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GEOLOGICAL DATA FROM DRILLING AND
EXCAVATIONS ALONG THE MOLONGLO PARKWAY BETWEEN
BEACK MOUNTAIN PENINSULA AND ACTON, CANBERRA, ACT, 1977-78.

by

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bу

G.A.M. Henderson

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SUMMARY

Geological mapping of excavations and logging of drillholes along the Molonglo Parkway, between Black Mountain Peninsula and Acton, have yielded useful data towards understanding the stratigraphy and structure of the Canberra city area. A conformable contact of Black Mountain Sandstone overlying State Circle Shale was exposed at the southern foot of Black Mountain, and an extensive excavation at Acton revealed Camp Hill Sandstone unconformably overlying the Pittman Formation. Exposures of ?Fyshwick Gravel were also mapped.

The excavation conditions were compared with those predicted and showed good agreement. However, predictions of orientations of joints were of limited value, as the few exposures at which measurements could be made did not provide a representative sample.

INTRODUCTION

The Molonglo Parkway, at present under construction (July 1978), is to be a dual carriageway from the northern end of the Tuggeranong Parkway west of Black Mountain, via the northern shore of Lake Burley Griffin to Commonwealth Avenue. Geological and geophysical investigations were carried out along the section of the proposed route west of Sullivans Creek by BMR (Purcell & Goldsmith, 1975; Bishop & Dolan, 1973; Ramsay, 1975); the Sullivans Creek bridge site and Acton Saddle area were investigated by Ground Test Australia (1973). Several deep excavations between Black Mountain Peninsula and Acton, have since revealed rock exposures showing stratigraphic relations of importance is understanding the geology of the Canberra city area. Useful data have also been obtained from the drilling for the foundation investigation of the bridge across the mouth of Sullivans creek. All the relevant geological data including information from previous mapping and drilling for other projects, were then assessed in an attempt to solve some of the stratigraphic and structural relations in the area. A comparison has also been made between predicted and actual excavation and foundation conditions for the structures associated with the Molonglo Parkway.

GEOLOGY

DESCRIPTIONS OF EXCAVATIONS Head of Black Mountain Peninsula

Three separate cuttings were excavated in this area, two along the parkway and one on a realignment of Lady Denman Drive (see Plate 1).

Roadcut 1

Roadcut 1, the westernmost of the cuttings on the parkway, is an extension back into the slope of a previously existing cutting on the former alignment of Lady Denman Drive. The rock exposed consisted of laminated shale (Sls) containing the graptolite Monograptus exiguus, which indicates that the shale correlates with the State Circle Shale - of which the type locality is the cutting

on the northwestern part of State Circle near Capital Hill (Fig. 1). The shale dips at moderate angles in a general northerly direction.

Roadcut 2

Roadcut 2 is on the parkway and crosses the ridge at the head of Black Mountain Peninsula. At the western end of the cutting, laminated shale similar to that in roadcut 1 dips east-northeast towards a north-trending vertical fault; pale grey siltstone and mudstone (S1) lie to the east of the fault which is defined by a zone of silicification a few centimetres wide. The siltstone and mudstone sequence shows bedding in only one place on the southern side of the cutting, where it dips 64° to the east; bedding is not evident on the northern side. The siltstone and mudstone sequence is massive, and contains oxidised pyrite negatives. At the deepest point of the cutting a steeply dipping contact was observed between the siltstone and mudstone sequence and the superficial deposits to the east (see sketch in Plate 1). The superficial deposits on the southern side of the cutting are mostly fine polymictic gravel up to a metre thick, horizontally overlain by a metre of very pale grey to white silt with a brown zone of iron oxide enrichment at the contact with the gravel. The silt and gravel are shown together as Cz in Plate 1. On the northern side of the cutting the upper part of the batter consists of fanglomerate (Q) with some gravel (Cz) exposed in the lower part; however, the nature of the contact between the two is not clear. Except at the steeply dipping western contact, the gravel overlies the siltstone and mudstone horizontally a few centimetres above the base of the cut on each side.

At the eastern end of the cutting laminated shale (Sls) was exposed; the contact with the siltstone to the west is obscured by fanglomerate. The shale dips to the north, and is overlain respectively by a thin micaceous sandstone bed and clay with a trace of gravel at its base. Some of the geological mapping in this area and to the south-southwest and northeast was derived from a previous excavation for a sewerage pipe that was at a lower level than the present cutting.

Fig. 1 MOLONGLO PARKWAY LOCATION MAP Sutton # BELCONNEN Plate 1 CANBERRA TUGGERANONG Tharwa Williamsdale SCALE 1:250,000 lo Km. NT. Built-up area W.A. Highway Secondary road .

Railway

Territorial boundary

155/A16/2185

Roadcut 3

Roadcut 3, in Lady Denman Drive immediately to the south of roadcut 2, exposed pale grey siltstone and mudstone (S1) overlain by gravel on the northern batter. Bedding is more in evidence at this exposure of the siltstone and mudstone than in roadcut 2; dips are as shown in Plate 1. The overlying gravel is mostly fine to medium (less than 2 cm), but with a few larger boulders. One disc-shaped well-rounded boulder of sandstone (probably Black Mountain Sandstone) measured about 50 cm across.

Between Black Mountain Peninsula and Sullivans Creek (roadcut 4)

Roadcut 4, midway between Black Mountain Peninsula and Sullivans Creek, exposed laminated shale with a bed of black shale dipping to the north at the western end; this is overlain successively by a bed of sandstone, another bed of laminated shale and, at the top, sandstone. The succession is conformable and the shale between the two sandstones yielded a specimen of Monograptus exiguus. Bedding attitudes indicate that the sandstone and shale occupy a syncline plunging north-northwest.

East of Sullivans Creek (roadcut 5)

Laminated siliceous shale dipping steeply to the southeast was exposed in roadcut 5 immediately east of Sullivans Creek. The shale, which has already been mapped from outcrop, is the Acton Shale, (Opik, 1958), and this locality is the type locality of the formation. It contains graptolites of Late Ordovician age.

Acton saddle

The Parkway at Acton crosses a gentle saddle between Balmain Crescent and Liversidge Street. The design of the roadway in this area is a cut and cover tunnel, with the roadway level at a maximum of about 12 m below the original surface. A total length of about 400 m of rock was exposed in the excavation (Plates 1 and 2).

Near the creat of the saddle, the excavation revealed a central section of cleaved siltstone (Omp_1) with minor sandstone beds, overlain by sandstone and silty sandstone (Smc_1) . Several steep to vertical faults, mostly of small displacement cut the excavated section, the westernmost one, Fault X, is a vertical fault with somewhat larger displacement. Siltstone and silty mudstone (Smc_2) immediately west of Fault X the eastern limb of an anticlinorium whose core of sandstone and silty sandstone (Smc_1) . Plate 1) lies to the west of Balmain Crescent. Sandstone and silty sandstone (Smc_1) were also exposed in most of the excavation east of Liversidge Street, except in one section on the southern side of the excavation where the succession passes up into siltstone and silty modstone (Smc_2) .

Minor excavations for a temporary road about 100 m south of the western section of the main cutting showed cleaved siltstone and sandstone (Omp₁) with dips indicating an anticline plunging south; this unit is overlain to the northwest by sandstone and siltstone (Smc₁) that dip to the northwest. Sandstone and siltstone (Smc₁) containing brachiopod fragments were exposed about 30 m to the north of the road in a pipeline trench (locality indicated by fossil symbol); small folds plunging north were evident in this exposure

The cleaved siltstone in the saddle in the centre of the main cutting (Omp₁) shows little evidence of bedding except in a few places where it is laminated or contains thin sandstone lenses. On the northern face of the cut small folds defined by these features plunge steeply to the north. A sandstone bed dipping steeply to the south overlies the siltstone on the southern face of the cut (section CD, Plate 2). Both the sandstone and cleaved siltstone at this location are overlain by the more gently dipping and silty sandstone (Smc₁), indicating an unconformity as shown in section CD (Plate 2). A few beds of coarse sandstone were exposed at and near the base of the sequence above the unconformity. Figure 2 shows the central part of the southern face of the cut at the easternmost exposure of the unconformity.

Two useful marker beds of prominent white sandstone were mapped in the sandstone/siltstone sequence (Smc,) east of Liversidge Street (Plate 2). Liesegang rings were well developed in this sandstone in some places, and also in other parts of the sandstone/siltstone sequence. Another useful marker defined by one or two very thin (5 mm) beds of chocolate brown mudistone occurs in the siltstone and silty mudstone between 15 and 30 m east of points A and C (Plate 2.)



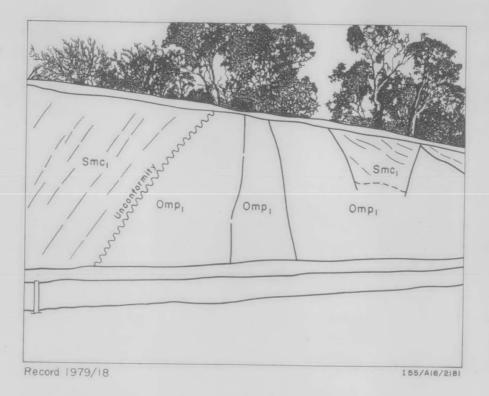


Fig. 2 Central section of southern face of Acton Saddle cut showing location of unconformity between Pittman Formation (Omp₁) and Camp Hill Sandstone (Smc₁)

The boundary between the sandstone and mudstone facies (Smc₁ and Smc₂) is gradational, and is highlighted by a change in colour of the weathered rock from mainly white to pale yellow-brown in the sandstone facies to dark yellow-brown, red, and purple in the mudstone facies.

