COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

RECORD No. 1963/76

GEOLOGICAL INVESTIGATION, PORT MORESBY No. 2 UNDERGROUND HYDRO-ELECTRIC POWER GENERATION SCHEME, LALOKI RIVER, T.P.N.G. 1962

by

E.K. CARTER and G.H. BROUXHON

GEOLOGICAL INVESTIGATION, PORT MORESBY NO. 2 UNDERGROUND HYDRO-ELECTRIC POWER GENERATION SCHEME, LALOKI RIVER. T.P.N.G.

by

E.K. Carter and G. Brouxhon.

Records 1963/76

GEOLOGICAL INVESTIGATION, PORT MORESBY NO.2 UNDERGROUND HYDRO-ELECTRIC POWER GENERATION SCHEME, LALOKI RIVER, T.P.N.G.

by

E.K. Carter and G. Brouxhon.

Records 1963/76

CONTENTS

CONTENTS (cont.)

SUMMARY

The Port Moresby No.2 hydro-electric project is designed to provide an ultimate 30,000 kilowatts of power for Port Moresby by utilizing the potential of the 500-foot high Rouna Falls, on the Laloki River, 23 miles by road from Port Moresby. The scheme consists of a storage dam, now nearing completion, 5 miles upstream of the Rouna Falls - the Sirinumu Dam - and power generation works in the vicinity of the Falls, consisting of a diversion weir, half-a-mile above the Falls, a power station 500 feet underground below the weir and a 2,700-foot long tailrace tunnel.

This report deals with the geological conditions that will affect the design and layout of the underground power station and related works. The presently-proposed layout was adopted because instability of the slopes, particularly the danger of rockfalls, made a surface power station, race lines and penstock too hazardous an undertaking. An alternative scheme for an underground power station near the Falls was rejected because of unsound rock conditions.

In the course of the investigation for the upstream underground power station 6,200 feet of diamond drilling has been undertaken and the surface mapped geologically. Drill holes have been water-pressure tested as required and selected drill core has been subjected to compression and durability tests.

The rocks of the area are gently-dipping agglomerate, unconformably underlain by a thick succession of conglomerate that consists largely of volcanic material, weathered near the top of the succession. Below the conglomerate is a basic igneous intrusive complex. The power generation works will be mainly in the agglomerate (which contains lenses of tuff) but about 1000 feet of the tailrace tunnel will be in more-or-less weathered conglomerate. The strata are cut by widely-spaced near-vertical and horizontal joints, and several faults, shears and fracture zones have been recorded. The whole rock mass appears to have been stressed to the point of failure and as a result is generally extensively, though irregularly, fractured. Weathering, with the formation of clay in many places, has extended along many of the faults, fractures and joints to below tunnel level. Fresh rock (agglomerate, tuff and conglomerate) is moderately strong but brittle, but weathered rock is generally weak owing to decomposition of the matrix.

The diversion weir site is not expected to offer any special difficulties. Foundations may have to be excavated to a depth of about 11 feet and the right abutment treated. Anchor bars are recommended in the foundation, and the abutments and foundation should be grouted.

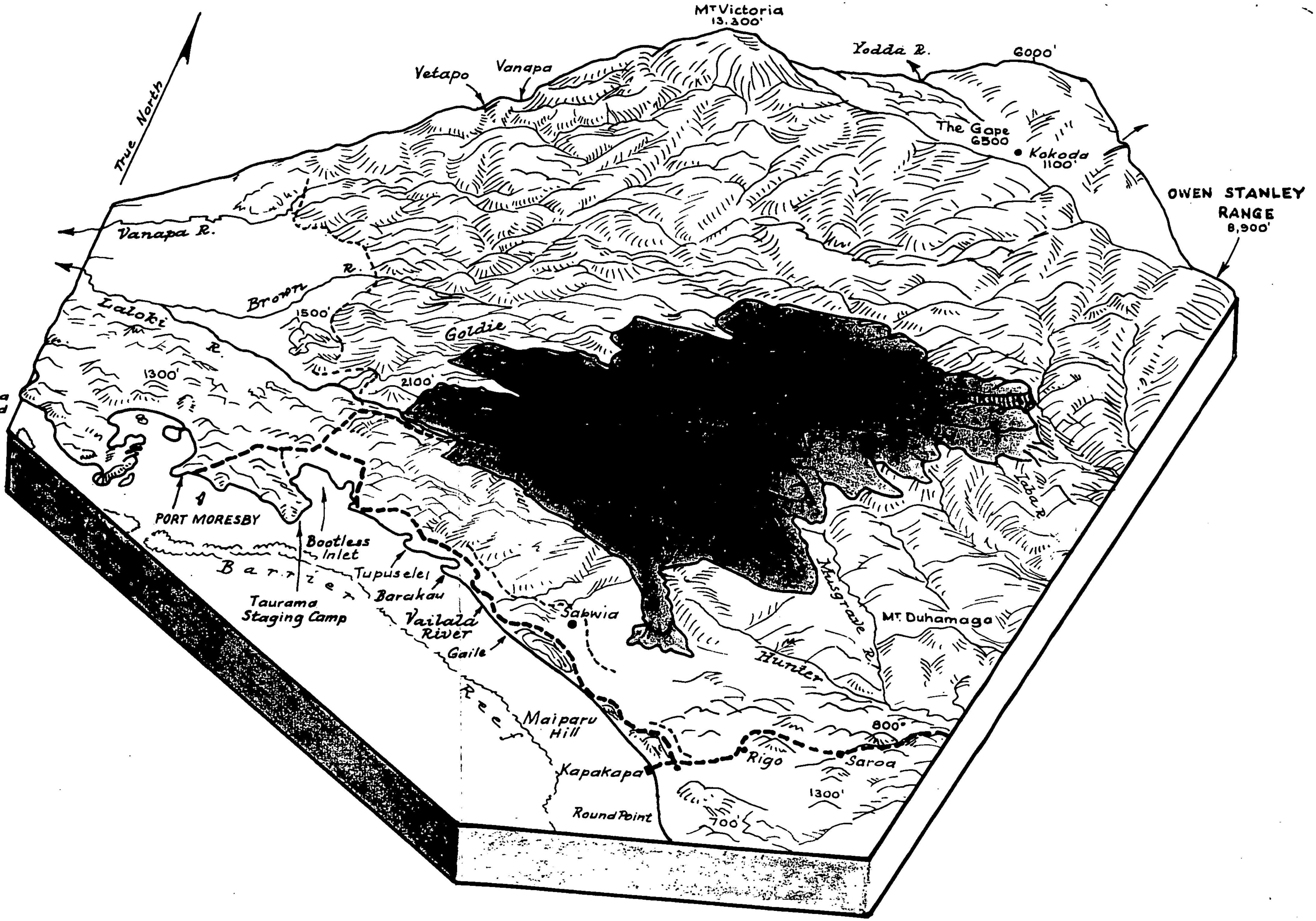
Conditions expected to be encountered in the tunnel line are summarized in the Plate 3. Water inflow is not expected to be serious. Considerable support may be needed for portion of the conglomerate, where it is weathered near the contact with the agglomerate, and special mining techniques may be needed in this zone to prevent excessive overbreak. Steel and concrete support may be needed in a number of other places but generally the fresh conglomerate and agglomerate should stand unsupported; local areas will require rock bolting. Gunite, with mesh where necessary, is recommended for all exposed parts of the tunnel because of the durability test results, but it may not be needed. Further tests are recommended.

The present location proposed for the machine hall and ancillary excavations appears to be satisfactory but the final location and orientation should be decided after exploratory excavations and drilling have been carried out during construction. Rock-bolting of the machine hall, together with steel and concrete support of a few weak sections, should prove adequate for support purposes. Owing to seepage along fractures a ceiling will be needed; some points of entry of water may have to be grouted. Rock temperatures are expected to be about 82°F.

No special difficulties are expected with the pressure and access shafts.

Concrete aggregate is available from the Sogeri quarry, about 2 miles distant. Fresh agglomerate extracted during mining would probably also be suitable for aggregate but conglomerate or tuff should not be used. Further work needs to be done to locate suitable sand.

The earthquake hazard in the region is not thought to be high; ground acceleration of 0.1 g should be allowed for in design.



Block diagram of Sogeri Plateau & environs.
Adapted from Stanley & Thompson (1946) with the
permission of the Australian Petroleum Company Pty. Ltd.

FIGURE 1

To accompany Record No 1963/76

INTRODUCTION

GENERAL

The increasing population of Port Moresby, the town's industrial expansion and the general raising of standards of living, have necessitated the provision of a new source of hydro-electric power. Investigation has shown that the harnessing of the Rouna Falls, on the Laloki River, is the most economical. The project is being carried out in two stages. The first stage involves the construction of a rock-fill storage dam at Sirinumu, 5 miles south-east of Rouna Falls, to ensure an adequate supply of water for power generation; this part of the project is now nearly complete. The second stage of the scheme includes a diversion weir half a mile above the Rouna Falls, a tailrace tunnel about 2700 feet long, an underground power station at a depth of 500 feet below the weir, and a surface transformer sub-station. Generating plant will ultimately consist of six alternators, five of which are to have a capacity of 30,000 kilowatts, or six times the capacity of the existing hydro-electric station below the Rouna Falls. The sixth alternator will be used as a standby set. The project is expected to meet the requirements of Port Moresby for the next thirty years.

Because of the general instability of slopes and the everpresent danger of rock falls, a surface power station scheme was abandoned in favour of an underground station, for which alternative sites were envisaged. Under one plan, a long low-pressure headrace was to supply water to an underground power station near the Rouna Falls; in the other it was proposed that a vertical intake shaft would service an underground power plant almost underneath the weir site and that a long tailrace tunnel would discharge near the bottom of the falls. The second alternative has now been adopted. The local geography allows for a dynamic head of 500 feet.

LOCATION AND ACCESS

The power generation works of the project will be situated in the Territory of Papua, some 15 air miles north-east of Port Moresby, the administrative centre of the Territory, i.e. at longitude 147°22'26" E and latitude 9°25'28"S.

The Rouna Falls, which form a prominent landmark, are situated 23 miles by road from Port Moresby on the south-western edge of the Sogeri Plateau. The Falls can be approached from the left bank of the river by a good all weather road which primarily serves the inland rubber plantations of the Sogeri Plateau (See Fig. 1).

The right bank of the river is also accessible by a good gravel road which turns north from the main Rouna-Sogeri road just past the bridge over the Laloki River known as the Low Level Bridge. Some distance along this road another road turns westward and eventually leads to a disused saw mill on top of Hombrom Bluff. About one mile and a half from this second junction a jeep track runs southward towards the river.

GEOLOGICAL INVESTIGATIONS

Early investigations of the geology of the Laloki River and its suitability for power generation were carried out by Condon (1949), Edwards (1951), and Gardner and Noakes (1959). Davies (1960a and 1961) reported on a weir site above the Rouna Falls and on conditions for a surface penstock and surface power station below the Falls. Some drilling was done at Sogeri weir site No. 3 and extensive diamond drilling and augering was done to test the foundations for the surface power station, for the penstock and for a possible underground station beneath the ridge west of the Rouna Falls. Davies recorded the presence of a shear extending west from the Falls which made geological conditions for an underground power station in the area unfavourable.

