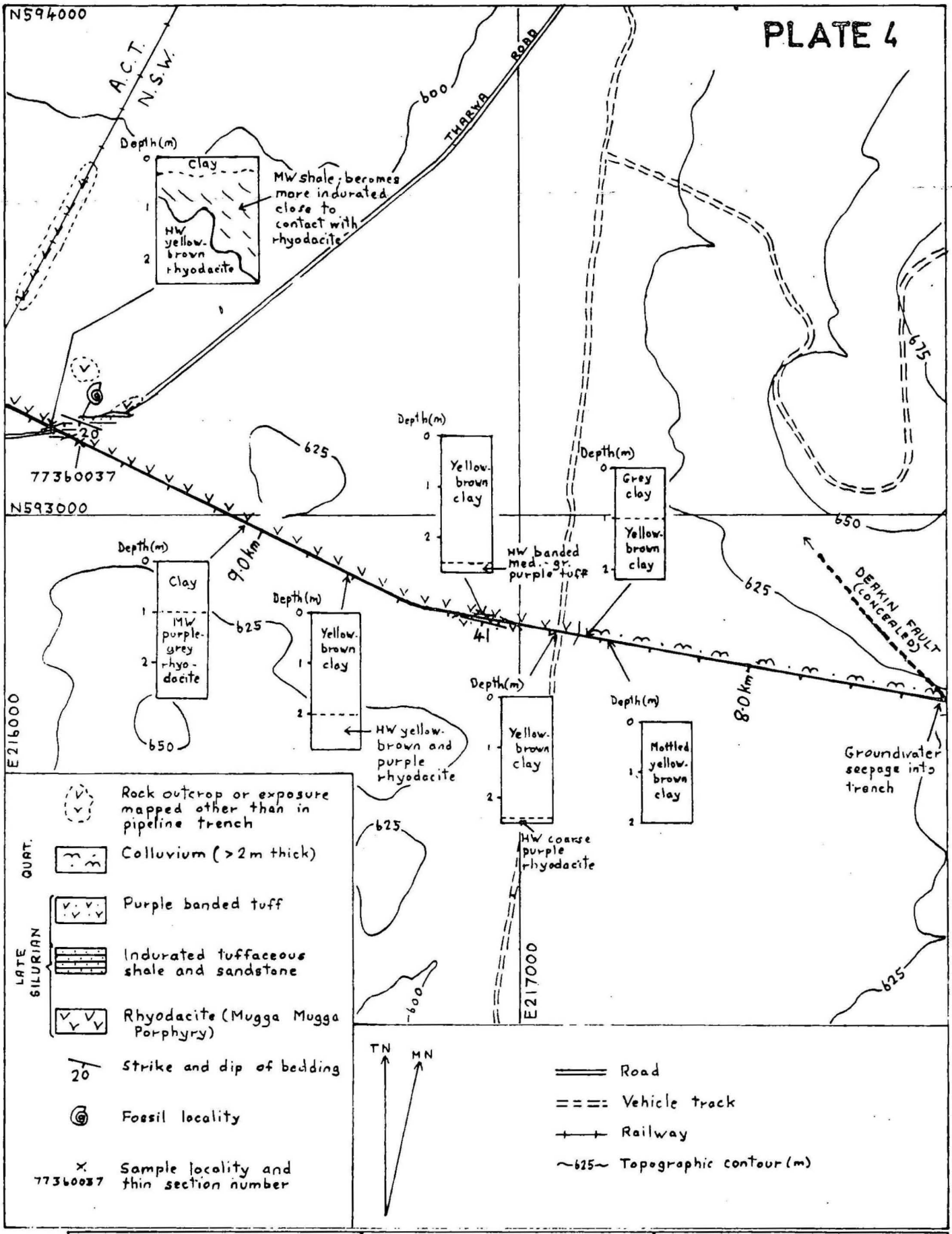
TITLE
GOOGONG PIPELINE

GEOLOGICAL DATA FROM EXCAVATIONS Sheet 3
CHAINAGE 6·74 – 7·12 km

To accompany	Drawn by	Drawing No.
Record 1978/84	G.A.M.H.	I55/A16/2096

PLATE 4



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A5			

SCALE 0 100 200 300 400 500m

Base map/survey A.C.T. 1:10,000 SERIES SHEET 216-588 & DEPT. CONSTR. DRAWING CD71/79811