DRILLHOLE DATA

Graphic logs of all drillholes in the area of Plate 1 are shown in Figures 3 and 4. The full detailed logs appear in various reports as follows.

Holes MP4 - MP12 : Purcell & Goldsmith (1975)

Holes 9-35 : Ground Test (1971)
Holes 37-42 : Ground Test (1973)
Holes DD5-DD12 : Henderson (1970)
Hole C5 : Henderson (1978)

In addition most of the holes 9-35 were logged independently by D.E. Gardner (BMR), and are included in Appendix 1 of this report. Full logs of holes 1 and 2B drilled at Sullivans Creek during construction are also included.

West of Sullivans Creek

Eight holes (MP4-MP12) were drilled to test the rock and soil to be excavated for the cuttings west of Sullivans Creek. A deep stratigraphic hole (C5) was completed at the head of Black Mountain Peninsula in 1972 (Henderson, 1978). All holes except C5-penetrated a single lithological unit below soil or superficial deposits. Hole MP4 penetrated fanglomerate (Q) overlying gravel (Cz), and the hole bottomed in mudstone. Hole C5 first penetrated shale (S1s) which then passed down into massive siltstone (S1?) over a gradational zone corresponding to a zone of poor core recovery (see graphic log, Fig. 3).

Sullivans Creek area

Twelve holes (holes 27-42) were drilled from a barge in the mouth of Sullivans Creek to test possible locations for pile foundations in bridgeworks (Fig. 4). Other holes were drilled onshore to the east of the creek. Two additional holes (1 and 2B) were drilled during construction (Fig. 3).

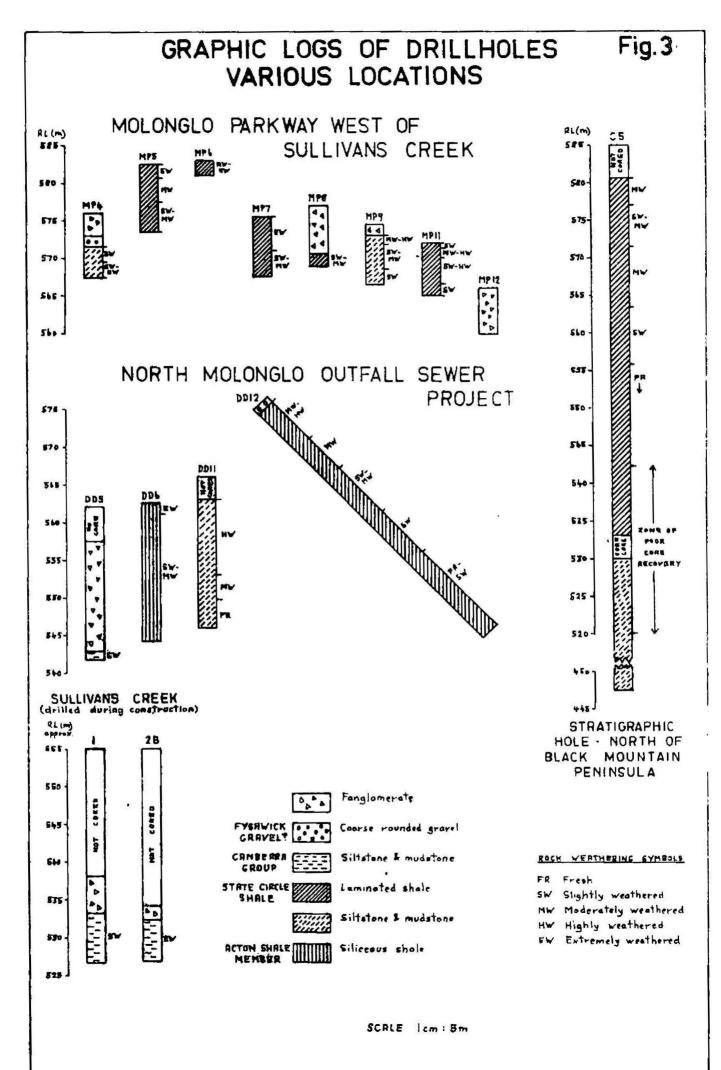
The concealed geological boundary (dotted line) shown immediately west of holes 28 and 38 (Plate 1) represents a change in the lithology of the rock under the cover of superficial deposits. East of the boundary the rock beneath a relatively thin cover of allowium (less than 10 m), is hard Acton Shale, similar to that exposed on the east bank. West of the boundary the rock is generally soft fine sandstone, siltstone and mudstone which in two holes (e.g., hole 40, Fig. 4) is highly weathered and soft to depths of more than 30 m. The superficial deposits are much thicker (up to about 30 m) over the soft rock. Hole 35 yielded a spiriferid brachiopod (see Appendix 1 for log of hole by D.B. Gardner).

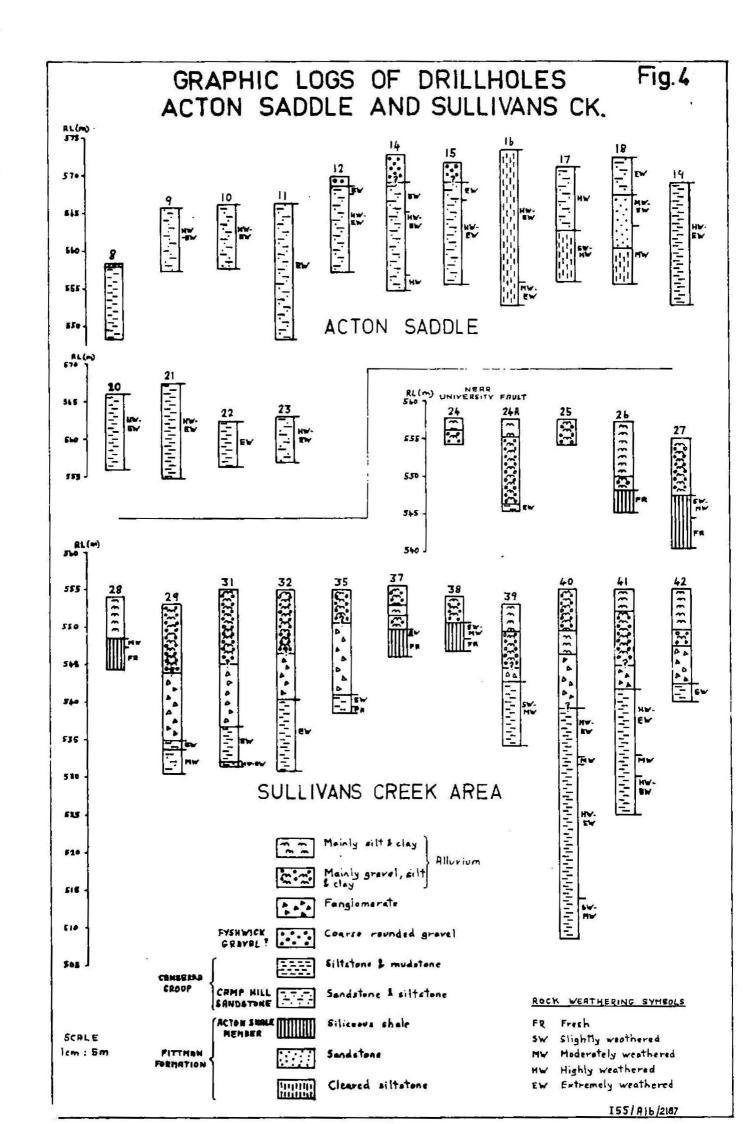
Hole 1 and 2B (Fig. 3 and Appendix 1) were drilled after difficulties with driving piles during bridge construction. They revealed fanglomerate (below 16 m depth) overlying extremely weathered and altered siltstone and mudstone represented by grey and brown clay. Hard ironstone fragments were also recovered from both holes in the clay below the fanglomerate.

The composition and inferred origin of the superficial deposits in all the holes in the creek and in four other holes (holes 24, 24A, 25 and 26) to the east is shown on the graphic logs (Fig. 4). It is not clear from some of the logs whether material described as gravel is fanglomerate or alluvium.

Acton saddle

Fourteen holes were drilled within the area now excavated on the Acton saddle. Three of them (holes 12, 14, and 15) penetrated the high-level gravel (Cz, Plates 1 and 2) before passing into sandstone and silt-stone. Two holes (holes 17 and 18) logged by D.E. Gardner (Appendix 1) penetrated the unconformity between units Omp₁ and Smc₁; in hole 17 the position of the unconformity is clear at 8.5 m (27 ft), but in hole 18 the lower part of the sandstone unit between 4.9 and 12.1 m (16-39.8 ft) is likely to be part of the sandstone bed mapped below the unconformity on the southern side of the cut (Plate 2, section CD).





Each of the other holes penetrated only one of the lithological units shown in Plates 1 and 2.

North Molonglo Outfall Sewer Project

Four holes (DD5, DD6, DD11, and DD12) were drilled in 1969 for the proposed North Molonglo Outfall Sewer (see Plate 1 and graphic logs Fig. 3). Hole DD5, near Clunies Ross Street west of Sullivans Creek, penetrated fanglomerate overlying grey clayey altered mudstone, similar to that observed in holes 1 and 2B. Hole DD6, close to the east bank of Sullivans Creek, penetrated Acton Shale (Oua). Hole DD11 was drilled about 100 m south of the Research School of Physical Sciences; it penetrated siltstone (S1?) with a thin bed of sandstone. Hole DD12 was drilled near the intersection of Balmain Crescent and Liversidge Street near University House; it penetrated Acton Shale.