In July 1961 D.G. Moye and J.A.S. McLeod, of the Snowy Mountains Hydro-Electric Authority, inspected the area and recommended the scheme which has now been adopted (Moye and McLeod, 1961).

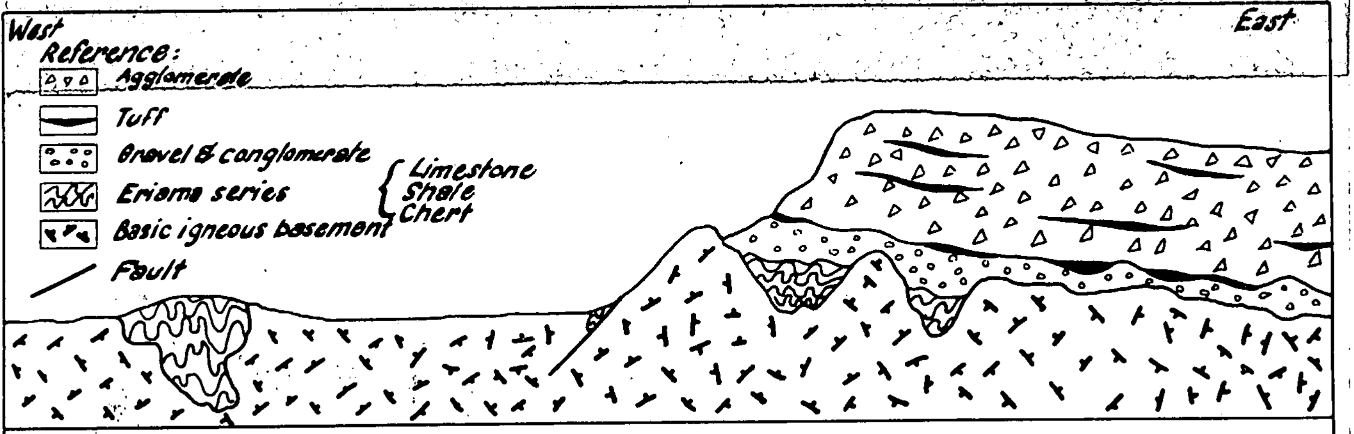


Figure 2. Schematic Section showing regional geology of the Astrolabe Range, Papua, looking North.

B.M.R. March 1963.

To accompany Record 1963/76

Geological mapping associated with the current project was carried out by P.W. Pritchard and G. Brouxhon, and drill core was logged by G. Brouxhon and L. Hamilton, under the supervision of G.A. Taylor. The geological investigation was under the direction, in consultation with officers of the Commonwealth Department of Works, of E.K. Carter, who visited the project on five occasions. Drilling and water pressure testing was under the supervision of officers of the Commonwealth Department of Works. E.J. Best measured drillhole temperatures.

TOPOGRAPHY AND GEOMORPHOLOGY

The southern and western margins of the Sogeri Plateau form a deeply dissected and prominent escarpment which rises abruptly from the surrounding terrain to an elevation of 2,177 feet above sea level at Hombrom Bluff. The plateau is broadly basin-like, with gently undulating topography. Across it the Laloki River flows sinuously in a north-westerly direction. The rectilinear drainage pattern of the Laloki River is apparently controlled by jointing in the underlying rocks. The river is fed by numerous consequent tributaries, many of which drain the elevated southern margin of the Astrolabe Range. The Laloki River upstream from the Falls has a catchment area of 120 square miles and a mean annual rainfall of 95 inches. The average flow rate for the river is 450 cubic feet per second.

From a geomorphological viewpoint the Laloki River valley can be divided into a lower course and an upper course, with the Rouna Falls as the main nick point in the longitudinal profile. In the four miles downstream of the Falls the river drops 650 feet; it is entrenched in a broad valley bounded on both sides by vertical rock faces, the feet of which are covered with extensive colluvial material. A series of small rapids extends for 2,500 feet upstream from the Rouna Falls. Above this point the river flows sluggishly for much of its course through a landscape that is in a youthful stage of erosion; it falls 250 feet in the 11¼ miles of river course from the Sirinumu Dam site to the Sogeri weir site, half a mile above the Falls.

The transverse profile of the Laloki valley downstream from the Falls shows valley-in-valley erosional forms. This can be seen from the Rouna Hotel looking westwards on to the valley slopes at Hombrom Bluff, where at least two erosional levels can be seen. Another more recent erosional profile can be seen on the right bank of the river downstream from the existing power station. At this point the river bed is separated from the outer wall of the valley by a saddle which runs for a mile along the valley. The edge of the saddle is a convex slope below which a vertical wall drops to the river.

The southern and western marginal areas of the Sogeri Plateau are attributed to the superimposition of more than one cycle of erosion. These are the result of a series of uplifts. The landscape of the lower levels of the valley downstream from the Falls is due to rejuvenation of the river bed by land slides. Large scale slumping of rock masses has taken place in recent geological times.

GENERAL GEOLOGY

LITHOLOGY AND STRATIGRAPHY

The Astrolabe Range, which forms the southern and western flanks of the Sogeri Plateau, consists of volcanic rocks resting on conglomerate. Both these formations overlie an igneous basement rock in which occur roof pendants of sedimentary rocks.

Ignecus Rock Basement and the Eriama Series.

The igneous rock basement occurs widely; it crops out extensively along the southern margin of the Astrolabe Range. Basic rocks are also found well up into the Laloki valley where they form the impressive hills flanking the left bank side of the valley opposite the existing power station. These hills are possibly faulted blocks formed before the deposition of the volcanic rocks.

The igneous rocks have a wide range of composition, from a true gabbro to a granodiorite. In places they show features of sedimentary contamination; they are commonly weathered.

Within the igneous basement are found remnants of folded and faulted sedimentary rocks consisting of limestone, calcareous shale and chert. These enclaves are thought to be roof pendants of the Eriama Series, to which a Cretaceous age has been ascribed. In places the rocks are sheared and metamorphosed by igneous intrusives.

Conglomerate

The conglomerate underlies the impressive sequence of volcanic rocks which constitute the Astrolabe Range. It crops out from near the bottom of the Rouna Falls, on the left bank, to a point near the storage pond of the existing power station. Glaessner (1952) mentions the occurrence of gravel and sand on the right bank of the river below, and to the west of, Hombrom Bluff which he calls the "Siro" beds. In all likelihood these beds of sand and gravel can be correlated with the conglomerate. The contact between conglomerate and basement has been observed at two points; in the Laloki valley due south of the present power station and at the 21-mile post on the Rouna Road. The conglomerate rests on an irregular erosional surface. Because of this irregular contact the conglomerate has a wide range of thickness.

The conglomerate is essentially massive, tabular and unsorted, with a slight preferred orientation of the boulders. The succession is made up of coarse rock components embedded in an arenitic groundmass and bonded by a calcareous cement. The coarser components consist of sub-rounded volcanic and metamorphic rocks occurring in different proportions from place to place. Near the Rouna Falls the coarsest components are much larger than elsewhere - up to large boulder size - and are predominantly of volcanic rocks. Near the storage pond of the existing power station a great number of the inclusions are metamorphic rocks. A variety of rock types has been recognized in the conglomerate; they include quartz, schist, slate, quartzite, dolerite, basalt and andesite.

The unsorted distribution and heterogeneity of the components suggest that they were transported by mud flows but they may have been deposited from torrential streams carrying heavy loads in suspension. The conglomerate can be regarded as an old valley fill which Recent erosion by the Laloki River has exposed.

Volcanic Rocks

Distribution and origin.

The Astrolabe Range consists of an aggregate of coarsely stratified fragmental volcanic material, known as the Astrolabe Agglomerate, which covers an area of some 64 square miles and is 1000 to 1500 feet thick. The material is restricted to the Sogeri Plateau. The Rouna Falls are located on the south-western corner of this geological and geographical entity. Overall the plateau is a broad structural basin. The regional dips observed on the western and southern margins are 5° to 7° north-east and north respectively. This apparent radial dip has probably been caused by recent regional uplift of the marginal areas of the plateau. The volcanic rocks consist of tuff and agglomerate. Both are grouped together under the name pyroclastics, the difference between the two being one of grain size rather than composition. The emplacement of the pyroclastic rocks is attributed to the formation of nuees ardentes by voluminous explosive volcanic activity. A nuee ardente is a gas-generating, eruptive avalanche, of which the heavy fractions of incandescent debris follow the depressions on the flank of the volcano and spread over the adjacent terrain. The lighter fractions of volcanic gases, sand, dust and hot air whirl upwards. Part of the agglomerate of the Sogeri Plateau was probably emplaced below water as in places it has been re-worked by running water. The nuee ardente origin of the agglomerate, and its redistribution, accounts for the wide range of physical properties of the rock.

Description

The agglomerate consists of angular to sub-angular fragments of volcanic rocks. The fragments range in size from volcanic dust to rock boulders up to 8 feet across. The average size of the components is 2 to 6 inches in diameter. The coarse fraction of the agglomerate is composed of vesicular basalt, massive basalt and augite andesite; vesicular basalt is the most common. The fine fraction consists of small rock particles, glass and individual crystals; the three commonly occur together. According to grain size, the fine fraction is called ash, tuff or lapilli.

The Astrolabe Agglomerate is sub-horizontally bedded. The beds range in thickness from fine laminations for the finer grade material to more than fifteen feet. The proportion of coarse to fine material varies from place to place, laterally as well as vertically. The matrix generally accounts for 30% to 60% of the rock.

No interbedded lava flows were observed in the area investigated although flows are reported to occur on the Jawarere road and in a creek bed east of Eilogo plantation. (Davies, 1960b). During surface mapping two tuffaceous horizons of some importance were observed. One occurs below the Falls, where it is 10 feet thick, jointed and fine grained; it is at the base of the agglomerate. The transition from conglomerate to tuff is sharp and clear while the contact between tuff and agglomerate is irregular and gradational. The second occurrence is above the Rouna Falls, near survey peg 13, at an elevation of 1463 feet. Here, the tuff band is 4 feet wide. The same bed is also found on the other side of the river where it thins out westwards and passes laterally into agglomerate. Both tuff beds have been preferentially eroded and form elongated caverns with overhanging agglomerate. Other minor tuff bands are common in the agglomerate. They are too small to warrant a detailed description. Some of them show graded and current bedding.

The tuff bands are not reliable marker beds because they commonly pass laterally into agglomerate. In drill hole R19, agglomerate overlies the conglomerate and there is no evidence for the ten-foot thick bed of tuff that crops out only 300 feet away.

STRUCTURE

Joints and Fractures

Joints are common in the agglomerate. They have determined the characteristic shape of many boulders and outcrops. The spacing between the joints is notably different below the Falls to that above it. Above the Falls extensive sheet jointing predominates; below the Falls jointing is essentially columnar. In both cases, two sets of near-vertical joints are mutually perpendicular to one another. Horizontal partings appear to result from the weathering of weaker tuffaceous beds. Joint measurements of dip and strike were taken above the Falls. One set of major vertical to steeply dipping joints crosses the river bed obliquely at between 315° and 357° magnetic. The other vertical to steep joints are secondary; they trend parallel to the river where they form cliff faces on many outcrops. The joints commonly terminate at depth at an underlying tuffaceous bed. Spacing between the joints varies from place to place but generally exceeds 10 feet and many intervals are 100 feet or more. Gaping is common in the primary joints but the gap is generally closed at shallow depths and in places joints are tight a short distance along strike. Gaps more than six feet wide are common, particularly where large masses of rocks are exposed in cliff faces well above the river. At river bed level the joints are fairly tight and have a low permeability because they are lined or filled with clay material. Secondary joints in the river bed are uncommon. The formation of joints and fractures in the agglomerate has been described by Gardner and Noakes (1959): "This cracking is in response to relief of stress within the rock by the natural process of 'unloading' or excavation by erosion; under tension, the rock tends to fail along widely spaced joint planes or incipient joint planes which become open cracks in the vicinity of free faces. A more advanced stage of disintegration produces loose rectangular blocks of agglomerate which part along near vertical cracks and horizontal planes of bedding."