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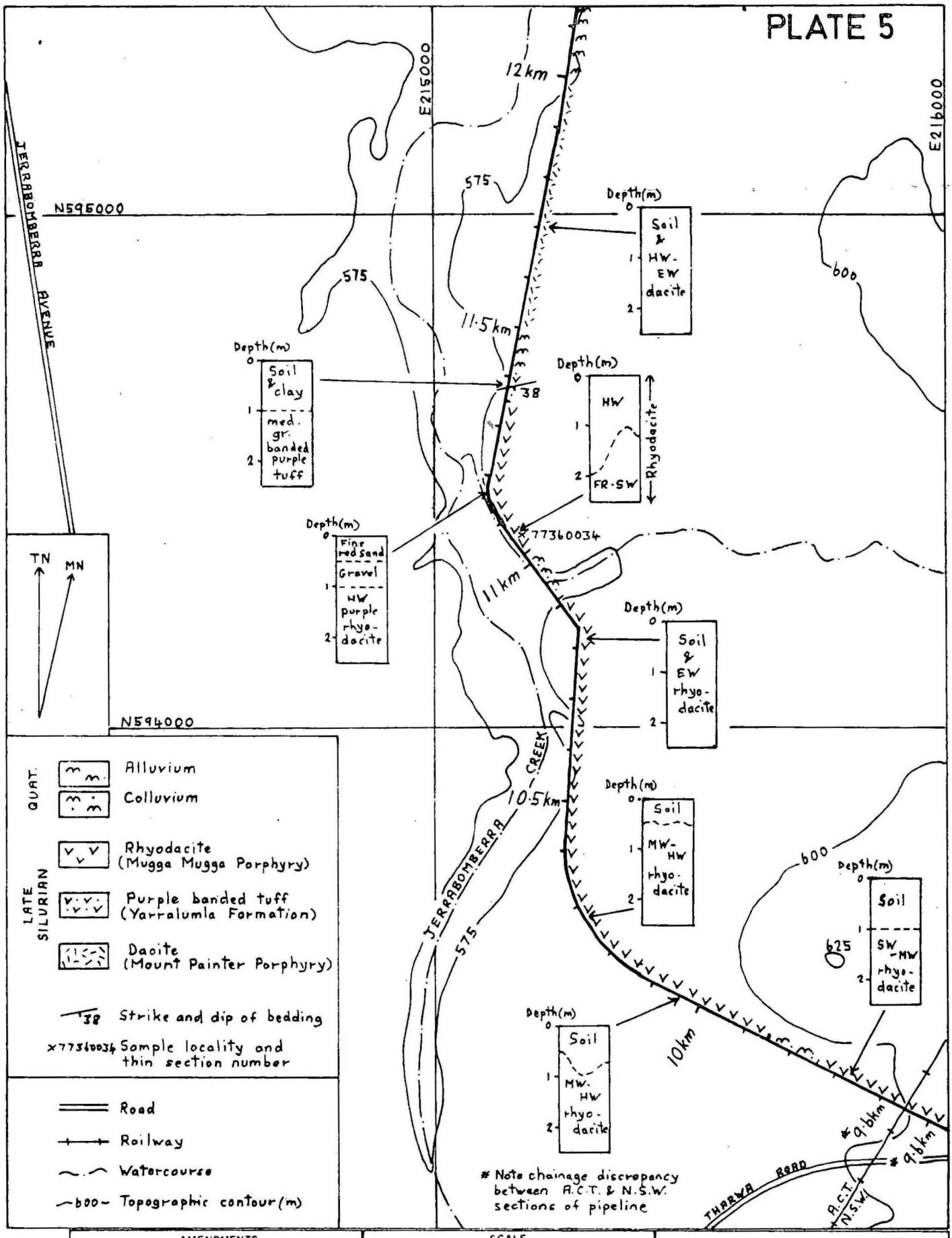
TITLE
GOOGONG PIPELINE
GEOLOGICAL DATA FROM EXCAVATIONS
CHAINAGE 7·12 – 9·56 km
Sheet 4