STRATIGRAPHY

West of Sullivans Creek

Two named rock formations of early Silurian age are exposed to the west of Sullivans Creek in the area shown in Plate 1. They are the State Circle Shale (Sls), identified as such by the presence in two places of the graptolite Monograptus exiguus, and the Black Mountain Sandstone (Slb). Before the cuttings were excavated, the generally similar northerly dips in the two formations implied that the sandstone conformably overlies the shale (Strusz & Henderson, 1971), although the contact was not clearly exposed. The recent excavations for the cutting about half way between the head of Black Mountain Peninsula and Sullivans Creek have confirmed the conformable relation beyond doubt. Interbedded sandstone and shale mark the transition from State Circle Shale to Black Mountain Sandstone, but the location of this boundary is indistinct.

A third, unnamed, formation (S1) also crops out on Black Mountain Peninsula. It was exposed in the Parkway cutting at the head of the peninsula in faulted contact with the State Circle Shale; Opik (1958) showed this area, mapped as S1, as Ordovician outcrop (Pittman Formation). The core log of drillhole C5 indicates a gradational change from State Circle Shale down into rock identified as probably S1; unfortunately a fault

zone was also encountered at about the same depth as the gradational change, and obscured the relation. Despite the fault zone it is still arguable that unit S1 represents a lower, non-laminated part of the State Circle Shale and is therefore of probable early Silurian, rather than Ordovician, age.

The age of the high-level gravel (Cz) at the head of Black Mountain Peninsula is not known. It is probably significant that the elevation of the base of the gravel is about the same as that of the Fyshwick Gravel at Fyshwick, and this would seem to indicate that the two gravels could be contemporaneous. The age of the Fyshwick Gravel has been the subject of various interpretations. Opik (1958) argued for a Permian age, but a Tertiary age has been considered more likely (Henderson, in prep.). The silt overlying the gravel shows extreme leaching, which indicates that it is at least as old as the oldest of the soil cycles of Van Dijk (1959; J.R. Kellett, BMR personal communication). The steep contact between the gravel and the siltstone/mudstone formation to the west of the gravel is probably the result of undercutting of the steep slope by the ancient (Molonglo) river that deposited the gravel. The silt overlying the gravel is of aeolian origin and would have been deposited after the ancient river changed its course. Later still, both the silt and the gravel would have been covered by the fanglomerate during the Pleistocene. The age of the fanglomerate on the lower slopes of Black Mountain is discussed by Costin & Polach (1973).

Sullivans Creek and Acton area

Rock units in the Sullivans Creek and Acton area range in age from Ordovician to Middle Silurian.

The rocks shown in Plate 1 as Ordovician (Pittman Formation) have been interpreted as such by their lithology and likely stratigraphic relation to the graptolite bearing Acton Shale Member which is of late Ordovician age. The rocks shown as Omp₁, which include the rocks exposed below the unconformity in the Acton saddle cutting, are regarded as underlying the Acton Shale Member because plunges are towards areas of Acton Shale outcrop; these areas are at Balmain Crescent to the south of the cut, and an area including the intersection of Balmain Crescent and Liversidge Street to the north of the cut (see log drillhole DD12). Exposures of sandstone

in the foundations of the Research School of Physical Sciences and in a trench on the opposite side of Mills Road (Plate 1) are down dip from the Acton Shale on the eastern side of Sullivans Creek; the sandstone is therefore regarded as overlying the shale, and has been shown as Omp₂.

Opik (1958) reported State Circle Shale (Lower Silurian) faulted against Acton Shale in the foundations of University House, as shown in Plate 1 (University Fault). Siltstone was later mapped in the trench to the east of Mills Road and is similar to the siltstone (S1) which underlies the State Circle Shale at the head of Black Mountain Peninsula. No bedding was seen in the siltstone. Mapping of excavations at Giralang (Henderson, in prep.) has revealed an apparently conformable succession from Acton Shale to State Circle Shale, with intervening units similar to units Omp₂ and S1 at Acton. A similar conformable succession could be based on the outcrop and drillhole distribution of units Oua, Omp₂, S1, and S1s in the Acton area.

The formations overlying the unconformity at the Acton saddle cut are regarded as Camp Hill Sandstone (Smc₁) passing up into higher parts of the Canberra Group (Smc₂) of which the Camp Hill Sandstone is the lowermost formation. This conclusion is based on lithology, on fragments of shelly fossils typical of the Canberra Group, and the presence of the unconformity which is only about 2 km from exposures of what is probably the same unconformity near Capital Hill. One exposure of Smc₂ (with dip 63°E) probably lies to the east of the Acton Fault, whose position in Plate 1 is that shown by Opik (1958).

The stratigraphic position of the deeply weathered sandstone, siltstone, and mudstone encountered by the drillholes in the western part of the Sullivans Creek is not known definitely. The spiriferid brachiopod noted in hole 35 by D.E. Gardner (Appendix 1) probably indicates correlation with the Canberra Group. Shelly fossils are known only in the Canberra Group and younger formations, and it is likely that some, if not all, the deeply weathered rocks in the creek also belong to the Canberra Group.

The high-level gravel (Cz) on the eastern side of the saddle cutting is probably of similar age to the gravel at the head of Black Mountain Peninsula, as it is at about the same elevation.

STRUCTURE

West of Sullivans Creek

Two phases of folding are evident in the Lower Silurian rocks west of Sullivans Creek. One of the fold phases is shown on the western edge of Plate 1, where stereoplots of bedding indicate folds plunging about 20° to the northeast. The other phase was evident in the cutting between Black Mountain Peninsula and Sullivans Creek where the syncline plunges about 18° to the north-northwest; other folds in the same system were mapped in a trench between 100 and 200 m northeast of this cutting.

The fault which is exposed in the cutting at the head of Black Mountain Peninsula indicates a vertical downward displacement of the Black Mountain Sandstone on the western side of about 100 m; however a horizontal component of displacement cannot be ruled out.

The inferred fault shown striking east-northeast across the head of Black Mountain Peninsula represents the most likely position of the fault intersected at depth in drillhole CS. The fault as shown could account for an apparent structural discordance between bedding in unit S1 and the State Circle Shale (S1s). The depth (50 m) of shale and the shallow dip $(0-20^{\circ})$ in hole C5 probably favours the presence of a fault rather than an unconformity between the shale and unit S1, given the proximity of S1 in the cutting to the south of the drillhole.

Sullivans Creek and Acton area

A complex structural history is evident for the Ordovician and Middle Silurian rocks exposed in the Acton saddle cutting (see Plate 2). Plunging folds relate to roughly north-south cleavage where observed in both the Ordovician and Middle Silurian formations. The intensity of the cleavage is greatest in the finest-grained rocks; this cleavage is well developed in the Ordovician Siltstone (Omp₁) and in unit Smc₂. Folds are tighter and plunges steeper in the Ordovician siltstone then in most of the Middle Silurian rocks; however, tight folds with a moderately steep plunge were exposed in the Camp Hill Sandstone near point B on the northern face of the cut (plate 2 and Fig. 5).

A broad anticline trending northwest is interpreted as separating the southerly and northerly plunges in the Pittman Formation (Omp₁ in the central part of the cut. If this anticlinal axis is extended to the northwest and southeast it coincides roughly with the position of a broad syncline in the Canberra Group rocks above the unconformity, based on the northerly plunges of folds on the western side of the cutting and the southerly plunges on the eastern side.

A structural problem in the Acton area is posed by the University Fault (Opik, 1958), which brings the Acton Shale and State Circle Shale into contact at University House. If the displacement is vertical only, a large downthrow on the northwest side of the order of 300 m would be necessary to remove units Omp, and S1. The fault of largest displacement in the Acton saddle cutting is on the western side of the central cut (Fault X). This fault was considered as a likely extension of the University Fault, but the displacement of the Camp Hill Sandstone on the western side probably does not exceed 20 or 30 m, which is considerably less than that of the University Fault. If Fault X is not the University Fault, then the University Fault must swing to the north of the cutting as shown in Plate 1. However, this would mean a downward displacement on the southeastern side west of Balmain Crescent, which would be the reverse of the displacement at University House. The solution to the problem probably involves a major left lateral strike-slip component of movement on the University Fault. One possibility is that the Fault X in the saddle cutting has been displaced westwards along the University Fault and resumes at Sullivans Creek to form the boundary between the Acton Shale and probable Canberra Group rocks in the centre of the creek (see sketch in Plate 1). The ironstone in holes 1 and 2B in Sullivans Creek possibly indicates a faulted contact between the Acton Shale and the probable Camberra Group to the west.

Another problem concerns the chocolate-coloured mudstone marker bed in the saddle cutting (see Plate 2) towards the western end of the main cut. The bed highlights a structural discordance between the northern and southern sides of the cut. On the northern side of the cutting the marker bed appears to lie well above the top of the Camp Hill Sandstone to the west. On the southern side, however, a syncline between the marker bed and the Camp Hill Sandstone indicates that the marker bed, should reappear immediately above the top of the Camp Hill Sandstone. No sign of the eastern limb of the syncline appears on the northern side of the cut. Possibly

the small fault on the southern side of the cutting shown on section CD extends to the northwest across the cutting and truncates both the syncline and the marker bed in the centre of the cutting. Alternatively the marker bed may lens out, or the chocolate-brown mudstone may occur at more than one level.

ENGINEERING GEOLOGY

EXCAVATION CONDITIONS West of Sullivans Creek

The weathering characteristics and rippability of the rock and superficial deposits in the cuttings west of Sullivans Creek generally accorded with those predicted from the drillholes, costeans, and seismic refraction investigations (Purcell & Goldsmith, 1975; Bishop & Dolan, 1973; Ramsay, 1975). However, the orientations of joints, especially in the State Circle Shale, were more varied than expected, mainly because the few localities where the joints could be measured were not representative of the whole area. No stability problems related to joints were encountered, but this was due mainly to the moderate (1:1) batters of the cuttings. Parts of the batters on the northern side of the parkway were formed in considerable thicknesses of superficial deposits. All batters will be stabilised by covering them with topsoil and sowing with grass. This has already been done (July, 1978) for the batters on the northern side of the parkway, where in some places the topsoil and grass have slipped from the underlying rock surface following saturation by rainfall.