Shear Zones

Four shear zones have been identified. Three of them can be seen along the Rouna Road; the other occurs near and west of the Rouna Falls. They were all observed in the agglomerate.

The most prominent one is found on the Sogeri Road from the second 'U' bend past the Rouna Hotel to a point 1200 feet farther along the road towards Sogeri. It looks like a complex faulted zone and consists of several open fractures 6 inches to 9 feet wide, filled with crushed rock material. Ten pronounced fractures occur in the 1200-foot stretch of road; many strike south-west and dip steeply to the south-east. Eight of the fractures occur just south of the look-out point over a distance of 170 feet.

In this zone, also, the rocks are cut by a system of joints spaced at intervals of 3 to 10 feet.

The faulted zone is in line with the deep, wide gully on the right bank below the Falls and the shear zone at the bottom of the Falls.

The shear fractures have irregular, curved and weathered wall-like faces which are distinctly banded along the sides. The fill material consists of red, gouge-like earth around boulders of agglomerate in various stages of weathering. Some of the boulders and cobbles of agglomerate show concentric weathering structures and others are closely jointed along planes parallel to the faces of the fracture. The presence of sub-horizontal striations on the wall faces indicates that some movement has taken place.

Two of the other shear or fault zones are also exposed on the Sogeri Road. One is located on the first 'U' bend past the hotel; the other is half a mile farther along the road towards Sogeri. They are denoted by the letters 'B' and 'C' in Moye's (1962) report. Both shear zones are characterized by low-angle shear joints.

The first zone on the 'U' bend, is indicated at road level by a striated tabular face or floor of agglomerate. The striations strike 042° magnetic. Stepped pluck-marks on the striations indicate that movement has taken place in a north-easterly direction; that is towards the Falls.

The second is a fault and dips 28°W, strikes 355° and has a crush zone up to 27 inches wide. The footwall is irregular and wave-like, probably due to the formation of large mullion structures.

Neither of the shear or fault zones have been traced any distance from the road owing to poor exposure, but Moye connects his fault zone B with the shear zone described below.

The fracture or shear zone west of Rouna Falls (described by Davies and by Moye) is exposed 400 feet south of the intake of the flume line for No.1 power station. A broken zone 30 to 35 feet wide and with a general east-west trend, is bounded by steep rock faces showing sub-horizontal mullion structures. The northern (footwall) face strikes 266° magnetic and dips 63° south. The southern boundary trends 275° magnetic and dips 45° south. Mullion structure plunges 6°east.

Both boundaries of the broken zone are marked by a zone 4 to 6 feet wide of intensely jointed, sheared and weathered agglomerate. Elsewhere in the broken zone, the surface rocks are fairly fresh and moderately jointed. The zone therefore appears to be a zone of moderately fractured rocks bounded by two strike-slip shears a few feet wide, rather than a 35-foot wide shear zone.

The tuff band which intersects the northern boundary of the fracture zone shows little displacement.

SLOPE STABILITY AND WEATHERING

Slope stability is a function of the rate of erosion by the river and retreat of the valley slopes; the accumulation or disposal of displaced rock material is determined by the slope gradient. Destruction of existing surfaces is commonly triggered by saturation of the ground during prolonged periods of heavy rain or by earth tremors, and the presence of joints or of weak tuff bands control in part the location and magnitude of slope failures.

In a region of such youthful topography as that of the Rouna Falls mechanical erosion is active and slopes rapidly become unstable. The vertical cliff faces of exposed rock below the Falls have been produced by rock failure along joints, and many of the ridges and spurs in the Laloki valley below the Falls are considered to have been formed by major landslips in Recent geological time. However, only one recent (post-war?) scar, which is fairly small, has been noted and the failure of substantial rock faces is thought to occur at intervals of decades or centuries, rather than at intervals of years. The cliffs above the proposed tailrace tunnel outlet must be regarded, in the geological sense, as unstable and subject to failure above river level, but no evidence has been found that failure is likely within a period of time that is significant for the proposed hydro-electric project.

Where cliffs have retreated away from the river the lower part is covered by a thick mantle of scree. The cliffs along the river have dumped shed material into the river.

Above the Falls slopes are more gentle and are largely covered by soil and rock debris (up to 15 feet thick), including large boulders of agglomerate. On the right bank, particularly, rock benches, some strewn by loose boulders which are commonly more or less in place, have been formed by well-developed open horizontal joints that appear to be lacking below the Falls. Failure of substantial masses of rock above the Falls is not to be expected; slope modification takes place largely by chemical destruction of the matrix of the rock and by wasting of soil, thereby releasing embedded boulders. The numerous boulders in the river channel and perched on slopes and benches show that this process is active.

In the absence of steep slopes the agglomerate weathers to a red clay. The tuffaceous matrix weathers first, and is followed by the alteration of the coarser volcanic components. Along the Sirinumu Road cuttings in agglomerate show a homogeneous lateritic clay grading downward into weathered agglomerate that shows relict textures of coarse fragments embedded in a red clay (decomposed tuffaceous matrix).

GROUNDWATER

Groundwater moves through the soil, along the soil-rock interface and along joints and fractures in the underlying rock. Most of the groundwater discharges finally into surface streams by migration through the soil, along the soil-rock interface and in the zone of circulating water above the static water table. As joints tend to close abruptly at short depths below surface most of the groundwater movement is within a few tens of feet of the surface. Groundwater in fractures has, however, penetrated at least 500 feet below the surface.

Springs on the left bank of the river below the Falls are considered to be mainly due to near-surface water movement, particularly that along the soil-rock interface.

Water movement in the rock masses is primarily along joints, fractures and faults. Fresh, unbroken rock has negligible porosity and permeability; even vuggy agglomerate lacks permeability because voids are generally not interconnected. Some movement may take place through the matrix and along grain or fragment boundaries of weathered rock, particularly conglomerate. Owing to weathering of the wall rock of fractures, joints and faults, with the consequent formation of clay, even these channelways tend to become sealed at depth; as a result water loss in drill holes at depth, even in broken zones, is small.

The water table level is generally within a few feet of the surface and slopes normally to stream level at a slightly shallower gradient than the land surface. In the spur west of the Rouna Falls the water table falls sharply behind the cliffs below the Falls, indicating fairly free drainage to the cliff faces. The small flow of water from the cliffs indicates that no significant leakage from the Laloki River above the Falls occurs through the ridge.

ENGINEERING GEOLOGY

SEISMICITY

A comprehensive discussion on seismic risk within the Territory of Papua and New Guinea is contained in a current Bureau of Mineral Resources Report (in preparation) titled "Earthquake Activity and Seismic Risk in Papua-New Guinea" by J.A. Brooks.

The report discusses seismic zoning in different regions of the Territory and generally indicates that the Port Moresby area is one of fairly low risk.

The epicentres of most earthquakes felt, at least in recent years, in the Port Moresby - Rouna - Sogeri region have been located either to the north-east, in the vicinity of Popondetta and Kokoda, or to the north-west, in the Eastern Highlands and adjoining districts where large, deep-focus earthquakes have been recorded.

There are no historical records of damage to structures in the Port Moresby - Sogeri region by seismic activity. Recently, following the installation of highly sensitive recording equipment at the Port Moresby observatory, extremely small earthquakes have been recorded.

Recommendations that structures in the Port Moresby area be designed to withstand lateral forces due to ground acceleration of 0.1 g are contained in section VI of Brook's report. This precautionary measure is currently adopted by the United States Bureau of Reclamation in the design of dams in earthquake areas.

PROPERTIES OF THE ROCKS

Agglomerate

Being a heterogeneous rock the properties of the agglomerate, even when fresh, display a wide range. It is, however, a massive rock and generally lacks pronounced bedding; it therefore has few prominent sub-horizontal planes of parting apart from widely spaced joints.

Mechanically, fresh agglomerate is only moderately strong, probably largely due to a weak matrix and to poor bonding between the inclusions of lava (which are very strong) and the matrix. Laboratory testing of the compressive strength of fresh agglomerate gave results in the range 10,340 to 4,200 pounds per square inch (see Appendix 3). Owing to the weak bond that commonly exists between the inclusions and the matrix the tensile strength of fresh agglomerate is very low. At the Sirinumu Dam some of the agglomerate appears to have been water-sorted after extrusion; this material is particularly weak in cohesive strength. Similar material may be encountered in the Rouna project.

The agglomerate appears to be fairly stable chemically but exposed faces show that the matrix weathers more readily than the inclusions. The wetting and drying tests reported in Appendix 3 suggest that the agglomerate would break down fairly quickly (although it appears to be more durable than the conglomerate), but no accurate guide exists to translate the results of the tests to durability under natural conditions. It is suggested that further durability tests should have as controls specimens of, say, granite, basalt, quartzite and crystalline limestone to provide a comparative figure.*

Examinations of the Sogeri quarry and road cuttings showed that weathering was no more than skin deep after up to 15 years exposure; this evidence suggests that fresh agglomerate is chemically stable, but does not provide information on resistance to erosion. Tests of erodability of the agglomerate, tuff and conglomerate should therefore also be undertaken.

The agglomerate is impermeable and all groundwater movement has taken place along joints and fractures.

---

* It is also suggested that wetting and drying may not be the appropriate test as rock in the tunnel would probably always be wet. Further, drying by gentle boiling introduces an element - differential thermal expansion of minerals - that would not be present in the tunnel.

Behaviour on impact shows that the rock is extremely brittle. At the Sirinumu Dam, where the rock is in general weaker than in the Rouna area, the agglomerate tends to break into small pieces on blasting and extensive shattering of adjoining rock commonly takes place. In fresh agglomerate a fair measure of control of line of breakage has been achieved, but severe overbreak commonly occurred in weathered, or otherwise weak, rock.

The agglomerate rock mass generally has widely spaced joints and these tend to be tight at depth. However it has been severely stressed and contains numerous irregular fractures and some shears and faults along which groundwater has moved to a considerable depth (below tunnel level in places). Some degree of weathering has generally occurred along these water-bearing fractures - ranging from superficial oxidation to the formation of thick clay seams.

Weathered agglomerate, which can generally be recognized by the brownness of the rock, is considerably weaker and less cohesive than fresh agglomerate; it would generally require slight to complete support in excavations, depending on the degree of weathering. Where groundwater has severely affected the agglomerate complete decomposition to a greasy plastic clay has taken place.

Tuff

Tuff occurs as widely spaced bands and lenses from an inch to about ten feet thick and commonly grades into fine-grained agglomerate. The mechanical properties of the tuff are generally similar to those of the agglomerate but are more uniform owing to the lack of inclusions. The tuff is also generally weaker than the agglomerate and tends to weather more readily. Exposures of tuff are commonly more deeply eroded than those of the agglomerate, and weathered tuff tends to be friable. The end product of complete weathering of tuff is, as for agglomerate, clay. Fresh tuff is essentially impermeable.