To accompany	Drawn by	Drawing No.
Record 1978/84	G.A.M.H.	155/A16/2097

PLATE 5



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A5			

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Base map/survey A.C.T. 1:10,000 SERIES SHEETS 208.588 & 208.596 & DEPT. CONSTR. DRAWING CD74/566

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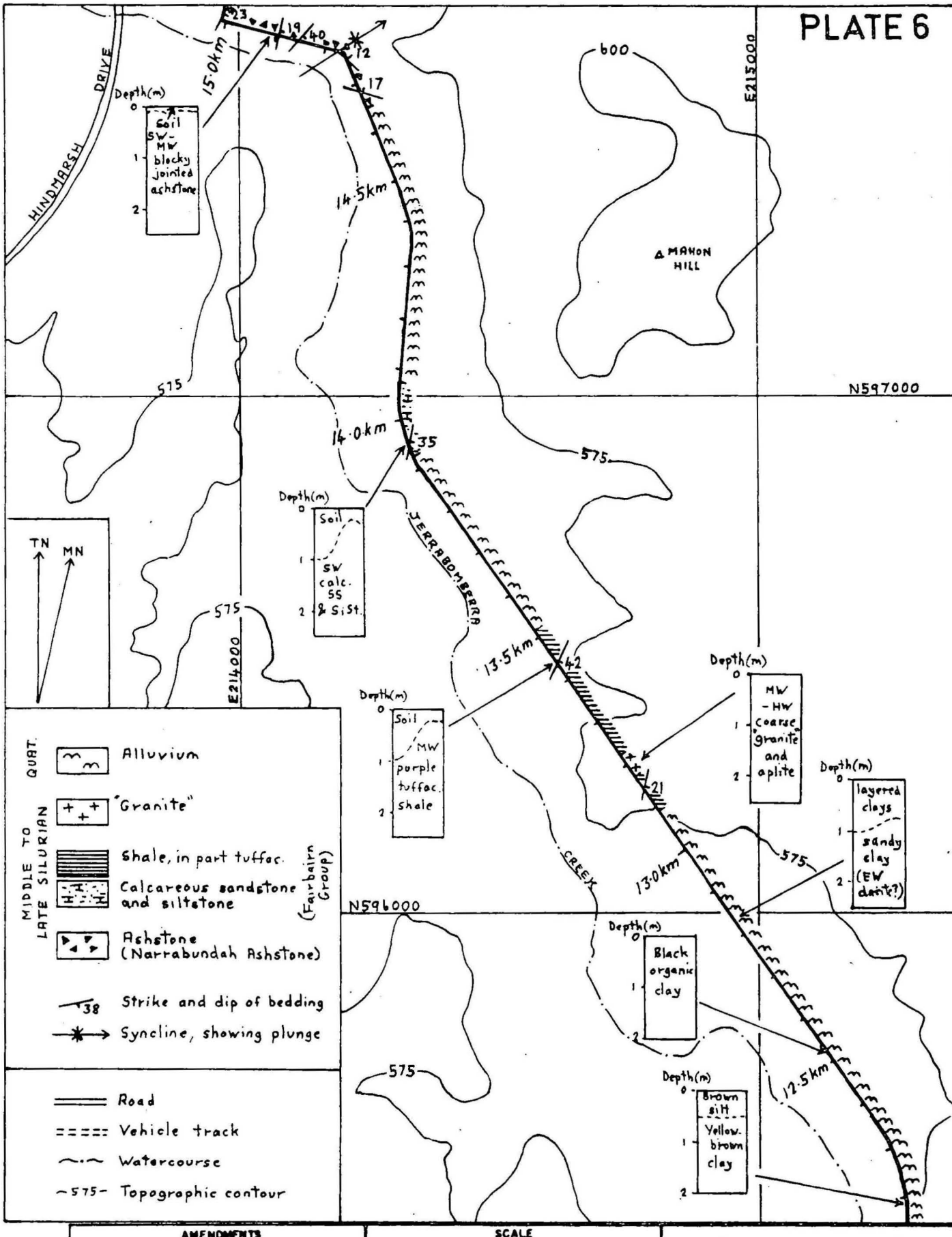
TITLE
GOOGONG PIPELINE