Acton saddle cutting

The exploratory drillholes and seismic refraction traverses in the Acton saddle (Ground Test, 1971; and Appendix 1, this report) indicated that most, if not all, the material to be excavated would be rippable. This assessment proved to be correct, although some difficulty with excavation was experienced in places where foundation trenches were dug in the floor of the cut. The hardest sections were in the Pittman Formation (Omp₁) in the central and deepest part of the cut.

Stability of the steep faces (about 1:4) of the central part of the cut was good. This can be attributed to the clay content of the weathered rocks and poorly developed joints in most rock units. Cleavage partings in some of the less weathered siltstone of the Pittman Formation did not pose a stability problem, as the cleavage was aligned almost at right-angles to the cut faces.

Slow but persistent seepage into foundation trench excavations in the floor of the central cut on the northern side at the western end was probably derived from the sandy and silty layers in the Camp Hill Sandstone and overlying siltstone and mudstone.

CONCLUSIONS

- 1. A better understanding of the geology of the Canberra area has been gained from the Molonglo Parkway excavations and investigation drilling, and from other projects in the area. It is now confirmed:
 - (a) that the Black Mountain Sandstone conformably overlies the State Circle Shale at the southern foot of Black Mountain; and
 - (b) that an extensive exposure of the Camp Hill Sandstone unconformably overlies the Pittman Formation at Acton.
- 2. The engineering geological investigations for the parkway accurately indicated the weathering state and rippability of soil and rock. However, measurements of joints in the few rock exposures near the head of Black Mountain Peninsula were not representative of joints in the roadcuts, and were of limited value in predicting the orientations of joints.

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APPENDIX 1

LOGS OF DRILLHOLES 1, 2B, 9, 10, 11, 12, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 27, 29, 31, 32, 35.

GEOLOGY & GE			CT MOLONGLO ON SEST		NS CREEK BRIDER	HOLE NO
	LOG OF DRILL HOLE	COORDI	Stromle	N. 603550 (eperox) R.L.	OF COLLAR 55.7m Cappeon	
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Casing Graphic Log	Pocore Pocore Pocore Of Core O	ROD Intercept Angle p 30 60 80 90	Structuree Joints, veins, seams, faults, etc	Woter Pressur Test Losses (Lugeons) *
	NOT CORED		14-84			
FRNGLÖMER ATE	SW Sandatone pieces & core ross	۵	17:70 11111			
	CORE LOSE in SS & sandy cla	- 1 ' 1				
	SW-MW sandstone pieces core Loss in "sand, silt F clay"	_ ^	18-60			
	Comented sandy silt		11:11			
MUBSTONE EW?	SW sandstone Grey sitt pieces Grey sitt CORE LOSS in brown clay	= 4	21-24			
WINDSLONE EM !	CORE LOSS in "blue-prey clay (BW Shale)"		21.75			
÷	Pale gray clay CORE LOSS in "blue-grey		24-25			
	Ev shale" Rale grey clay	-	25-11			
	Guff-brown clay		25.75			
"SHALE" L	CORE LOSS IN EM-HW Brown SP		21·10· 27·25		.*	
IRONSTONE	Black & CORE LOSS in yellow-brown EW red-brown shall (limonite) ironstone fragment		28.00			
	PND OF HOLE				28.40m	<u>×</u>
	7					
r						
	,					
			1			
			Notes		Water Pr	seaure Teata
Feed Core barrel type	Fracture Log — N Bedding and Joint	Planes — A	Angles are measured	of core. Zones of core loss relative to a plane normal l thears, joints,fractures) p	o the core axis sheets. Test sec	ons should be read ith computation tions are indicated ips
Driller Readers	5 L	core occ	curring at specified ii - <u> </u>	ntercept angle range. Is in progress at specified	Core Photogra	ph Negative No.
Completed May	enderson	1.		leted hale on specified date		
Vertical scale_L_LG	. Co	re 015	material as Fe	ported by driller	,	
Checked by		31	0.5			

OLOLOGI & GL	OPHYSICS	PROJECT MOLONGLO PARKWAY, SULLIVANS CREEK BRIDGE.	HOLE NO.2.B.
GEOLOGICAL	LOG OF DRILL HOLE	angle from Horizontal (8) 90° DIRECTION COORDINATES\$209075 Neo3550 (apprex.) RL of Collar 557m (apprex.)	SHEET.1. OF.1
Rock Type and Degree of Weathering	Description Lithology, colour, strength, etc	Defect Frequency Structures Defect Frequency Structures	₩oter Pressul
	NOT CORED	0.6.2 is.	
FANGLOMERATE	Cont Loss in "sand, clay	20.78	3
FANGLOMERSTE k Ew Mubertone 7	Small sandstone pieces Small sandstone pieces CORE LOSS in The brown shale St pieces & brown clay CORE LOSS	21.56 0.0 21.77 22.10	
"SHALE" &	Dark brown & yellow-brow (limonite) ironstone frage. Mostly < 2cm diam; some pieces to 7cm diam below 23.80	24-15	
	brown shale Brown clay & ironstone per coak Loss in "Ew brown shale & some narrow banks of Hw shale	24-95	
	Small ironstone fragments in brown clay Core loss in EW-HW brown shale with some soft band of 100mm	21.81	
	END OF HOLE	28·12 m	
	·		:
	<u> </u>		
Drill type Feed Core barrel type	Fracture Log — N Bedding and Joint Defect Frequency	mber of fractures per 25 cm of core. Zones of core loss blacked in. **Values in lug in conjunction w sheets. Test each Number of natural defects (shears, joints,fractures) per 25 cm of	easure Tests sons should be read with computation tions are indicated rips.
Driller RRIPSE Commenced Completed May Logged by GAM H	Water Lavel Meas	core occurring at specified intercept angle range. Core Photograments — Level when hole in progress at specified depth. Depth (m) Blo	ph Negative No.
Vertical scale 10.0	Core	loss material as reported by driller	I 55/AI6/2I9

BUREAU OF MINES	PAL RESOURCES, LOCATION	300 5.4			of Live			LC TON			HOLE	NO.
GEOLOGICAL LOG	une e	A.C.T.	90	•		DIRECTI	ON V	Jertice	<u> </u>	l	7	
	COORDIN			6032	92 (Stromlo	metric)	د5	565:7m		SHEET		OF _
HISCH TYPE 8 DEGREE OF MEATHERING	DESCRIPTION	ITC COG (4)		000 0 AO	STRUCTURE	ES TS. CPUSHID 70NLS	<u>.</u>		PRESSUA		foor	104C F
	NOT CORED	A 4	-	В			1.2				i !	
Fine-grained	Yellow	8 .		MH	04-1 (-3)							
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highly	and pale.				04-1 (.3)				Hir		Ш	11
weathered	brown	n·s	///			Short Split Core				1		
and		14	111111									
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completely	prominent	20-2	-11111///	4						']}		F
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VERTICAL SCALE 1 = 10)_E.U.F)·					COLOUP		100		
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BUREAU OF MINE		PROJECT A	200	E.a	+		الله - ه						Stc			100	но с е }О	
GEOLOGICAL LOG	OF DRILL HOLE	ANGLE FROM	HORIZO	NTAL	90	2		74 (51-	cmla me	DIRECTION	<u>y</u>	enct	ic.	<u></u>		⇒£€T.		of
POC- 1-PE	DESCRIPTION ITHIN OCT, COLOUR, STRENGT		(Aabae	(f.t.)	LOG	at cont by aP cout P	SHEET SOUTH	STAUCT EINS, SEAMS, FA	CPES ULIS, CRUSHED	ZONES !		LOSE I -I	₩ΔΙΕΡ n gai	PRES	SURE minuh	TEST Per	foot	100 100 100 100 100 100 100 100 100 100
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Completely Weathered	Cream, Yellow, and white Soft. A.fairly large pro- partion of clay Probably 1:Hle Swelling. End	6 4 24		16.5 18 21 21 22 26			1- 1·	2 (1) 5 (Dus 5 2 (1.5) , clog 4 5 to 2"	bed ZS- Predom (ora leng 1-6 mode)Hus inclus	5 7							
	Column A Clay in inche	Â							amn B agment g sige	ed,								
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BURELU OF WINDERLAND CONTROLLED C		PROJECT A	LTON SA	DIDLE	m	AJOR ROAD	INK.	_		- Total	Τ	OLE NO	
GEOLOGICAL LOG OF DRILL HOLE SECTION OF STATE O		RAL RESOURCES, LOCATION 3	oo Freet	_50	MH	-east of Liver		41 41	Stren	-l-,	ľ		
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Not Cornel. Claythone Completely 12 12 12 12 12 12 12 12 12 12 12 12 12	GEOLOGICAL LOG			30	NA	23251 (Stromlo m	etric) a	5	66.3	m	SHEET -	-0.0	
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FRED HYDRAMLIC CORE BANNEL FIPE NMLC TRIPLE TUBE DRILLE GROUNDTEST COMMENCED 2-13-70 LOGGED BY D.E. GARDNER VERTICAL SCALE 1"= 10. Feet. Snd. Sand Sipe FRED HYDRAMLIC FRED HYDRAMLIC FRED HODGRAPH REFERENCE STSTEM COLUMN B COLUMN B FRED HYDRAMLIC SUPER 1796 FUPD: LINE VERTICAL SCALE FRED HYDRAMLIC SUPER 1796 FUPD: LINE VERTICAL SCALE FRED HYDRAMLIC FRED HYDRAMLIC SUPER 1796 FUPD: LINE VERTICAL SCALE FRED HYDRAMLIC FUPDICATION OF GROUND FUPDICATION OF GROUND FUPDICATION OF GROUND FUPDICATION FUPDICATION FRED HYDRAMLIC FUPDICATION FUPDICATION FUPDICATION FUPDICATION FUPDICATION FUND FUND FUND FU	-	is tairing Lare.	1 :			li					1		8.
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AND ADDRESS OF THE PARTY OF THE	Record 1979/18		1 (5)	-							[55/A	16/219	96