Wetting and drying tests (Appendix 3) indicate that tuff is probably less durable than the agglomerate.

Conglomerate

The inclusions in the conglomerate in the Rouna-Sogeri area are generally of volcanic rocks which are strong where fresh but weather in a manner similar to the inclusions in the agglomerate; a few schist inclusions, which are weak, have been observed. The inclusions are generally well-rounded but poorly sorted; they range in size up to at least 30 inches across. The bond between the inclusions and matrix is commonly weak. In general, fresh conglomerate appears to be slightly weaker than fresh agglomerate, and to be less durable under wet and dry conditions.

The matrix is coarse to fine-grained and consists largely of weathered fragments of lava and tuff and metamorphic rocks, giving a greywacke matrix. As in the agglomerate, quartz is rare and feldspar is abundant; as a result the matrix, on weathering, tends to decay with a breakdown both along grain boundaries and throughout the grains. The upper part of the conglomerate was deeply, but irregularly, weathered before the agglomerate was emplaced, and very weak, thoroughly weathered, conglomerate is consequently to be found below strong agglomerate. In general, also, the conglomerate, except near present exposed surfaces, is fresher and stronger at distance from the agglomerate - conglomerate contact. However it is not expected that the tunnel line, where it passes through conglomerate, will be farther than 120 feet vertically from the agglomerate-conglomerate contact and probably only local patches of fresh conglomerate will be encountered.

In the weathered zone the conglomerate commonly has a greasy feel, probably owing to the partial breakdown of ferro-magnesium minerals into chlorite. The worst material encountered, in drill hole R28, is almost completely lacking in cohesion and would require special mining techniques involving immediate support to avoid excessive overbreak. The strongest conglomerate observed would probably not require support, but gunite lining would be advisable.

Greywacke occurs as irregular beds and lenses in the conglomerate succession. It is similar to the matrix of the conglomerate but lacks volcanic pebbles and boulders, and its mechanical properties are similar to those of the conglomerate.

ENGINEERING ASPECTS OF STRUCTURE

Agglomerate - Conglomerate Contact

This contact is an erosional surface, the geometry of which is not known. The surface on which the agglomerate was deposited may have been extremely irregular and it is therefore not possible to predict the relationship of the contact to the tunnel line. None-the-less the exposure of the contact in the cliff west of Rouna Falls and the intersections in drill holes R19 - R28 give an apparent dip of 10 - 18° upstream along the tunnel. Further, R24, although continued 175 feet below the tunnel invert, did not intersect the conglomerate. Probably, therefore the conglomerate does not extend along the tunnel line more than about 1000 feet from the outlet portal. However if the surface is very irregular it could be intersected at several places beyond R19; this is not thought likely.

As the top of the conglomerate tends to be very weathered and weak both in compressive strength and cohesive strength, wherever the base of the agglomerate is approached from below very difficult mining conditions can be expected, with very serious overbreak and serious weakening of walls by explosives. Close support right up to the working face may be needed. Water pressure tests, however, indicate that large volumes of water are not to be expected.

Bedding

Bedding is generally poorly-developed, particularly in the conglomerate, and is not expected to have an important effect on the engineering properties of the rocks. Tuff bands may, however, provide weak layers in the agglomerate.

Joints

Earlier investigations have revealed that joints, though represented at the surface by wide clefts or soil-filled fissures, are generally closed at very shallow depths. At the level of the power station and tailrace tunnel most joints are completely tight but some have acted as channels for groundwater movement; where groundwater has moved along joints the walls of the joints are generally slightly to moderately weathered and some are clay-lined or clay-filled.

The tight joints should have little effect on the strength of the rock in which they occur or on the stability of openings, but in broken ground any clay-lined joints may provide slip-out planes for blocks of broken rock, which may have to be controlled by rock bolting. It would be prudent to orient structures so that major joints do not run parallel to the walls as this may result in overbreak or structural weakness.

Fractures

Drill core is generally broken at intervals of ¼inch to 2 or 3 feet. Apart from joints, faults and shears, these fractures are generally irregular and are apparently due to tectonic stressing of the essentially brittle agglomerate and conglomerate. They are generally not planar and owing to the interlocking of the blocks produced are not expected to produce serious structural weaknesses. Many of the "broken zones" recorded in drill logs probably represent local fracturing near the intersections of joints and faults. Rock bolting should effectively support fractured rock where the rock is not generally weathered. However fractured rock should be gunited in the tailrace tunnel to prevent weathering and erosion along the fractures (see p.27). Where the fractured rock is weathered its strength may be seriously impaired. Groundwater movement is greater in fractured ground than in unfractured rock but water movement even in the worst zones of fracturing is not expected to present any serious water-flow problems.

Shears and Fracture Zone

The probable shear zone near the Rouna Falls, shown by Davies (1961) in Plate 2 and discussed by Moye (1962), appears to be a zone of strong fracturing within two shears, marked at the surface by shallow-dipping slickensides and comminution. The surface evidence shows that the northern shear dips 63°S while the southern shear dips about 45°S and that movement was almost horizontal. Between the shears the rock is fairly strong and closely jointed but is not sheared. At tunnel level no major shears were encountered but several minor shears with weathering and some clay probably mark the limits of the zone. In between, the conglomerate is extensively, and in places closely, fractured, but is fairly strong and should only require rock-bolting for support. The zone should be regarded as a zone of fracturing between irregular shears. Displacement on the shears does not appear to have been large.

Vertical drill hole R21 is believed to have passed for about 200 feet through a zone of weathered and broken rock associated with a fault that strikes 074°magnetic and dips 88°N. A cliff face of this orientation stands only 18 feet south of the collar of R21 (see Plate 1 and Fig.4). The persistence of the fracturing in R21 suggests a weathered and broken zone up to 5 feet wide, provided the hole did not deflect along the structure; such a wide zone is more likely to be due to a fault than a joint. However R23 did not reveal any significant shear or fault zone along strike, so possibly R21 intersected the junction of two joints.

On the present information it should be assumed that the structure intersected is a fault filled with material of very low strength, and the power station should be sited at sufficient distance from it to avoid undue stress concentration in the southern wall of the station. Further information on the nature of the structure should be obtained during construction - the access tunnel will cut across it.

WEIR SITE

The diversion weir proposed consists essentially of a concrete sill about 10 feet high from which rise two concrete piers and abutments to carry radial gates of span 44 feet and height 30 feet. This design is necessary because of the high flood discharge of the Laloki River. In this type of structure a severe sliding force is placed on the foundation of the weir, and the absence of low angle joints or fractures is of vital importance.

The weir will be sited in agglomerate which is exposed in the river bed and on the right abutment. Soil cover is slight on the left bank as is indicated by several costeans and auger holes (Plate 4); the costean nearest the axis of the weir revealed an average depth of soil of about 2 feet, underlain by weathered, but fairly strong, jointed agglomerate. Drill hole R25 tested the left abutment at depths below the surface of from 12 to 33 feet; strong, sparsely fractured and jointed, rock was encountered below the abutment and beneath the river. Extensive broken ground was intersected in R25 at hole length 320 to 385 feet. This is 180-280 feet below the right bank of the stream and about 30 feet upstream from the axis of the dam.

Drill hole R30 was drilled in the right abutment to check whether the broken ground in R25 was related to two linear soil-covered areas, one parallel to the river and above the right abutment, and the other on the right bank in line with the axis and striking at 65° to the course of the river. No substantial unsound rock was encountered in the drill hole or in R31, which tested the weir foundations. The broken ground encountered in R25 will therefore have no effect on the soundness of the dam foundations.

The depth of soil and of weathered rock below the linear soil-covered area above the right abutment has not been established. It will be necessary to excavate all unsound material and replace it with a concrete plug large enough to support the right abutment and to prevent any water leakage. As the soil-covered area is 40 to 60 feet above the river bed level very little treatment may be necessary.

The left abutment should also be stripped and any joints cleaned out by sluicing or other methods and grouted up. It may be necessary to ensure that the upper 10 to 15 feet of the rock is sound by test drilling.

An attempt was made to test the soundness of the weir foundations by a grid pattern of vertical holes but these were not successful owing to the instability of the drilling platform which prevented satisfactory core recovery. In general the core was fresh and strong from the bed of the river down (see logs of holes A3 - A6 and B3 - B6, Appendix 1). A cavity was encountered in B3 from 4 - 5 feet, and tuff occurs in A4 from 5 to 11 feet and B6 from 8¾ to 10¼ feet. The cavity may be due to a horizontal joint. It may be necessary to remove the tuff and any weathered rock below the cavity; provision should therefore be made for stripping of the bed of the river to a depth of about eleven feet. Further probing by diamond drill to ensure that no other joints occur at shallow depth in the foundations of the weir should also be carried out during construction, and the foundations grouted to a depth of at least 20 feet. Grout holes should be oriented to intersect known joints. In view of the low mechanical strength of the agglomerate and the stresses to which it may be subjected during high flood it is considered wise to set tie rods in the foundations. An opinion as to the length of tie rod needed is beyond the competence of the authors.

Agglomerate from Sogeri quarry is being used for construction purposes at the Sirinumu Dam and the material presumably has an acceptably low reactivity with concrete. Despite this, several samples of rock from the foundation of the weir should be tested for reactivity to ensure that a satisfactory bond will be obtained between the foundation rocks and the concrete sill.

A few yards downstream from the dam several joints that cross the river obliquely have been eroded out by water action. They may fall within the area of the sill, in which case they would be treated adequately during preparation of the foundation of the sill. If however, they occur a short distance downstream of the sill they should be plugged to avoid turbulence and possible damage to the downstream toe of the sill.

No difficulty should be experienced with the take-off works - intake, settling tank and head works of the pressure shaft. All will have to be excavated from weathered to fresh rock and as load factors are low and the intake works will be completely lined no difficulties should be experienced even if some deeply weathered zones are encountered.

The slopes on either side of the weir site are fairly gentle and no difficulty is expected from falling boulders near the weir and intake works. Some boulders on the existing slopes may have to be removed. Provision should be made to prevent large boulders brought down the river by saltation during floods and floating debris from lodging in, or damaging, the weir or intake works.

TAILRACE TUNNEL

Plate 2 shows a summary of the available geological information along the line of the tailrace tunnel. The position of the tailrace tunnel is provisional, as the outlet portal may require variation to afford maximum protection from falling boulders from both sides of the river and from blocking of the outlet by river-borne boulders at times of high flood. The location of the power station may also have to be varied in the light of knowledge gained during construction of the tailrace tunnel or the access shaft.

This is discussed elsewhere. The section through the tailrace tunnel is based on a drawing provided by Mr. J.B. Fraser, in which the position of the outlet portal as shown in Works Department Drawing HC62/197/B was moved downstream 40 feet. In the section all drill intersections within about 50 feet of the plane of the section are shown with an unbroken line; other information is presented within a dashed representation of the drill hole position.