GEOLOGICAL DATA FROM EXCAVATIONS Sheet 5
CHAINAGE 9·56–12·14 km

To accompany	Drawn by	Drawing No
Record 1978/84	G.A.M.H.	156/A16/2098

PLATE 6



AMENDMENTS			
No.	Description	Author	Checked
A1	Pipeline chainages added to title 5/7/78	G.A.M.H.	
A2			
A3			
A4			
A5			

SCALE 0 100 200 300 400 500m

Base map/survey A.C.T. 1:10,000 SERIES SHEET 208.594
& DEPT. CONSTR. DRAWING CD74/564

Geology by G.A.M. Henderson

Compiled and checked G.A.M.H. Project geologist

Checked and approved Senior geologist

E. G. WILSON Supervising geologist

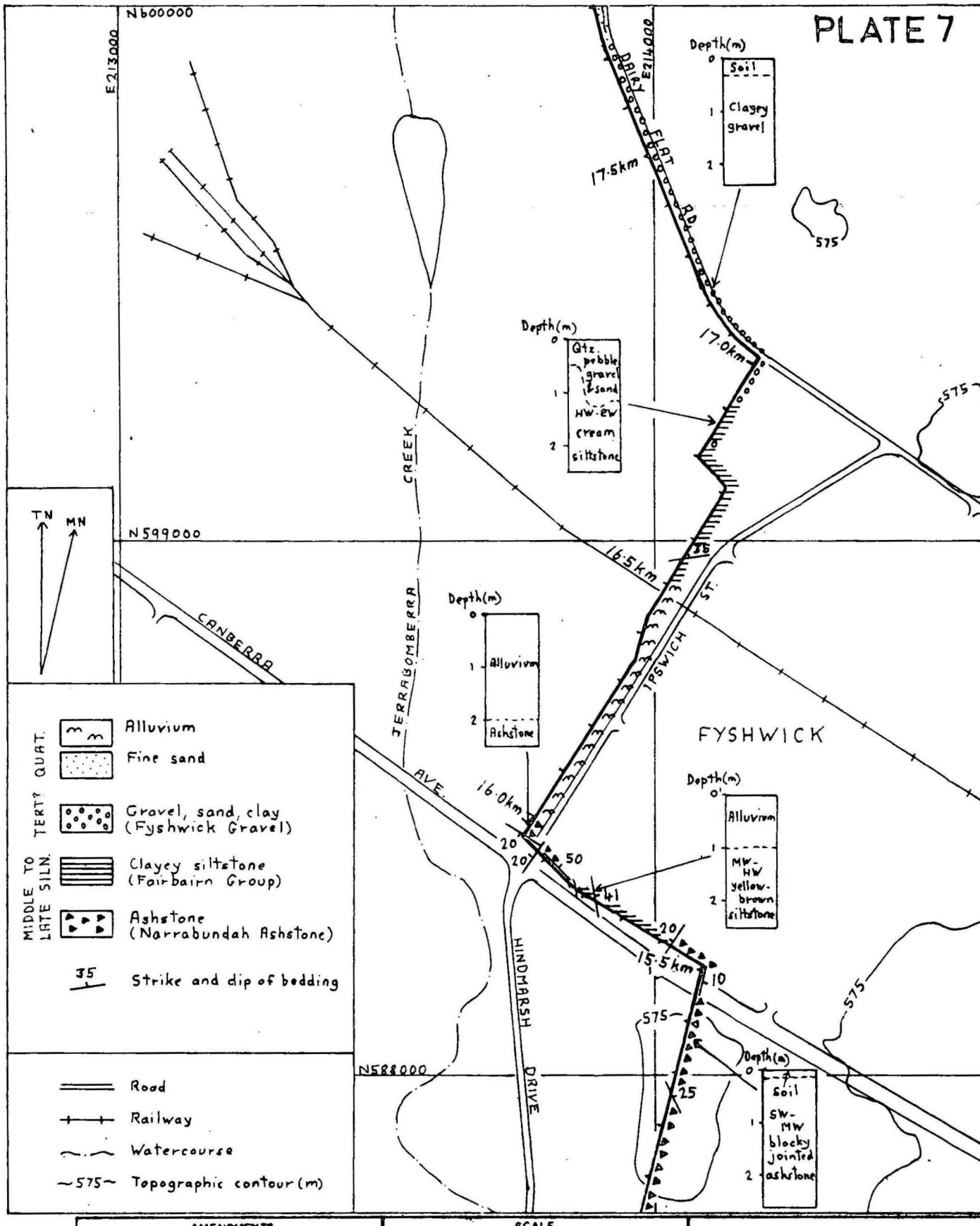
COMMONWEALTH OF AUSTRALIA
BUREAU OF MINERAL RESOURCES
CANBERRA, A.C.T.