ACTOM SADDLE MAJOR ROAD LINK PROJECT __ HOLE NO BUREAU OF MINERAL RESOURCES, LOCATION 100 FEET SOUTH EAST OF LIVERSIDGE ST. GEOLOGY AND GEOPHYSICS ACTUM, A.C.T. 12 DIRECTION VERTICAL gos ANGLE FROM HORIZONTAL ___ GEOLOGICAL LOG OF DRILL HOLE E 209805 N 603265 (Stromlo metric) at 569.9m SHEET __ OF _ COORDINATES OF SCHOOL ON THE HAMONISS, 1 TO # 1 'pai a waquagand STOCKTURES JOINTS, VENS, SEAMS, TAUL'S, CRUSHED 70NLS NOT CORED SILTSTONE . YELLOW 12.3 ARGILLITIC , BROWH. HIGHLY TO 16.7 COMPLETELY 18.2 WEATHERED . 10 20.4 25.3 8[27.2 50% CLAY 31.7 10 m SEVERAL SEAMS 0.5.1" ON BEDDING. PLASTIC 8 37.4 PLASTIC IT of HOLE . END ML THE PENNORILL WATER PRESSURE TESTS 110 ___HYDRAULIC_ PRACTURE LOG . Number or fractures per fool of core fames of core tiges are bracked in CORE BARREL TYPE N.H.L.C. SUPPLY TINE _ TRIPLE TUBE VERTICAL SCALE _ COLUMN A figures given are gauge pressures. Lest sections are indicated graphically as anacrea in MILLO GROUNDTEST PHOTOGRAPH REFERENCE SYSTEM COMPLETED 29 - 9 - 70 PROTICAL SCALE LINCH : 10 FEET 155/AI6/2I97

BUREAU OF MINER GEOLOGY AND		LOCATION	LIVERSID	GE STRE				HOLE A	NO.
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GEOLOGICAL LOG	OF DRILL HOLE	COORDINATES		9750	N603277 (Stromle			SHEET _L (of <u></u> _
B DICEST OF MENTALMENME	OUSCHIPTIC 113-01-067, COLOUR, STRIP	STH, HARDNESS, FIC	LOG (F.C)	LOG PECOVER	STRUCTURES JOINTS, VENS, SEAMS, FAULTS		Loss in guillons per in		100 and 100 an
	NOT COR						m.		
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HIGHLY WEATHERED	LE	50% 50% 44 30% 60% 74THS	54.5 56.5		SND _3" (<1) R CORE LENGTH SND _3" (<1) AS AROVE SND AROKEN (TO 1" (<0.5) SND _1 (SND O.5 _1.5 (1) SND _1	CORE TO 3" AND CLAY	15 m		
	END COLUMN A CLAY IN INI 50% CLAI FOR 60 INCHES	OF A	59		COLUMN B CORE FRACH CIVING SIZE RANGE IN I (AND HOOSE IN BRACKET SNO: SAND	- B FD.	8·0 m		
DOLL TOPE PENHORS	C		50° ERT (CAL;	LINED WIT	TE_OXIDE.		SUPPLY SINE	I graphically by hopes	
COMMENCED	DHER_	ICH OF THE	CORE HA	IS 4 SLAT	Y OR FRACTURE		PHOTOGRAPH R	FERENCE STSTE	

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		ANGLE FROM	20 200		9.9			* -		DIRECTI	U		ica			13	5
GEOLOGICAL LOG	OF DRILL HOLE	COOPDINATES			1724		N 60	3237	(Strom)	o metric)	P.L	71.	7m		SHE	er	_ OF
a Droatt Or eteletare?	(# SCRIPTION "-IN OG!, COLOUP, SIRFNGIH	, HARDHI \$5, § 7C	(COAD-AC) LOG	(F.t.)	1.06	% CO PECOVI	5 S S	JONES, VENS	STRUCTURE , SEAWS, FAUL:	5 5.CPUSHED JONES	0.4	ر رمن ا ا		R PRESSI Blons per r)#03 - 08
	NOT CORED	Ø CORE LENGTHS					R				4.9						
FELDSPATHIC OR ARCILLACEOUS SANDSTONE, HIGHLY TO COMPLETELY WEATHERED.	FINE TO MEDIUM GRAINED. CLAYEY, SOFT MATRIX PALE YELLOW- BROWN AND GREY. HUCK	2.5 (4) 2.5 (3) 3.6 (4) 3.7 (3) 3.8 (3) 4.2 (3) 4.2 (4) 4.9 (6) 2.8 (5)		38.5 38.5 40.1 -				SHO - SHO - SHO - SHO - SHO - SHO - TWO	as to 3" EY SAND -2 (cor SOFT, SPL. 2" (0.5 CORES, 3	(1.5) E1") intery) SOFT	10						
	END MORE THAN HE FIRST BOX (T CONSISTS OF LENGTHS; MORE THAN SECOND BOX OF FRAGMENT	OF OLT THE OLTER CORE HALF THE CONSISTS		53				8	Giving Si in inci	B. AGHEMTED IZE RANGE HES IN BRACKETS	16.2						
DALL THE PEHNING. THE HYDRAM LICE CORE BRANKL THE N.M. TRIPLE THE DALLES GROWNOT COMMENCED COMMENCED COMPLETED 25-9-1 LOGGED BY D.E. GART VERTICAL SCALE LIMCH		Number of fraction DINT RANTS - AND UTTING 70° DINE VERTICA XIDE SCAT LITLY HARDE	AHD AL AH TEREC	40° но ів 5 тн Ву т	REQUE ROMGI	AR HOUT	₩ίτμ Γ.	ч С ФН	o sicici:	Fication)	8	SUPPLI VERTIC Tigores Test se	TYPE LINE	RAPH R	draby.c	8 ¹ 1, D, S ² 1	Scied in 1979s

BUREAU OF MINE	PROJECT		TON SAL		AJOR ROAD LINK			HOLE NO
GEOLOGY AND			TOH A	.c.T.				16
GEOLOGICAL LOG	OF DRILL HOLE ANGLE F	ROM HORIZO	E 2096		N 603258 (Stromle mairie)	rion _1	FRTICAL	
MOC- 1104	DF SCRIPTION	Column	I DEPTH I	1 1	STRUCTURES	1 1	WATER PRESSUI	SHEET OF
S OF COLF OF STREETING	FITHOLOGY, COLOUR, STRENGTH, HARONESS.	rc LOG	(f.t.)	% CORE	JOINTS, VEINS, SEAMS, FAULTS, CRUSHED TONES		Loss in gosions per m	
	_							
	HOT CORED	A			8	2-4		
Grand de la companya	WHITE SOFT;	1//	1 ##		0.5 - 2" (1") BEDDING	l		!
SILTSTONE	AND EASY EXCAVATION	4 	1 ^{10.5} 1		H13041 2:			
AHO	YELLOW (PROSANLY		15.3		DISTINCT			144141
SILTY, SLATY	OR IN SITU, WOULD	11/	1 1		O.I. 3" (1") VERTICA	L SM		
MUDSTONE	PALE SUPPORT BROWN HOBERATE	11/			CORE 3"-7" _ HUDSTON			
	LOADING	14	205		1.3" (1.5") 70"+20			
		1/.] ###		CORE 1"- 7" BEDDING	t g	'	
HIGHLY		11://	/ ##		960ut 25°			
. 10	VERY EASY CORE 5.04	1/	26.6		- SNO 2" (0.75") SMALL		1111111	
COMPLETELY	erch. 3-44	[/.]] -		1-2" (1.5) SCALE	9		
WEATHERED	Cole		**		50.25 - 2 (0.5) STRUC-			*1111111
720M 10'-17'	2". 3	· {//	1 ##		and the same of th	10	m	. 1111111
RESEMBLES	POOR CORE	1	34.9	1 7//// H	SND 1"-(0.5)			
SEDIMENTARY	DATION SPLIT		38.7		0.1 - 2" (1")			
Baeccia	VEIN QUARTZ 136		140.7		SHS_1 (0.15)	7		
O#		- 1 /]"'		DST 1.5" PROBABLE			
STATE CIRCLE	14,] ###		CLEAVAGE FALLT			
SHALE	14	"¶ //	45.8		TLAKES ZONE			•
	A FEW QUARTZ	$\parallel \times$		пинн	0.1 = 2" (1")	15.	<u>, </u>	
	TRACHENTS CORE LENGTHS		50.2			-		.
	FIRM; '		1 ===	- V /////	SHA_1" (0.5) CORE 2"_3"			1
SLATY	During Excavation		1.,		SHO 0.5 (0.15) (4"			
MUDSTONE	•		57.4		U.S.2 (1.5) COLE	11		s
MODERATELY	1005				SHD1.25 (0.1) 2"-6"			<u> </u>
To	2"- 6" (4")				CLEAVAGE		. !	.
COMPLETELY		2"	63.1		SLIVERS 1.5	Н	! [] [] []	111111
WEATHERED.	4	2"	1 1		\$49 0.25 (0.1)	20	m	1111111
	2", 3" « 6"	4	68 1		22_1" SOME SHO	20-7	<u>, </u>	<u>!</u>
	END OF		1.11		HOLE			
			1 111					
	,							
			4111					
	-	1						<u>iiiiiii </u>
DALL THE PENHOR			* 2	OTES	•			SSURE LESTS
FELO HUDRAULI		- Angles ore	loor at core Zones of measured telature to a	dors falls dre plane harmon	bhoghea in to the core asia		PAC+ER T+RE	
TRIPLE TUBE	DRILLED DRU	(418.0	COOLING)	10. 63.	I' ID DRILLED WITH WATER		VERFICAL SCALE	1904 - 190 1904 - 190
COMMENCED	COLUMN A	~ H0131	i i				Figures given are gauge pre Test sections are indicated a DecCTOCRADIA. De	Light ACT (247,1) M. Scoopically by pioched in striba- perior
COMPLETED_16.9	70Claude incus	5 3· E		COLUM	78-38 ²		Brace and mails """	
LOGGED BY D.E. CAR	OHEK	. <u>⊬</u> -≣		2116	PRACHENTED GIVING			Ŀ
The state of the s	40% CLAY	(ES 44)	1	SHO.	= SAHDSIZE = DILST		COLDUR	
g/ [®]	, DA 30 INC				11		•	I 55/A16/2200