In Plate 3 uncorrected water pressure tests (i.e. gauge pressures and water consumption in gallons per minute per foot of test section) and an interpretation of the most probable position of the conglomerate - agglomerate boundary are given. It is emphasized that the position of the agglomerate - conglomerate contact may be very different from that shown as the surface is probably not planar (see p.16). In addition the expected groundwater conditions and support requirements are set out; the interpretations are subject to a number of qualifications which are discussed below. Full geological logs and water pressure tests results are set out in Appendices 1 and2.

Groundwater

In only a few of the holes were applied pressures adequate to produce an effective pressure in the test section equal to the theoretical pressure exerted by the groundwater. Possibly greater flows would have been obtained with higher pressures but the results are considered to give the correct order of water leakage.

During drilling some anomalous static water levels were measured - in some holes the water table was apparently many feet below river level. Further, the water level dropped as the hole was deepened. It is concluded that the depth readings represented the difference between the hole volume and the volume of the drill rods. Possibly some sealing of fractures in the rock drilled, by fine products of drilling, made the holes temporarily impermeable. Subsequent readings gave water levels consistent with a normal piezometric surface. Tests were also made, as suggested by Moye (1962), on 7th June 1962 to establish whether the holes were watertight by filling the holes with water and noting the time for the water level to return to the static level. Results were as follows:

R.19 Vertical hole

Static water level 283 feet below natural surface.
Natural surface R.L. 1423.
Water level raised to 185 feet by pump.
Level dropped from 185 to 283 feet in 4 minutes.

R. 20

Drill hole blocked by caving; could not measure water level.

R21. Vertical hole

Static water level 49 feet below natural surface R.L. 1458.76.
Static water level 1409.76.
Water level raised to natural surface by pump.
Water level dropped from top of hole to:

	Time
10 feet	3½ minutes
15 feet	6 minutes 10 seconds
20 feet	11 minutes 25 seconds
30 feet	14 minutes
35 feet	19 minutes
40 feet	24 minutes
45 feet	44 minutes
47 feet	120 minutes

R.22 63° Slope hole

Static water level 7.8 feet below natural surface.
Natural surface R.L. 1423.9.
Static water level raised to natural surface by pump.
Water level dropped from top of hole to:

	Time
4 feet	¾ minute
6 feet	1 minute 5 seconds
7.8 feet	3 minutes

R.23 71° Slope hole

Static water 92.5 feet Slope distance below natural surface.
i.e. 87 feet vertical distance.
Natural surface R.L. 1494.12.
Water level pumped to top of hole.
Water level dropped from natural surface to:

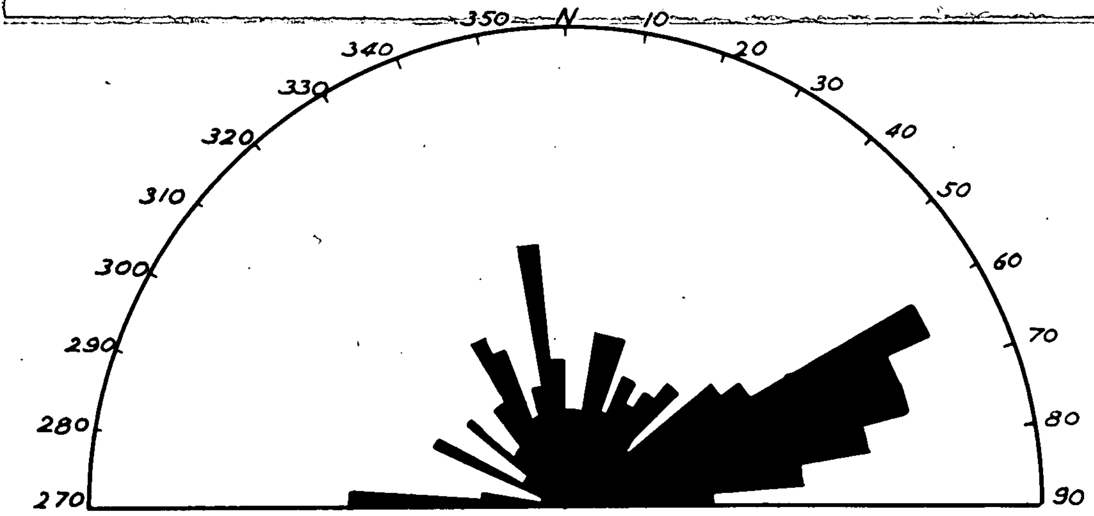


Figure 3. Joint rosette, showing frequency of joint directions.

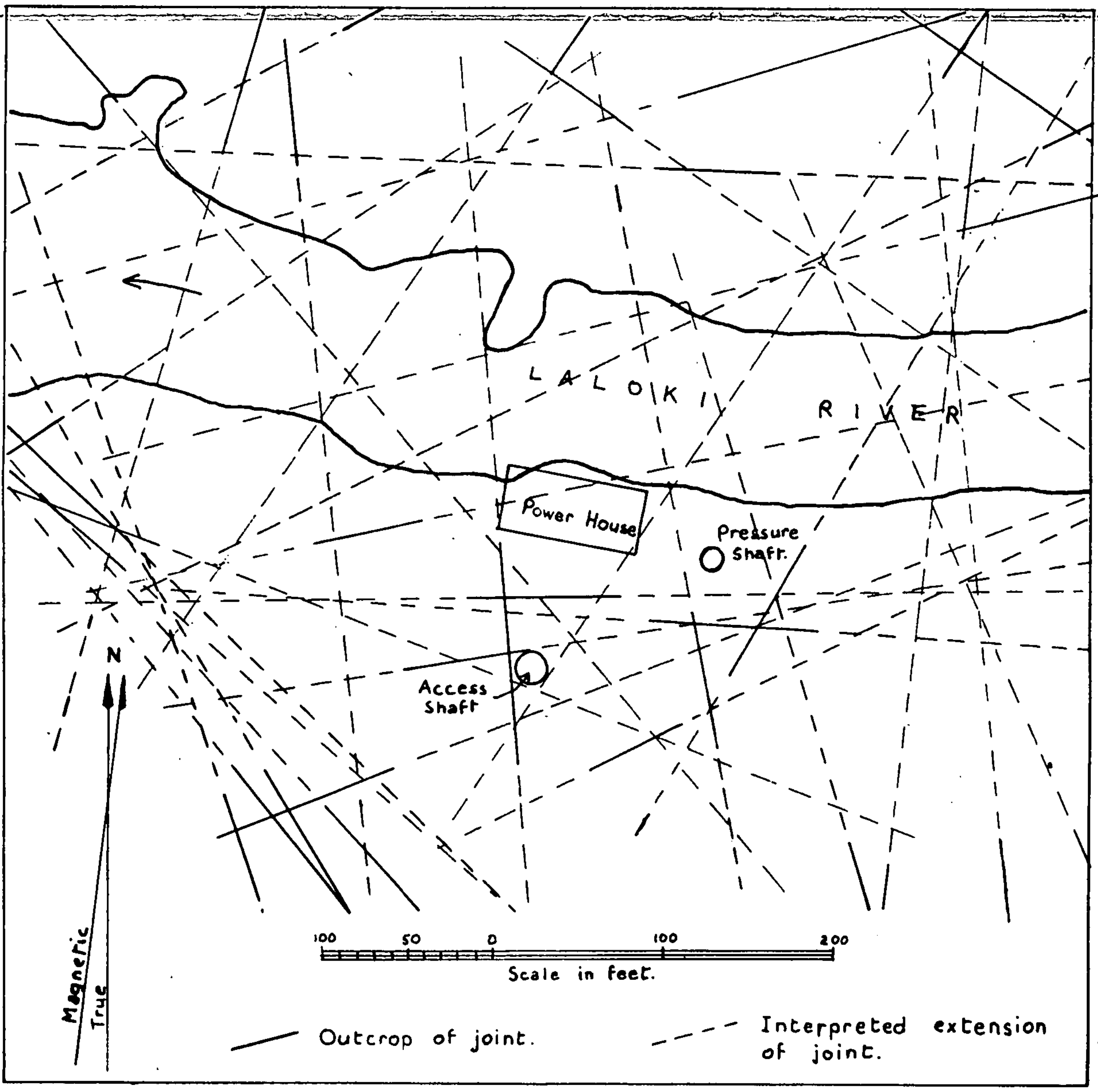


Fig. 4 :- Location of underground power station in relation to joints at the surface.

	Time
20 feet	3 minutes
40 feet	6 minutes
60 feet	9 minutes
80 feet	26 minutes
90 feet	40 minutes
92 feet 1½ inches	155 minutes
92 feet 7 inches	4 hours.

R.24 74°18' Slope hole

Static water level 21 feet below natural surface.
Natural surface R.L. 1417.2.
Water level could not be raised by pumping. No return water was obtained when drilling this hole.

The results indicate that near the surface the agglomerate is very permeable i.e. that groundwater can move freely along fractures. At the level of the tunnel, however, the water-pressure tests indicate that permeability is low, even in the fracture zone tested by R26 and R28. Because of the possible pugging of fractures in drill holes, and the opening of fractures along the tunnel line that might be expected as a result of blasting, inflow of water into the tunnel may be considerably greater than that to be expected from the water pressure tests. Wet conditions can be expected in many places but water inflow should not present any serious difficulties, nor should groundwater pressures materially affect the stability of openings.

The piezometric surface above the tunnel line west of the Rouna Falls shows that drainage occurs freely to the cliffs below the falls. However the lack of substantial spring action and the low yield of water (at low pressure) from drill hole R11 prove that there is no significant leakage from the Laloki River above the falls through the spur of the cliffs below the falls, and that the fracture zone does not behave as an aquifer. Should, however, the fractures below the river, intersected by R20, persist as permeable zones to tunnel level (this is considered unlikely), substantial inflow of water into the tunnel may occur.