TITLE
GOOGONG PIPELINE

GEOLOGICAL DATA FROM EXCAVATIONS Sheet 6
CHAINAGE 12·46–15·03km

To accompany	Drawn by	Drawing No.
Record 1978/84	G.A.M.H.	I55/A16/2009

PLATE 7



AMENDMENTS			
No.	Description	Author	Checked
A1	Pipeline chainages added to title 5/7/78	G.A.M.H.	
A2			
A3			
A4			
A5			

SCALE 0 100 200 300 400 500m

A.C.T. 1:10,000 SERIES
Base map/survey SHEET 208.894
& DEPT. CONSTR. DRAWING CD74/516

Geology by G.A.M. Henderson

Compiled and checked G.A.M.H. Project geologist

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COMMONWEALTH OF AUSTRALIA
BUREAU OF MINERAL RESOURCES,
CANBERRA, A.C.T.

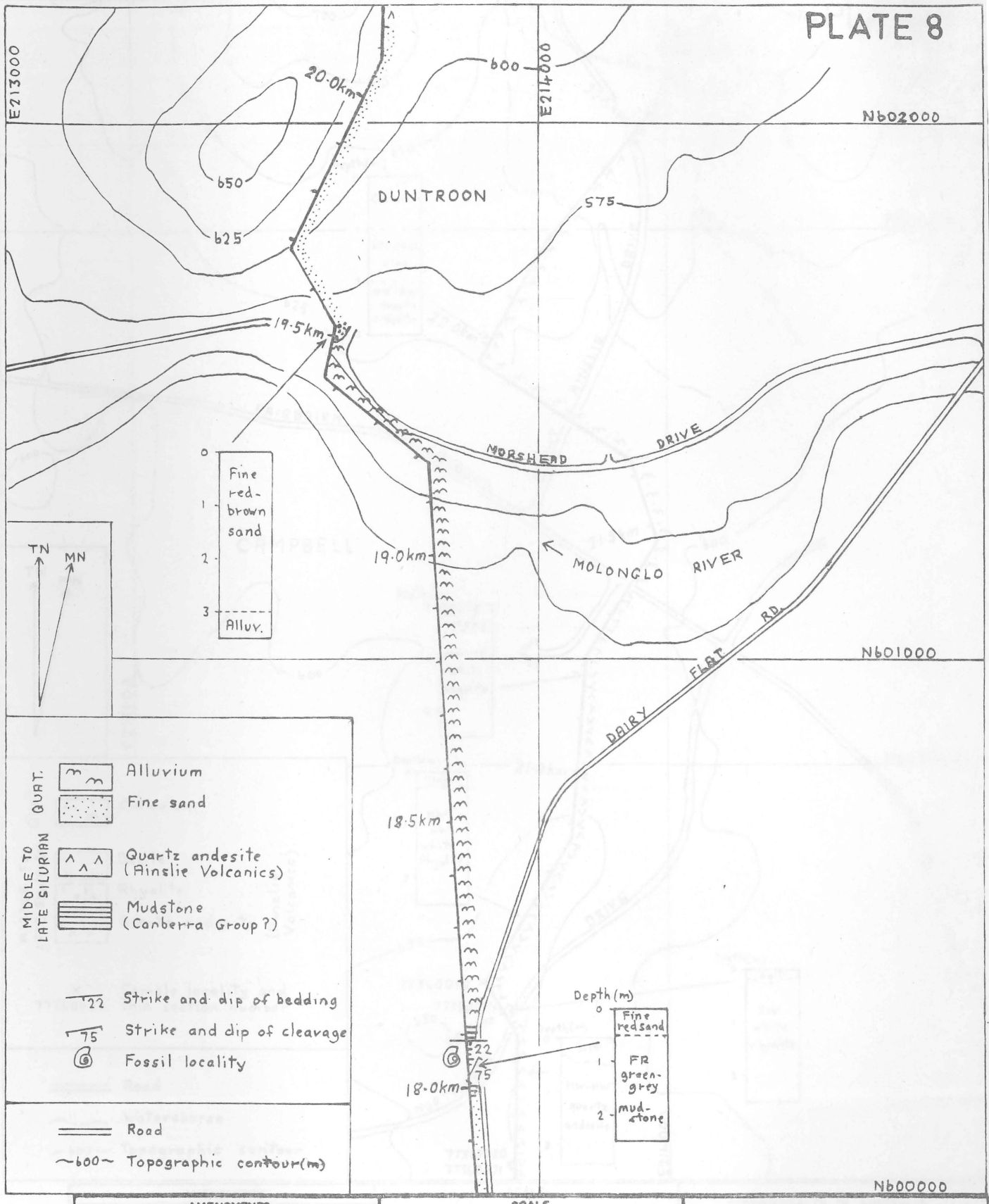
TITLE
GOOGONG PIPELINE
GEOLOGICAL DATA FROM EXCAVATIONS Sheet 7
CHAINAGE 15·03 - 17·00km

To accompany Record 1978/84

Drawn by G.A.M.H.

Drawing No. 155/A16/2100

PLATE 8



AMENDMENTS			
No.	Description	Author	Checked
A1	Pipeline chainages added to title 5/7/78	G.A.M.H.	
A2			
A3			
A4			
A5			

SCALE 0 100 200 300 400 500m

A.C.T. 1:10,000 SERIES

Base map/survey SHEET 208.600

& DEPT. CONSTR. DRAWING CD 74/566

Geology by G.A.M. Henderson

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COMMONWEALTH OF AUSTRALIA
BUREAU OF MINERAL RESOURCES
CANBERRA, A.C.T.