													0.15	-				
BUREAU OF MINER	AL RESOURCES	PROJECT							ROAD L		0					н	DLE N	0
GEOLOGY AND		LOCATION				A.C.		<u> </u>	31. 4HC	BALMAIN	LCK	F 2C	EN!	 .			17	
GEOLOGICAL LOG	OF ORILL HOLF	ANGLE FROM				RTIC				DIRECT	ION						٠,	
	or bridge rioce	COORDINATES		E 209	b52	2 1	6032	83 (Stromlo	metric)	R.L. 5	7).	lm		. SH	EE1 _	L 0	r <u>1</u>
B DEGREE OF ARATHERING	DESCRIPTION	, HARDNI 55, 11C	106 ((ft)	I DC		124	its, vein	STRUCTURE S SEAMS FAUL!	S, CAUSHED 70%LS	Π	,		R PRES			v	A . A.
<u> </u>		· SOURCE LANGE			• 1	RECOVE	#43				<u>.</u>	1		111	1.		: 1	ဦ င်္ခ
				101	Ш							\prod	Π	П	ÎÌ	Πi	ĪΤ	
				3	Ш		H										11	
	NOT CORED			-	Ш		H								1	П.		
		А		8	Ш		ß				2.4	m			ļi	li	Ш	
		11-		9.3	#		和司		1980	BEDDING					il		1	
SILTSTONE,	MAIHLY	1		10.7	##			c	CORE	FAINT;			.	Ш				1
HIGHLY.	FIRM ;	4		14.3 -	Ш		13	×	LEHGTHS	DIP 250 ?			11		i	Ш	\prod	
WEATHERED	WOULD	1	\Box	11.3	Ш		7 -	ĸ	2 TO S INCHES	JOINTS	Sm					Ш		
	PROBABLY	3		184	#11			×	MODE	FE. UXIDE		Ш				Ш		
İ	Support		/	2000 20 3	Ш				4 INCHES	NID			11		1:	Ш	1	
	MODERATE	3 -		20.6	Ш	1	加二			40.50°	1				ļ:			
	LOADINGS			-	411	182				OTHERS	<u>.</u>		11	H	i			
		, _		25.9	1111	1///				CLEAM	١.	ı Î			i			ł I
		6								STAINED			11	H				
SILTSTONE,		3		28.9	Ш		 			70°								
FINE _	MAIHLY	}	//// /		Ш		ᅦ	C	ORE	CLEAVAGE					١.			
GRAINED SANDSTONE	HARD ;		1/4		4				LENGTHS	AND AND AND ASSESSMEN	10	6						
SLATY	Would			36.7 T	Ш		1		2 TO 12	ABOUT					1:			
MUDSTONE,	SUPPORT	4		330	Ш			γ	HODE	75°				11	1	Ш	П	
MODERATELY TO	HEAVY		44	40.2	₩	1844		X	S INCHES	BEDDING			li		1		Н	
WEATHERED	LOADINGS			42.3	##		4			60°					1		11	
FOOTHOTE T			1	-7	##					BEDDING		1			ĵ'.			
MINOR SLUMP			\angle	46.4	 		4 13	x		45				$\{ \} \}$	-		H	
STRUCTURES			\angle	48.6	₩								11.		1.		11	
	END C	F HOLE	-	50	Ħ₩		111	- 10		_	15.2	m	11		+	H	₩	-
<i>t</i>	4			-	Ш		-	<u>8</u> □	COLUMN	3		1			1			
LOCALLY	COLUMN A	A		-	Ш			4	BROKEN	ard			11		1		Н	
WEATHERED (GREY)				-	Ш	1111				MENTED					1			
SOME BEDS	SOFT, FRIABLE	4	i	=	Ш		111 1						11				Ш	
HIGHLY	OR CLAYE			-	$\ \ $		∭ ′]	i I			1			-
COMPLETELY	teem resolvery	1		-			3	χ.	BROKEN	AT							$\ \ $	
(BROWN)				7				dr =		SECTING								
					Ш		Ш,	У	BRECCI		Н		1				Ш	
				4	Ш		Ш	•	FILLE	JOINTS					111			
ı	*			3					FE_O SOME									
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er .																		
*	7			7	$\ \ $		111		•							Ш		
				3	$\parallel \parallel$		Ш	-						Ш			8	
PENNORI	u T			351	alel -	W178~			.00	4	V -		-	ATER P	AESSU	RE IFS	rs .	
HYDRAULIC	FRACTURE LOG	- Number of fractur			a-e1 a1								1+21				-	-
TRIPLE TUE		QUARTZ								IDE		VERTIC	AL SCA	LL		* ·	- die	
MILLO _GROUND	TEST	-										Figures	2		pressure	is nically by	P-04 - 64	-A SIFIPE
COMPLETED	LITH	OLOGY .	CAMP	E 28	'5A	ORE	RESEM	IBLE	5			0		GRAPH	REFER	ENCE :	YSTE	!
INGGIO 8. D.E. GAR	DHER	Ŀ	BELO	w 28	48	ORE.	RESEM RET)	IBLES IT RE	S PITTMA SEMBLES	H FORMAT	JM.	210	oreste re Sine					
VERTICAL SCALE LINCH:	OFEET		city	HILL.	SHA	re (;) IN D	RILL	CORE AT	ALBERT HA	LL.	COLOV	,			e de		
-	· .s.														10	5 /A i	. / 0 /	· · ·

BUREAU OF MINE GEOLOGY AND			PROJECT	ACTO ACTO	95/2	DEE	St.	, MAJO	R ROAL	LINK						,	*OLE	
GEOLOGICAL LOG	OF DRILL I	HOLE ,	ANGLE FROM COORDINATES	HORIZONT	لـــ ،ه	Vert	ical	3b (Stro	mlo metr	DIRECTION		72.	3 m		Si	:		of
a Dicalf Ds *Evritaide	1-1-0L06+, CO	DESCRIPTION LOUR, STRENGTH,		J	7.t.)	PACTIFIE LOG	urt	rr -	STRUCTURES SEAWS, FAULTS, CR				#ATE	P PRES	SURE	TEST		5 5 5 8 2 8 9 2 8
	Not	Cored	•		-						1.2							
Sandstone (calcareous) completely weathered:	Cream gray pale brown white	coarse mudst sand silte	grained one stone,	ZZ,	7 -7 -4 -5			mainly to 3 inc. Frgls w between	ingths to frgts, das hite uugg q.4'-16'. Ltstone	t size								
Completely to moderately uselhered	Palo	4 Vein Clayey S Silic her Mediun	and stone	16	50 00			Mair	n ly		56	. !	ļ .	1	1			
Fossil moulds at 4'-5' 12'-14'?	brown 2nd groy	to fine gra	ined	2. 2				clay.						:				
Moderataly weathered		clayey	ne ecomposed): 21	3 3 575 775			- 2	, , , , , , , , , , , , , , , , , , ,		10	fr :	• •		ï			
SLETY Shele mudatone end Silty mudatone mainly moderately weathered	F. Mo:		weathered.		9.6			nearly v split cor Jointing	80°-90° Two core	re • " Lengths;	15							
	:	·ND	0F	5				HOL			16.8	<u> </u>						
DALL TIME PENNOR THE HYDRAULY CORE BARRIL TIPE NM. Triple Tub DRILLE GROUND to COMMENCED COMPLETED 7-9-76 LOGITO 8- D. F. G. HATICAL SCALE 1": 1	C	#nd c	ni Planes - an	e bei of mo	Low ooler	et of	pan norm /" /5			hard		VERGIO Figures Test te	LINE . AL SCA Juan o Civens o PHOTO AND W	e gauge	prosser ted grap REPEF	es Micoly PENCE	syst	EM