Intersection of 88° dipping fault on joint by drill hole R21

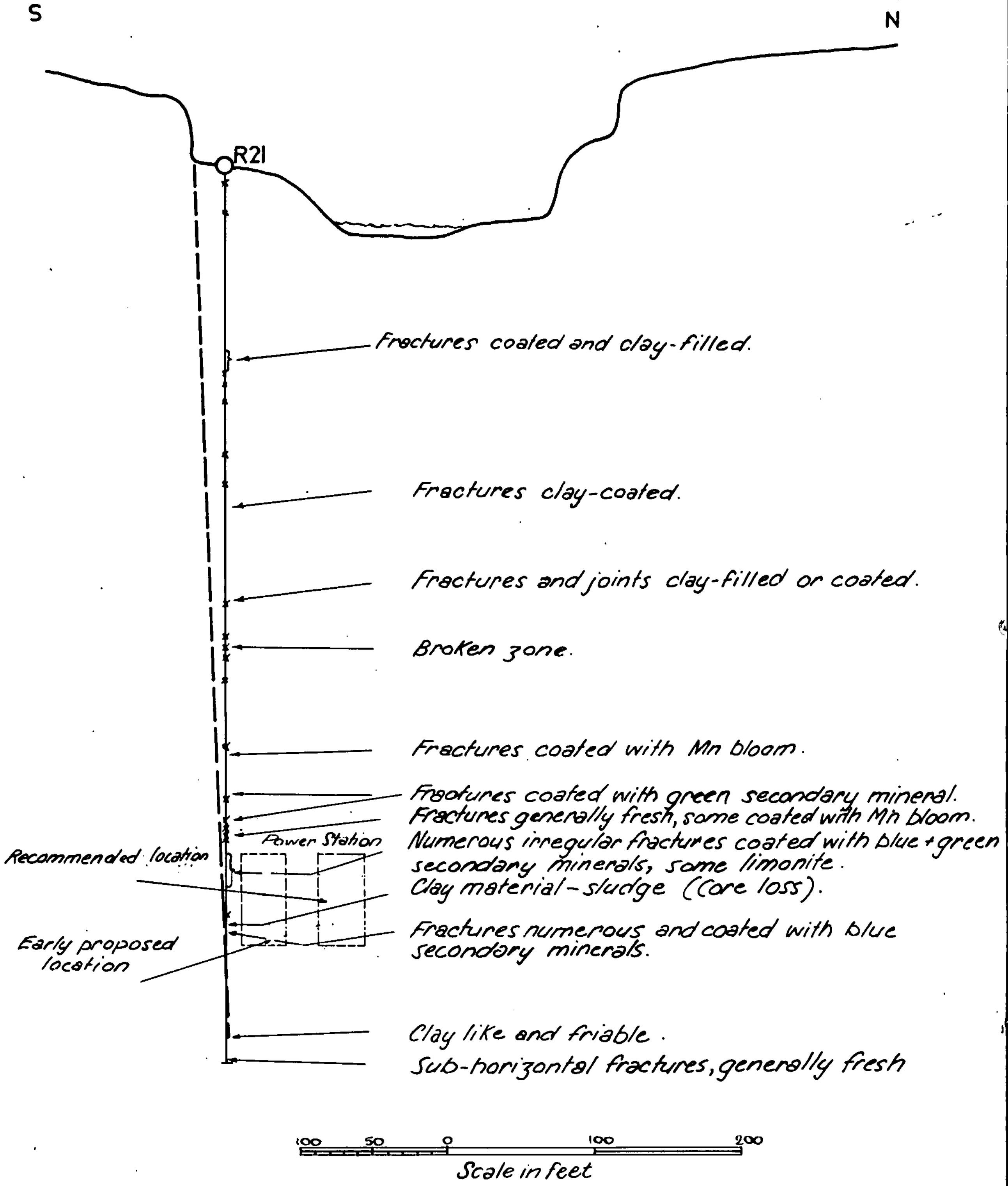


Figure 5.

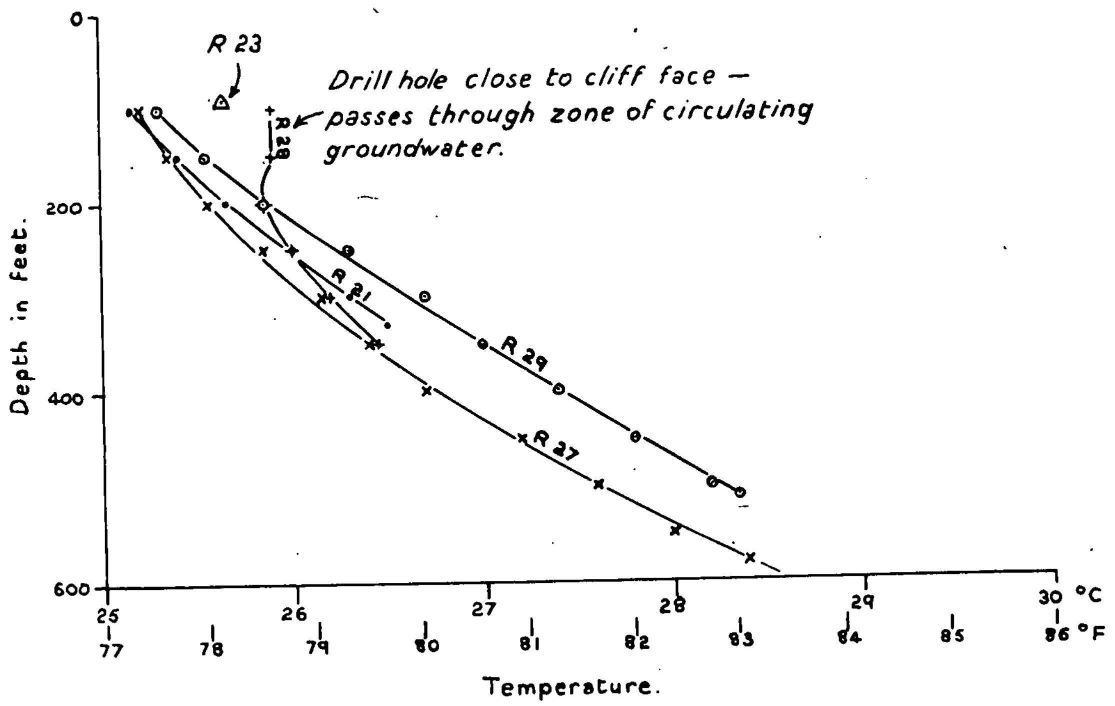
To accompany Record 1963/76

B.M.R. March 1963

Mining Conditions and Support Required

As bedding planes and sub-horizontal joints are widely spaced they are not expected to result in serious overbreak during tunnelling, but the brittle nature of the agglomerate, with poor bonding in places, and the weak cohesion of the conglomerate may result in substantial over break in places. Drill hole R28 shows that in places at least 20 feet of the upper part of the conglomerate, which is severely weathered, has extremely little cohesive strength; if this material occurs widely at the top of the conglomerate serious difficulty may be experienced in preventing overbreak as the conglomerate - agglomerate contact is approached; further, mining techniques may have to be adopted that provide immediate and total support right up to the working face. It should be noted that the uppermost conglomerate in R19 is much stronger than in R28 but up to 4 feet of core was lost.

The behaviour of the agglomerate in blasting is referred to on p.16. In fresh agglomerate little difficulty is expected. Moye's suggestion, that drilling at close centres to effect smooth-wall blasting be adopted during mining, is supported. Locally substantial overbreak will occur where joints, faults or shears intersect at unfavourable angles. Rigorous inspection of walls and backs should be made after each round is fired. In weathered agglomerate conditions will be worse and light charges and burnt cuts should be used. The conglomerate is expected to behave in a somewhat similar manner to the agglomerate as both rocks contain strong inclusions set in a weaker matrix. Mining will mainly be in weathered to slightly weathered conglomerate and in fairly fresh agglomerate; mining conditions will be worse in the conglomerate. Very weathered conglomerate, such as in R28, may have to be mined without blasting. Breaking will normally occur around boulders in the conglomerate rather than across them unless smooth-wall techniques are used; therefore where boulders are large the falling out of boulders will result in overbreaking and projecting boulders will need secondary drilling and blasting.



Drill hole close to cliff face — passes through zone of circulating groundwater.

Fig. 6 :- Temperature — depth relationships.

It is understood that it is proposed to drive two short experimental tunnels, one in agglomerate and the other in conglomerate, to determine mining conditions. It is suggested that the tunnel in the conglomerate be as near as possible (but not closer than 20 feet) to the agglomerate - conglomerate contact. Possibly the tunnels could be sited so that they could subsequently be used as explosive magazines. During the experimental tunnel-driving close attention should be given to a possible relationship between drilling conditions and rock behaviour on blasting as it may, with experience be possible to gauge explosives and support requirements from the jack-hammer drilling.

Lining

In Plate 3 provision is made for lining with gunite and mesh all that part of the tunnel not supported by steel or structural concrete. This is because of the apparently poor resistance to wetting and drying shown by durability tests (see Appendix 3). Additional tests, as recommended (see P.15), may indicate that the results of the tests to which the agglomerate,tuff and conglomerate specimens were subjected indicate good durability. If this is so a considerable saving could be effected in tunnel protection. It is expected that weathered agglomerate, tuff and conglomerate will need surfacing to prevent erosion and fretting.

In the early stages of power generation, before the station is developed to full capacity lining of only the lower part of the tunnel may be necessary.

As the groundwater head will be about 500 feet over much of the tunnel guniting will not be possible where there is any significant water inflow. Such areas may require grouting before the gunite is placed. Minor seepages could probably be temporarily controlled by plugging of fractures with burlap, or wooden wedges, and mesh and gunite then affixed. In all wet areas relief holes should be drilled through the gunite into the rock to allow escape of groundwater. The relief holes should be designed to intersect known fractures.

POWER STATION

The power station will be entirely in agglomerate and tuff which is generally fresh to moderately fresh, and therefore fairly strong. Core specimen Nos. 7-Q-52 to 56 and 7-Q-74 to 78 (Appendix 3) are from within, or near, the provisional machine hall site and have ultimate (static) compressive strengths of 4,200 to 9,230 pounds per square inch and Young's modulus of 0.5 to 1.6×10^{-6} pounds per square inch (some higher results probably essentially represent the strength of inclusions rather than the rock). No drill core was lost within the proposed site of the power station in either of the holes into the area (R22 and R23). Some fractures and joints are weathered and a few are clay-coated or clay-filled. Core pieces ranged in length from fractions of an inch to 30 inches.

Location

Drill hole R21, the first hole to test a possible site for the underground power station, encountered very broken and weathered agglomerate from 350 to 550 feet. As the collar of the hole is only 18 feet north of a cliff face that dips north at 88° it appears that the cliff represents a fault plane, the downward extensions of which was intersected by the drill hole. A plot of the postulated fault and the intersection of poor ground in R21 (Figure 5) suggest that the fault zone is about 5 feet wide. Drill hole R23, however, does not show any significant broken ground where it cuts the line of strike of the fault; possibly, therefore, the poor ground in R21 is at the intersection of two major joints rather than part of a fault zone. It would, never-the-less, be prudent to site the machine hall at sufficient distance from the 075° striking structure to avoid any weakness in the southern wall.

Drill holes R22 and R23 were designed to test a block of ground at least 30 feet north of the projection of the fault to R.L.950; they indicate acceptable rock conditions. The information they have supplied is, however, inadequate to fix a firm site for the power station, and additional testing will be needed during construction.

This should be done from an underground site. The foot of the access shaft would be a very suitable location for a drill site. This would require that the access shaft be excavated in advance of the tunnel line, and may not be practicable. The alternative appears to be to drive the tailrace tunnel to within, say, 200 feet of the presently-proposed machine hall site and to advance from that point with a smaller exploratory tunnel, simultaneously drilling to test the walls, roof and ancilliary works of the machine hall.

When selecting the site for testing by drill holes R22 and R23 consideration was given to the location and attitudes of joints at the surface, and the presently-proposed location appears satisfactory from that viewpoint (see Fig. 4). As, however, the joints are only known to dip about vertical and their persistence at depth is not known their relationship to the power station site can only be indicated very roughly.

Orientation of Machine Hall

A study of surface joint directions - see joint rosette (Fig. 3) - indicates that the best direction for the long axis of the machine hall is about 120°(i.e. 113° magnetic) - an angle of about 20° to the river near the weir site. There will be ample opportunity to make a much more complete study of joint directions during excavation of the tailrace tunnel, on which to finally determine the orientation of the machine hall.

Shape of Machine Hall

Moye (1962) has discussed the strength of the agglomerate in relation to likely stresses around a machine hall and concludes that the rock is sufficiently strong to enable an underground power station to be built. In the absence of information on horizontal tectonic stresses and in veiw of the fairly small safety margin between maximum possible stresses and minimum rock strength (both compressional and tensional), the designed shape of the machine hall should be kept as simple as possible.