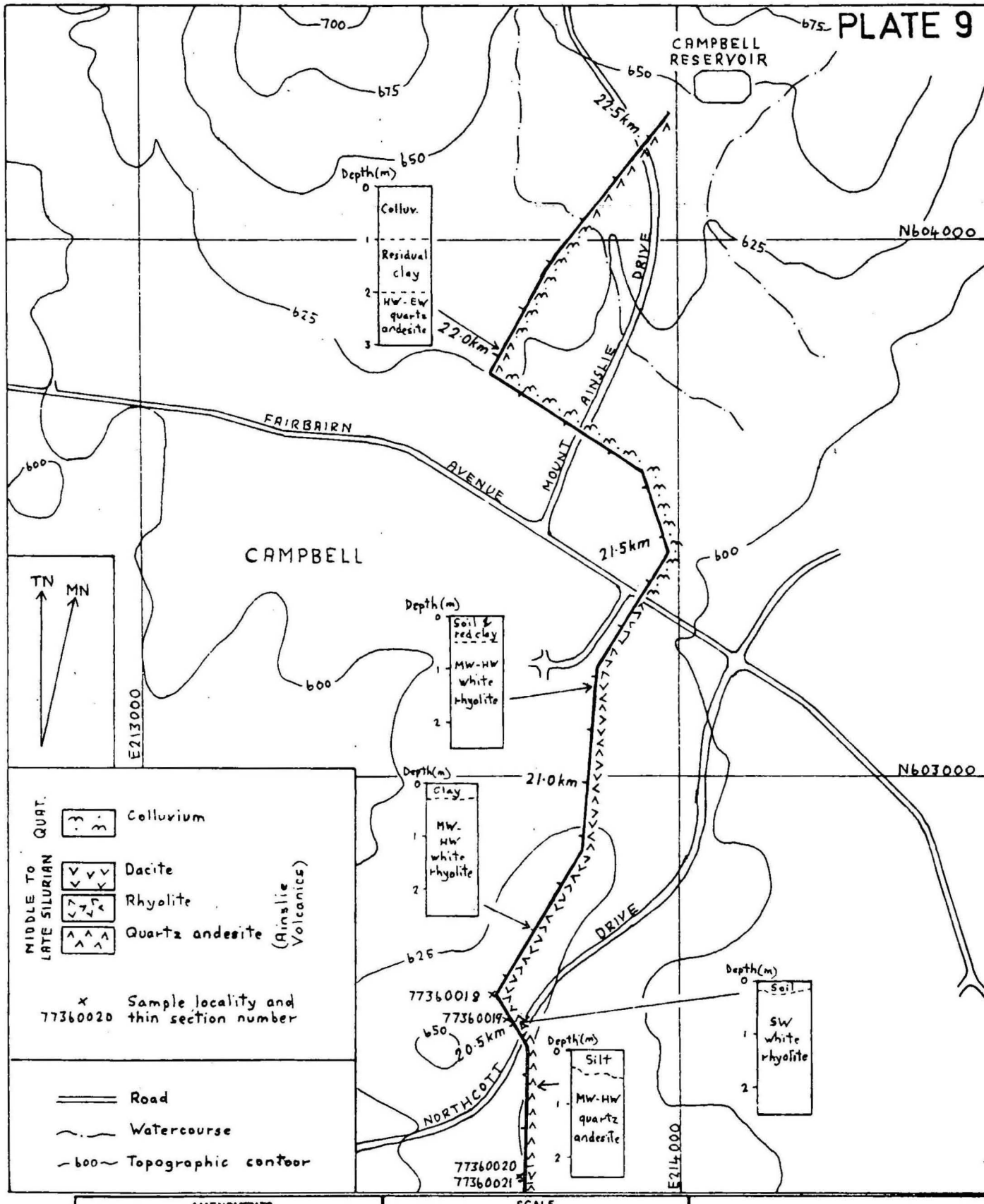
TITLE GOOGONG PIPELINE

GEOLOGICAL DET. FROM EXCAVATIONS Sheet 8

CHAINAGE 17·80 – 20·18 km

To accompany Record 1978/84 | Drawn by G.A.M.H. | Drawing No. 155/A16/2101

PLATE 9



AMENDMENTS			
No.	Description	Author	Checked
A1	Pipeline chainages added to title 5/7/78	G.A.M.H.	
A2			
A3			
A4			
A5			

SCALE 0 100 200 300 400 500m

Base map/survey A.C.T. 1:10,000 SERIES SHEET 208.600 & DEPT. CONSTR. DRAWING CP74/566

Geology by G.A.M. Henderson

Compiled and checked G.A.M.H. Project geologist

Checked and approved Senior geologist

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COMMONWEALTH OF AUSTRALIA
BUREAU OF MINERAL RESOURCES
CANBERRA, A.C.T.

TITLE
GOOGONG-PIPELINE
GEOLOGICAL DATA FROM EXCAVATIONS Sheet 9
CHAINAGE 20·18 - 22·56 km

To accompany	Drawn by	Drawing No.
Record 1978/84	G.A.M.H	I55/A16/2102