Burgay of Mus	D							MAJOR ROAD LINK		17		-		HOLE	NO.
BUREAU OF MINE GEOLOGY AND		JRCES, LO				Bal. A.C.		Crescent & Liversidge S			- 1	-		1:	a
GEOLOGICAL LOG	OF DRILL	HOLF 4	NGLE FROM	+ORIZO	NIAL	Vort	ical	DIRECT	ION					/ ;	5
		C.	DOPOINATES	E	20761	5 /	1603	263 (Stromlo metric)	R.L. 5	69-(0 m	- "	SHEET		of
BOCK TYPE B DESPEE OF WEATHERING	i it~a.oci. i	OF SCRIPTION COLOUR, STAF NGTH, HAI	704E\$\$, 1.FC	100 Chtrac	(f.t.	LOG	S COPE	SIAUCTURES JOINTS, VEINS, BERMS, FAULTS, CRUSHCO TONES		بوريا المال	AATER PA	PESSURI Per men	E TEST ule per	f004 1 1	PHOTO REFORM
Sou	Λ	lot				-		CORED	1.5						
Mudstone	Azle ·	Soft	J 8		5			Jointing			Design of the second			i	
and silty	brown,	or	П		8·Z	H		commonly 30°-40°					Ш		
mudstone,	red -	clayoy (harl	а		-			Commonly coated					!		
highly to completely	brown	(inches) Remainde	. 31			#		with Fe-Mn oxide	1		HH		111	Ш	
weathered	200	is firm	9	-	14.6	#								Ħ	
	yellow-	· Moderat	7 15		16.6	<u></u>			5m			11			
	brown	losa been				-[#]]]		Fragmented, Showing						Н	1.
		capacity	·ng :	<u> </u>	20.4			Size range and		i	111	l i			H
		at 6'	1	7		11111		fragments .		П	Hili]].
Fossil	Pale		2		LA 75						Hili			Ш	
casts	brown		2		25.5			Bedding dips about 300				Ιİ			111
	and							1 0:25-3" horm 0:75"			!!!!	i I			
Silty	red -		2		288			sand size to 1.5",					E		
51119	brewn	40% firm trgt	5 30		31.3	-		norm < 0.5		Ī				П	
	3 4		,				1	Sand size to 2",	10	m				Π	
mudstone	1		- 1	1				7 Joints 40', 60', 80 -90'	1	1		11			
Silistone, .			714		37.2			with Forth axide		ı	1		11	П	
mud stone			5					10	1	i	1.[]	Н		3	
and		40% firm frgt.		_	40.75	- 1111		Sand size to 2"		i					
fine grained '		or firm fryt:	. 19		42.75	1		norm !"			1111		Ш	H	1 F 1
Sandstone	· '	or time regis	16		44-2	11111	m	Joints 10° + 90°		ì				11	
					45.2	Ш		H herm o.e."		1	1111	1	i l l	11	
	1		3	-	17.5							.		Ш	
			•		50	1		,	15	mi]]] [\mathbf{H}	
	2	20% firm frgt	s 19	ļ	51.5	1				ĺ					
				1—	53_	-11111		J	16.2	<u>—</u>	 	$^{+}$	-+-	+	$H \perp$
END		0 f				1		HOLE							
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	1					11111	$\Pi\Pi$	Įį.						Н	
	L			1		ЩЩ				Щ	Ш		Ш	Щ	
DELL THE PENNOR	1/4		•				0763				WATE	R PRES	SURE .	TS	
TILLO HYORAULI	<u> </u>	I MACTURE LOG - N				Zores at	core loges or			PACEER	1 PPL				
Triple Tube		BEDDING AND JOINT	PLANES - A	-Q-41 G-4 -	-481u/88 *1	9 97 4411219	\$19N4 NOTES	er og the core de-t			LINE				3
onice Ground								×	300	1-gures	21407 Grd 90		Euros Ophir all	, D. 164	eaga in strip
COMM(4CED	4								- 25		HOTOGRA				
LOGGED BY										BLAC*	AMD armit(_		10	
VERTICAL SCALE / IN Ch	: 10 feet							2) No.							
						-				COLDU			10401879	()r	
											-	1	55/	416/	2203

\$20 Minus		PROJECT					AJOR ROAD LINK				-	_		HOLE	NO
BUREAU OF MINER GEOLOGY AND		LOCATION		TOH ,		ESCEM T.	<u> </u>		1			_		2	0
GEOLOGICAL LOG	OF DRILL HOL	E ANGLE FROM			90°	Иb	03293 (Stromlo	DIRECTION	on_ <u>v</u>	ERT bb.	icar Im		SHEET		0F <u></u>
a DISPIT OF MEATHERING		CRIPTION STAT WOTH, HARDNESS, ETC	CRAPPIC LOS	(ft)	LOG	1 1	STRUCTURES JOINTS, VERS, BEAMS, FAULTS				PETAN	parssun	5 11 5 51		100 100 100 100 100
	NOT CORE	i D		,			В		1-2	m					
Hudstone, Highly to Completely Weathered Resembles Riverside Formation OR City Mill Shale	PALE BROWH, YELLOW AND PALE PURPLE VERY FIT SAMDSTO FINE SANDST OR SILTSTONE ENTRICATE LIESE GANG STRUCT. END	CORE 21 2"-6" 21-6" 21-6" 21-6" 21-6" 22-6" 24-6		19			0.25-4 (1) 0.5 - 1.5 (1) 5HD - 0.75 - 0.25-2 SHD - 1 (0.25) 0.5-2 (1) HOLE	DiP 30-50° SMALL SCALE SCUMPING BEODING DIP 45° CORE 2"-8" noam 5"+		7					
OFFIL TYPE PENN DR	C FAC BEDO	TURE LOG - Number of Facts			Zanes at	olane work	of to the core deck	ß		BACATO SUPPORT	1 -PL _	ER PRE	SSURE	PESTS	
TRIPLE TUBE DOLLIO GROWND T COMPLETED 18-9-7 LOCATE BY D.E. GAS VESTICAL SCALE LINCH!	EST C	CLAY in in	CHES	3	•		LUMN B LORE FRACHENTED, IVING SIZE RANGE INCHES) AND HODE (IN BRACKETS)			Figures Test ser	given ore crions ore PHOTOGR AND area	POVE PIC	FERENC	£ \$15	IEW
Record 1979/18			7					7 10					100	AIE	/2204

																-			
BUREAU OF MINE GEOLOGY AND											MAJOR ROAD	57.						O(E /	Ne.
GEOLOGICAL LOG			ANGLE									DIRECTION _						21	1
				NATES				\neg	1167	Т	<u> 248 (Stromlo metri</u>		<u>Б</u> Ь7					<u> </u>	or_E
P DEGASE OR ASTRICTURE	t+f≈0c.Q6+,	DESCRIPTIO COLOUR, STREW	ST-, -APDRESS	, ETC	106	lit.t		DG G	COVER	4	STRUCTURES ADINTS, VEHS, SEAWS, FAULTS, CRUSHE	D TONES],		F PRESS			₩	525
DRILL	ER'S	606	-			<u> </u>	1	Щ	Ш	П			П	П	Hi	1	П	П	П
Brown clay		*				4						1-2	<u>_</u>						11
Soft					ı.		1				Standard								
Shale;					Ĺ		1				penetration		£					\prod	E
brown	é										Tests ; copy of			ļ į					
							1	Ш			results to be obtained					i			\prod_{i}
Mudstone			perple .	ben		15.5	Ш			訓	Soft core &"-2" to	1a/ 5n	1						
. and		ve; c				19	-	HIL		卌	and soft fryts	/y -			1	[11	
S1/+y	P. C. Control	cale by	1000			22	111				weath but firm , to 2.5'; remainder is clay and soft fr	TWO DOTTO	0						
mudstone	A 5"	cora la	ingth	8		23	#				Bedding dips abo	No.							
highly to	2000	to com	20 0000			İ	1				20° 21 19'- 19'6					1			
weathered.	for 10	maind; n					2									İ			
Resembles	1415		1000		9					ı	·								
bodsof	Pale bi	rown 5	off core		1	32.5		\prod		1	Last 9" broken, dr.	iling.	5			1			
Riverside :- Formation						37		#		Ш	70 Joints-	77							
	Core 3 Weath			.k				Ш			34-35 Bodding a	9.0				ı			
	Westh										Bodding dipateut	•	2 m]		
	End	of f	7 0 /c				1		\prod		8	•							
	į						4					,							
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DALL TYPE PENN D	8111			·	I r		_Ш		111.	П			<u> </u>		114		لال	1.1	4-4-
110 HYDRAULI	HYORAULIS PRACTURE LOG - Business of Proctures per head of sore Comp. of core beas are blacked in												ER TYPE	MATER P		<u></u>	4!S		
Triple + UE	iple tube										•	(1000)	KAL BO			Ť			
COMMENCED	Groundtest Badding appears to show small scale slump:											Figur Tuşi	sections o			easty (umb us garrigid.	
COMPLETED 3 - 9 - 1	3-9-70											et a c	991010	GRAPH	**************************************	wct.	a/a/l	-	
VERTICAL SCALE LINES				-							o Mn oxides		_						
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BUREAU OF MINES							JOR ROAD LINK						HOL	E NO.
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GEOLOGICAL LOG	OF DRILL	COORDINATES			953		N 603304 (Stromlo metric)	4 L _	562	3m		SHE	cr <u>1</u>	_ or
SOLERE OF WEATHERING	i -t-oLogr, co	DESCRIPTION DEDUR, STRENGTH, HAROMISS, FIG.	r oe evb-c		L OG	LIFT % COME RECOVERY	STAUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES		افا ا	₩Δ1ξ s n go t l	R PRESSU	nute p	ST er foot	2 1000 2 1000 2 1000
	нот	CORED						1.2	3					
SLATY, SILTY MUDSTONE		PROBABLY NOT SWELLING ERED TO CLAYEY		7.8			TRACES OF BEDDING?							
AHD FINE SAHDSTONE		FINE SAND	 	10 _ 11,5 12			DIP ABOUT 60°							
COMPLETELY WEATHERED		ERED TO CLAYEY SILT AND CLAYEY FINE SAND	-	16				<u>5m</u>	3					
	E	ND OF					HOLE							
DALL IVE PENHOR				-	ni	žES	-				VATER PRE	SSURE	IESTS	,
CORE BARREL TYPE M.M.		FRACTURE LOG Number of fractur BEDDING AND JOINT PLAN(\$ - And			Zones of	care loss an			PAC=EP	TYPE		حالت		
TRIPLE TUBE DOULLES GROWNDTS COMMENCED 12.9.	TRIPLE TUBE RESEMBLES WENCED LENNOX PLITTE 12.9.70					HOLE		10	Property Test to	PHQ10		FEREN	ICE ST	nocked in stries STEM
HATTER SCALE LINCH	DHER_			1									-	
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BUREAU OF MINES	A Charles of the Country of the Coun	PROJECT	20	O FE	ET W	EST	DE.	R ROAD LINK	VERSIDO	jE_	STRI	ET		-	9 - 1 ¹ - 1		E NO	į.
GEOLOGICAL LOG		ANGLE FROM HO		ITAL		14 CR		ENT 270 (Stromlo me	_ DIRECTII	DN	<u>ver</u> 563	F1C	ΔL		SHEF	2 工		
B OLCALL OF WEVINESIAC	DESCRIPTION OF SCHOOL STREET		LOG	(t4')	PACTURE LOG	LIF1	SHIS A	STAUCTURES DINTS, VEINS, SERMS, FAULTS, CAI	· · · · · ·			₩Δ	Ed bi	RESSUR PET TOT	E 7E5	i T	7	
		А				Ť	Ī _B		3 -51	0.6				H		П		I
SILTSTONE AND FINE GRAINED SANDSTONE; A GAND OF SILTY CLAY STONE HIGHLY TO COMPLETELY WEATHERED	PALE YELLOW- BROWN AND PALE BROWN	43 60%		89				SNO. TO 2" (1") SNO. TO 3" (2") SNO. TO 2" (1") .	BEDDING DIP ABOUT 40°		2					I		
	siti y c	18 40%	$\overline{}$	17.5		1///		SILTSIZE TO 0.5" A	200,000									
	PROSABLE FOUNDATION FOR MODERATE LOADING ON SPREAD FOOTING AT 2.75 FEET DEPTH							HOLE										
OFILE 1198 PENHOR FILED HYDRAM LICE CORE BARREL 1198 N.M. TRIPLE TUBE COMPLETED SOUNDT COMPLETED 15-9- LOGGED 8. D.E. GAR VERTICAL SCALE J. LINCH	FACTURE LOG BEDDING NO AC COLLUI	Number of linecures on PLANES - Anger 11 M A A IN INCH 500 CLAY DR 43 INCH 6	ES.	equived reli 41	/ones of	01000 NOT	CoLI Co Gi Ai		3	÷	COPP VERT Sugare Team	PHOTO AND	CALE _	R PRES	 turpi yoshic (ן זפן נייו	-04 - 40	, o suc-