Groundwater

The maximum loss below 400 feet depth in drill holes R21, R22, R23, R27 and R29 during water pressure testing was 0.2 gallons per minute per foot (in R22 at 60 pounds per square inch gauge pressure). Leakage at a comparable rate from a persistent fracture or joint in the roof or wall of the machine hall would produce wet conditions, but unless permeable fractures are much more numerous than the drill core indicates no serious water inflow is expected. Inflow could be substantially reduced by grouting of the larger water paths.

As seepage and dripping from the roof is to be expected provision should be made for a suspended ceiling, as recommended by Moye.

Mining Conditions are expected to be similar to those for the agglomerate in the tailrace tunnel. Smooth-wall blasting should be adopted at the walls, roof and floor of the machine hall and in the tailrace access shaft and tunnel but once faces have been established in the machine hall conventional methods of mining by benching could be followed.

Special care should be exercised when excavating the slots for the inlet pipes for the generators as the intervening pillars are likely to fracture.

Support

Moye considers that rock-bolting of the roof and walls will provide sufficient support. As clay seams were intersected in drill holes within the proposed site of the power station some measure of additional support appears necessary in view of the span of the roof. Also, hole R29 (pressure shaft) intersected some rather friable and broken agglomerate at power station level. If this zone extends into the eastern end of the machine hall some support beyond that provided by rock bolts may be needed. Provision has therefore been made for 20 percent steel and concrete support in the machine hall in Plate 3 but the support required will have to be re-assessed after conditions, including tectonic stress, have been determined after excavation.

Rock Temperatures

A thermister probe, loaned by the Department of Geophysics, Australian National University, Canberra, was used to measure rock temperatures in several holes. Holes R21 and R23 were probed on 25th September 1962 and the remaining holes were done on 7th December. The results are shown in Figure 6.

Rock temperatures at power station level are therefore between 27.5 and 28.2°C (about 81$\frac{1}{3}$ - 82$\frac{3}{4}$°F). As significant seepage into the machine hall is expected humidity would approach 100% without forced ventilation and working conditions would be very trying.

Instrumentation

As the existing stress conditions in the rock mass, due to tectonic forces, are not known and as the existing stress field will have a very marked effect on the stress distribution around openings, stress and strain gauges should be installed as soon as possible and in as many places and directions as possible. In this way data could be built up on which to base final decisions about support for the machine hall.

It is also suggested that the gauges could be maintained and read regularly after completion of the project. Valuable information might be built up about response of stress conditions to seismic activity and secular variation of crustal strain. This information, in addition to being of great interest to seismologists and others, may be of considerable use in the design and construction of other projects in the region. Probably officers of the Port Moresby Geophysical Observatory of the Bureau would be interested in participating in any study programme.

PRESSURE AND ACCESS SHAFTS

Pressure Shaft

Soil, clay and decomposed rock extends 10 feet from the collar of the drill hole (R29) and weathered and broken rock extends a further 1½ feet; a steel and concrete collar will therefore need to extend about 12 feet from the top of the shaft to R.L. 1424. Below this point the agglomerate, apart from fractures and joints, is generally fresh and is amply strong to stand during excavations of the shaft and to support the internal pressure in the shaft under maximum operating loads. Weathered zones and clay around and in fractures and joints persist to the bottom of the hole. In the last 160 feet the core is generally rather broken and minor core loss occurred. It may therefore be necessary during construction to rock-bolt several zones and to afix mesh to prevent minor fall-outs of rock. Experience gained in driving the tailrace tunnel should enable techniques to be adopted which will prevent excessive overbreak and no difficulty should be experienced in placing the concrete lining and tying it satisfactorily to the rock wall.

Water inflow during construction should not be serious as to a depth of 400 feet the maximum water loss during pressure tests was 0.04 gallons per minute per foot. From 400-450 feet the loss was 0.12 gallons per minute, at gauge pressure of 60 pounds per square inch. This section may require some grouting at points of water entry before the concrete lining is placed as plugging would be difficult because of the high groundwater pressure.

The concrete lining would have to withstand a static groundwater head of nearly 500 feet at the bottom of the shaft - a pressure of about 280 pounds per square inch.

Access Shaft

Conditions generally are similar to those in the pressure shaft, but the ground is not so broken near the bottom of the hole (R27) as in R29. The collar should extend to about R.L. 1406. The treatment recommended by Moye - mesh lining during construction and subsequent lining by gunite - should be satisfactory. A few broken zones may require rock bolting, and perhaps grouting for permanent control of water; the one-foot wide zone of clay and decomposed rock at hole depth 418 feet may require special treatment, depending on the angle of the zone to the shaft. The few tuff bands present should not require special protection.

CONSTRUCTION MATERIALS

No homogeneous material suitable for use as concrete aggregate is available within many miles of the Rouna area. Aggregate for use in the Sirinumu Dam project is obtained from Sogeri quarry only 1.2 miles, in a straight line, from the weir site; crushed and sized material from the quarry is reported to be entirely satisfactory. The rock in the quarry is agglomerate, similar to that in which much of the power generation works will be sited. It has a high proportion of inclusions and a correspondingly small tuffaceous matrix; the inclusions are strong basalt and andesite fragments. It is concluded that on crushing, the matrix, which is weaker than the inclusions, is finely broken and is discarded in the undersize fraction (which is used for road surfacing). The sized product from the Sogeri quarry should be quite satisfactory for use in the power generation project and should be cheap. Routine reactivity tests should be made. Road haulage distance is about 2 miles to the weir site and 3½ miles to the portal of the tailrace tunnel. Ample supplies of suitable rock are available.

It is not known what proportion of matrix is included in the sized product. Should small quantities of matrix-free aggregate be required for special structural concrete very large boulders of lava, probably andesite, lie in the bed of the creek between the quarry and Sogeri village. They have been eroded from the agglomerate but are quite fresh.

Unweathered agglomerate spoil from the tunnel and power station should prove as satisfactory a source of concrete aggregate as the rock from Sogeri quarry. The conglomerate should not be used because it is generally weathered and it contains a proportion of schist pebbles and boulders. Tuff should also be rejected.

No large supply of sand is known in the area. As the outcropping rocks are all almost, or completely, devoid of crystalline silica little quartz sand is formed by erosion; most of the sand deposits consist of weathered ferromagnesium and iron oxide minerals. A small deposit occurs at Sapphire Creek but it contains a large variety of minerals. The weathered conglomerate at the 21-mile peg on the Port Moresby - Rouna road might possibly provide suitable sand by washing. The matter requires further investigation as the occurrence is extensive.

WATER QUALITY

The Laloki River is normally clear and carries very little material in suspension; it also does not have any dissolved impurities likely to be injurious to structures or machines. However in time of flood it is very discoloured and clearly has such an erosive power that substantial suspended material and bed load are to be expected. This matter is discussed by Moye (1962) and his conclusions as to the need for intake works designed to remove transported solids are supported.

CONCLUSIONS AND RECOMMENDATIONS

1. Investigations have shown that the underground power station scheme recommended by Moye and McLeod (1961) is practicable.

2. The proposed underground power station, access and pressure shafts, weir, and probably about 1700 feet of the tailrace tunnel will be in agglomerate, with included thin lenses of tuff, of the Astralobe Agglomerate. The remainder of the tunnel (about 1,000 feet) will be in more or less weathered volcanic conglomerate.

3. Fresh to moderately fresh agglomerate is strong enough to stand in openings without support but the agglomerate is extensively fractured, jointed and locally faulted and sheared. Joints are widely spaced and are generally fairly tight but weathering has taken place to below tunnel level along many fractures and other places of parting. The end product of weathering is clay.

4. Tuff appears generally weaker and less durable in exposed surfaces than agglomerate but occurs in thin beds and lenses only - the widest measured bed is 10 feet thick.

5. The conglomerate, where fresh, is probably as strong as the agglomerate, but probably very little fresh conglomerate will be encountered in the tailrace tunnel.

6. Results of durability tests conducted by the Department of Works Central Testing Laboratories cannot be translated into durability under operating conditions, and it is recommended that additional tests be carried out, with other rock types as standards. Provisionally, in the meantime, it is considered that allowance should be made for lining by gunite, or gunite and mesh, all unprotected parts of the tunnel.

Proposals by Department of Works engineers for tests of resistance to erosion by agglomerate, tuff and conglomerate are supported.

7. Weir site foundations are sound but will have to be excavated to any open flat-lying joints and probably the tuff encountered during drilling should be removed. Possibly about 11 feet will have to be removed but further drilling is needed to establish maximum depth of excavation needed. Some grouting and plugging of joints will be needed, particularly in the right abutment, and anchor bars in the foundations are recommended.

8. Conditions likely to be encountered in the tailrace tunnel are summarized in Plate 3. Generally conditions should be fairly good but extremely bad ground is likely to be encountered in the conglomerate near the contact with the agglomerate. For upwards of 100 feet special mining techniques may be needed, with strong support, and considerable overbreak - possibly to the base of the agglomerate - is likely. Several smaller weak zones can be expected, particularly in the conglomerate, where full support will be needed. Elsewhere local rock bolting will probably be needed.

Water inflow should not be serious but some broken zones will need grouting before guniting.

Experience at Sirinumu has shown that the agglomerate is very brittle and care will therefore have to be exercised in the use of explosives to minimise fracturing of the tunnel walls and to restrict overbreak. Smooth-wall drilling, as proposed by Moye, is supported. The conglomerate will probably behave in a manner similar to the agglomerate.

9. Excavation conditions for the machine hall are expected to be similar to those in the agglomerate in the tunnel. Some steel support will probably be needed and, because of the greater size of opening and the consequently increased stresses around the opening, rock bolting throughout is recommended.

Water inflow should not be serious but provision should be made for a ceiling, and the main points of entry of water may have to be grouted.

10. Drilling to date has indicated only one structure which should be avoided in siting the machine hall; this is the fault or weathered joint intersected by drillhole R21. On present information the currently proposed location appears satisfactory but a final decision should await additional information obtained during construction. The most favourable orientation of the long dimension appears to be about 120^o (true bearing).

11. Rock temperatures in the vicinity of the machine hall are expected to be about 82^{o}F. Owing to seepage and dripping, humidity will be high and forced ventilation will be necessary.

12. As nothing is known about tectonic stresses in the agglomerate, stress and strain gauges should be installed in the workings as soon as possible after excavation.

13. No difficulty is expected in the excavation of the pressure and access shafts. The pressure shaft will be lined; mesh for safety purposes, and finally gunite (as recommended by Moye), with some grouting should generally be sufficient for the access shaft.

14. Aggregate from the Sogeri quarry is being used at Sirinumu dam site and should be satisfactory for concrete for the Rouna-Sogeri works. Fresh agglomerate from the tunnel and power station could probably also be used to produce aggregate but the conglomerate and tuff should not be used.

Further investigations to locate a suitable source of sand are needed.

15. It should be assumed that substantial suspended matter and bed load is moved by the Laloki River in times of flood.

16. Compared with most of Papua-New Guinea the seismic hazard in the Port Moresby region is low. It is suggested that a ground acceleration of 0.1 g be allowed for in design.

ACKNOWLEDGEMENTS

The geological investigation was carried out at all times in close co-operation with officers of the Commonwealth Department of Works, Port Moresby, who provided survey facilities and arranged and supervised drilling contracts. They also provided labour and other services as required. The investigations were designed in consultation with the Investigation staff of the Department of Works in Melbourne and Port Moresby.