BUREAU OF MINES		CES, LOCA	ECT <u>AC</u>	TON .	SADOLE	MAJOR Mouth	ROAD A F Sullivan	S Creak	- "OLE	
GEOLOGICAL LOG		OLE ANGL	E FROM HORIZ	TONTAL VS	rtical Nb035	12 (Stromlo	DIRECTIO		_	
S DECEST OF STATESING	cithocast, co.	DESCRIPTION DUP, STRENGTH, HARON	- Lane	01975	CTION LIFT OF % CORE PECOVERT	STRUCT JOHN'S, VEINE, SEAWS, FI	TURES HULTS, CPUSHED ZONES	MATER PI	PESSURE TEST per minute per Ituli	100 C
Water				6.5				2.0 m		
Mud and	Not	cored	č			Standard penetrat tests	101			
alluvium ?				411111		Copy of	/ • • O	5m		
			"_3" <i>t</i>	7 27				82 m		
Black Shale, fresh to slightly	Hard black Sill- coos shale;	Frgts o.5-3 Three Care / 2"-3.5" Core 2"-4" Frgts 9 Core	2" (,, 3" (ngths	32.1		Fregtd. dr. 6 30° Joints 36'9-37'6,	Shear 70° r	ιο.		
weathered	ding /4	Core 1.5"-7	T"	1		41'1 - 41'7 drilling 2 at two 90	10.5" 10.00 to 20.00 to two 20.00 to 15.00 td. 15.4			100
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PENN DE HYDA AU A	LIC	FRACTURE LOS - Num	ber of fractures o	er lose al cura l'o	<u>NOTES</u> Max of core less de	s blacked in.		. PAGKER TYPE	R PRESSURE TESTS	
Triple fub DITING FOUNDER CONNECTED COMPLETED LOGGED BY P.E. 4	c est:::	Smooth	planes carban sily	- polishoo	d three	ared with ship, and			MICORE PERENCE STE	ilem
VENTICAL SCALE A."	(01861		n prassiv	e + shee	•	11th Knife. 19th; Low te	nsile stren	gth colour	155/AI6/	2208
Record 1979/	/18	3						· · · · · · · · · · · · · · · · · · ·		

BUREAU OF MINE GEOLOGY AND		PROJECT					MAJOR ROAD		Κ,			_			LE NO
	•2°	ANGLE FROM H		TOH,	Qo°		<u> </u>	OI@ECTI	_	V	ICA)	Ţ		2	9
GEOLOGICAL LOG	OF DRILL HOLE	COORDINATES		E 200			603524 (Strom						SHE	er <u> </u>	_ or <u>_1</u>
MISCH THOSE N DEGREE THE HEATHERING	DI SCRIPTION HIMINUST, COLOUR, STREWETH	, HAPONESS, ETC	L OG	(it)	L DG	COPI PCOVER	STRUCTU JONES, VINS, SEAMS, FAU			LOS1	#ATER n.golli	PRESSI	1 380 Hunar	ST per foot	90.50 10.00
	N OT CORED		g.				t		5m	3					
TUBE SAMPLE PEBBLES 1-1.5 CM. COARSE SAND 2-6 MM. TUBE SAMPLE GRANULES AND SMALL GRAVEL 2.8 MM. A FEW PEBBLES.	NOT CORED			30					15 -						
THIN BEDDED TO LAMINATED FINE GRAINED QUARTZ SANDSTONE	Z" TO S" AHD	BROWN CREAM GREY FIC CLAY		67.4			DIP OF BEDDING 20° TO 30°. SMALL IRREGUI ASSOCIATED WIT AT ABOUT 60° FROM 73'4 TO SHATTERED TO NO	LAR FRACTURE H SHEARING	19-3 20	11					
Oua (?)	EHD	of		74.2			SHATTERED TO HI SHAPES AND SP HOLE	ALO WEOGE	22.6	F					
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		PROJECT						JOR ROAD LINK		-	11				OL E	NO
BUREAU OF MINER GEOLOGY AND		LOCATION						IFFIN , NEAR MOUTH			-		- 1			
OLOLOGI AND	OLOPHI SICS	_	SUL	Livan			EK				-				31	
GEOLOGICAL LOG	OF DRILL HOLE	ANGLE FROM	HORIZON	TAL	90	<i>o</i>		DIREC	ION_	/ERT	ica	L				
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S DECREE OF ALASHERING	1-0x OG+, COLOUP, STRENGTH	, MARDMF35, ETC	100	(f.t)	1.06	PE 50	COPE	MINIS, VEINS, SEAMS, PAULTS, CRUSHED TONE	MATER LEVES	وها		lam se			DOI 1	1000
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CORE BARREL TYPE N.H.	L.C BEDOING AND J	OINT PLANES - An								SUPPL						72.0
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	& HIGHLY TO COMPLETELY											_	155			850

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GEOLOGICAL LOG	OF DRILL HOLE	ANGLE FROM							DIRECT	10N	/ERT	icar.			32	
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WEATHERED.	CLAY AND FIR	M ACHTS	\vdash	77				3" AHD 1" .05 - 2 (.25	CORE	۵					3	
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	PROJECT	ACTON SADO	IF MATO	R ROAD LINK			HOLE NO
BUREAU OF MINER	RAL RESOURCES, LOCATIO	N LAKE BURLI	Ey GRI	FFEN, HEAR HOWTH	OF.		
GEOLOGY AND				ACTON , A.C.T.		ERTICAL_	35
GEOLOGICAL LOG	OF DRILL HOLL	FROM HORIZONIAL	90°	03351 (Stromlo metric)	RL 5	SEM APPHOX	SHEET 1 OF 1
Service 1 - COP N. CHICARDED III AND A THE PERSON	priscaletion	AND 21014	are 1	STRUCTURES HATS, IFINS, SEAMS, FAULTS, CRUSHID, 70NF	ТТ	WALLER DELISION COSS F QUIDOS DE POL	
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	TUBE SAMPLES]			275		
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THE GRAINED SAMOSTONE,	GREY BLACK MOD. HORD	54.1		SHP _ (0.5) BEDDIN	٩ ا		
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1	WHERE NOT TRIABLE OR			INDISTINCTLY LAMINATE			-11111
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	CORE IS GROKEN TO			5iP 25°		i	-11111111
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OMIL IVER PEHHDR			NOTES	 		THE COLUMN TWO IS NOT THE COLUMN TWO IS NOT	SSURE TESTS
CORE BARREL TOPE -M-E	1. C. C BEDOING AND JOINT PLAN	al fractures per limble at comp. ¿gras. ES — Angles are madeured relative h		Had in		PACETH LIME	
TRIPLE TUBE	COLUMN	<u> </u>	<u>Co</u>	LUMA B	В	VENTICAL SCALE	essines graphically by Discoud in stript
COMMENCED	DECOMP	€. 7 🗂	9	CORE FRACHENTED, GIVING SIZE RANGE		PHOTOGRAPH RI	FERENCE SYSTEM
COMPLETED _ 2 _ 10 LOUGED B D.E. CAT	70 SAHOY		(INCHES)	П	Brack and white	
VENTICAL SCALE LINCH		, 	ı	IN BRACKETS)	Ш		
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