Discussions and correspondence were conducted on a number of occasions with officers of the Snowy Mountains Hydro-Electric Authority, particularly Mr. D.G. Moye. Mr. Moye's and Mr. J.A.S. McLeod's reports have been drawn on extensively while conducting the investigations and writing the report.

Strength and durability tests of specimens of drill core were carried out by officers of the Central Testing Laboratories, Department of Works, Port Melbourne.

Professor Jaeger and Mr. J.H. Sass, of the Department of Geophysics, Australian National University, Canberra, made a thermister probe available for measuring drill hole temperatures, and Mr. Sass instructed Mr. Best, of the Bureau, in its use.

Officers of several construction authorities and organisations were consulted in various technical matters.

Permission to use the block diagram, shown as Figure 1 was given by the Australasian Petroleum Company Pty. Ltd.

The assistance given by all these people is gratefully acknowledged.

REFERENCES

CONDON, M.A., 1949 - Report on dam sites on the Laloki River, Papua. Bur.Min.Resour.Aust. Rec. 1949/25 (unpubl.).

DAVIES, H.L., 1960a- Geological report on Sogeri No.3 damsite, Upper Laloki River, Central District, Papua. Bur.Min.Resour.Aust. Rec. 1960/9 (unpubl.).

DAVIES, H.L., 1960b- Geological report on Sirinumu dam site No.2 Upper Laloki River, Central district, Papua. Ibid. 1960/57 (unpubl.).

DAVIES, H.L., 1961 - Geological report on the surface penstock route and the No.2 power station site, Port Moresby hydro-electric scheme. Ibid 1961/81 (unpubl.).

EDWARDS, A.K.M., 1951 - Geological report on the proposed hydro-electric installation Laloki valley, Territory of Papua. Bur.Min. Resour.Aust.Rec. 1951/1

GARDNER, D.E. and NOAKES, L.C., 1959 - Geological reconnaissance of the Laloki River hydro-electric project, Port Moresby. Bur.Min.Resour.Aust.Rec. 1959/21. (unpubl.).

GLAESSNER, M.F., 1952 - Geology of Port Moresby, Papua. In SIR DOUGLAS MAWSON ANNIVERSARY VOLUME. University of Adelaide, 63-86.

MOYE, D.G., 1962 - Report on an inspection of the site of the proposed No.2 hydro-electric station (upstream underground arrangement) Port Moresby, Papua. Snowy Mountains Hydro-Electric Authority. March 1962 (unpubl.).

MOYE, D.G. and McLEOD, J.A.S., 1961 - Report on an inspection of the site of the proposed No.2 hydro-electric station, Port Moresby, Papua. Snowy Mountains Hydro-Electric Authority. July 1961 (unpubl.).

STANLEY, G.A.V. and THOMPSON, J.E., 1946 - Report on Kemp - Welsh Reconnaissance survey. Australian Petroleum Company Pty.Ltd. Report NE 1946 (unpub.).

APPENDIX 1 - GEOLOGICAL LOGS OF DIAMOND DRILL HOLES R18 - R31

A3 - A6 and B3 - B6

Logs of drill holes R8 - R15 (Rouna Falls area) appear in Davies (1961) and of drill holes R16 and R17 (No.3 Sogeri Weir site) appear in Davies (1960a).

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA FALLS HYDRO-ELECTRIC SCHEME

HOLE NO A3

R.L

LOCATION Weir Site

ANGLE FROM HORIZONTAL

DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
Fresh agglomerate	All medium agglomerate except 10'0 to 18'8" which is largely tuff (containing a few lava) fragments	Fracture spacing BX	Δ	90	Core grinding every 2"	
		10	Δ	90	Core grinding every 6"	
		3"	Δ	100	Core grinding every 3"	
		20	Δ	95	Core grinding every 3½"	
			Δ	100	Core grinding every 4"	
		30	Δ	100	Core grinding every 4"	
			Δ	100	Core grinding every 7"	
		4" 40	Δ	100	Core grinding every 20"	
			Δ	100	Core grinding every 6"	
		50	Δ	100	Core grinding every 5"	
	End of Hole.					

DRILL NO

TYPE

DRILLER

COMMENCED

COMPLETED

Δ Agglomerate

LOGGED L. Hamilton

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA FALLS HYDRO-ELECTRIC SCHEME HOLE NO. A4 R L

LOCATION Weir Site ANGLE FROM HORIZONTAL DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	Fracture Spacing	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
Fresh agglomerate	Medium grained aggl.	1"		Δ	15	Regular joint at 3' Core grinding every	2½"
Slightly weath. agglomerate	Tuff with a few large fragments.	1½"	10	▒	100	Core grinding every	3"
Fresh agglomerate	Medium grained agglomerate.	1½"		Δ	100	Core grinding every	3"
		2"	20	Δ	100	Core grinding every	7"
		2"		Δ	100	Core grinding every	5"
			30	Δ	90	Core grinding every	4"
				Δ	100	Core grinding every	2½"
			40	Δ	100	Core grinding every	4"
		3"		Δ	100	Core grinding every	5"
		4"	50	Δ	100	Core grinding every	6"
	End of Hole.						

DRILL NO

TYPE

DRILLER

COMMENCED

COMPLETED

▒ Tuff

Δ Agglomerate

LOGGED L. Hamilton

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO A5 R L

LOCATION Weir Site ANGLE FROM HORIZONTAL - DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
Fresh agglomerate.	Medium grained agglomerate		Δ	50	1'6" to 1'9" ½"	rounded fragments
				75		
			Δ	75	Core grinding every	4"
		10	Δ	100	Core grinding every	12"
			Δ	100	Core grinding every	12"
		20	Δ	100	Core grinding every	10"
			Δ	100	Core grinding every	10"
		30	Δ	100	Core grinding every	8"
			Δ	100	Core grinding every	10"
		40	Δ	100	Core grinding every	15"
			Δ	100	Core grinding every	3½"
			Δ	100		
		50		100		
	End of Hole Note:- All core is generally fractured at 2" to 3" intervals, mostly if not wholly by drilling practices					

DRILL NO

TYPE

DRILLER

COMMENCED

COMPLETED

[Δ] Agglomerate

LOGGED L. Hamilton

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA FALLS HYDRO-ELECTRIC SCHEME

HOLE NO. A6

R.L.

LOCATION Weir Site

ANGLE FROM HORIZONTAL

DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	Fracture spacing	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS, SEAMS FAULTS CRUSHED ZONES	
Fresh agglomerate.	Medium grained agglom.	1"	NX	Δ	66	Badly broken	
		1½"	8X	Δ	90	Core grinding	
		1½"	10	Δ	75	Core grinding every 5"	
		2"		Δ	100	Core grinding every 4"	
		½"	20	Δ	90	Core grinding.	
		3"		Δ	100	Core grinding.	
			30			joints not obvious fractures weathered.	

DRILL NO.

TYPE

DRILLER

COMMENCED

COMPLETED

[Δ] Agglomerate

LOGGED L. Hamilton

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Rouna-Hydro-Electric Scheme HOLE NO B3 R.L.

LOCATION Weir Site ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
			NMLC			
Fresh to mod. fresh agglomerate.	Fragments of core <1"			98%	Fractures with weathered surfaces coated with limonite	
	Core pieces 2", ground throughout.	NM			Cavity, other fractures fresh and sub-horizontal.	
Mod. fresh to slightly weathered agglomerate.	Core pieces 2"-3"	BX		75%	Fractures with slightly weathered surfaces throughout.	NOTE:, Grinding and broken nature of core is essentially due to exessive vibration of drill, uneveness of river bed and the presence of pot-holes.
	Fragmented zone.	10		0	Fragmented core No Recovery	
	Core pieces 1", fragmented in place.			90%	Much grinding of core.	
Fresh agglomerate.	Core pieces 3"-4".					
				0	No Core recovery	
Moderately fresh agglomerate.	Core pieces 1"			100%		
	Core pieces 2"-3"	20		100%	END OF HOLE	

DRILL NO

TYPE X-RAY

DRILLER

COMMENCED

COMPLETED

LOGGED G. Brouxhon.

VERTICAL SCALE 10 feet to 1 inch

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Rouna-Hydro-Electric Scheme HOLE NO B4 R.L. (River bed)

LOCATION Weir-Site ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
	NO RECOVERY			0		
Moderately fresh to slightly weathered agglomerate	2 feet of very broken agglomerate has been was recovered.	BX 10		24%	Large core loss because of pot-hole.	
	Cores 2" to 3" long, fragmented in places.			0 90%	Fragmented zones.	
	Cores very broken throughout. Core pieces ½" to 1" long. Also has many zones of fragmented material 6" to 1' in length.	20		100 100%	Fractures with slightly weathered surfaces. Grinding has obscured many surfaces. **END OF HOLE**	

DRILL NO

TYPE X-RAY

DRILLER

COMMENCED

COMPLETED

LOGGED G. Brouxhon

VERTICAL SCALE 10 feet to 1 inch

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Rouna-Hydro-Electric Scheme

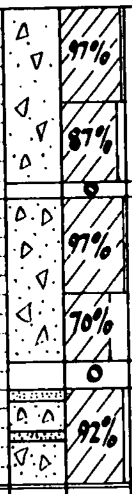
HOLE NO. B5

R.L.

LOCATION Weir Site

ANGLE FROM HORIZONTAL 90°

DIRECTION



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
Moderately fresh to slightly weathered agglomerate throughout hole.	Cores are uniformly broken throughout. Average length of core pieces 1 inch.	BX		97% 87%	Fractures often obscured by grinding.- Fractures when not ground are sub-horizontal and fresh.	
		10'		0	No core recovery	
				97% 70%	Ditto	
		20'		0	No Core recovery	
	6" wide tuff bands			92%	Ditto **END OF HOLE**	

DRILL NO.

TYPE X-RAY

DRILLER

COMMENCED

COMPLETED

LOGGED G. Brouxhon

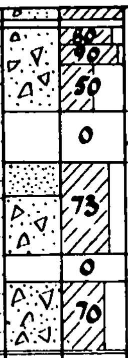
VERTICAL SCALE 10 feet to 1 inch

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Rouna - Hydro - Electric Scheme   HOLE NO B6   R.L.

LOCATION Weir Site   ANGLE FROM HORIZONTAL 90°   DIRECTION



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY %	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
Moderately fresh to slightly weathered agglomerate	Core pieces 1"-1.5" long throughout.	BX		80 90 50	Fractures sub-horizontal, either fresh or with slightly weathered surfaces.	
				0	No core recovery	
Mod. fresh to slightly	weath. tuff band. Core pcs. 1"-1.5" long	10'		73		
As for	0 to 8 feet			0	No core recovery	
		18'		70	END OF HOLE	

DRILL NO
TYPE X-RAY
DRILLER
COMMENCED
COMPLETED

LOGGED G. Brouxhon

VERTICAL SCALE 10 feet to 1 inch

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Hydroelectric Scheme N°2 Powerhouse
HOLE NO. R18
R.L. 1474·3
LOCATION Rouna Falls Port Moresby
ANGLE FROM HORIZONTAL 90
DIRECTION

ROCK TYPE & DEGREE OF WEATHERING

Soil and Scree

Fresh Agglomerate

Extremely weathered at 32'4"

Fresh Agglomerate

Moderately Fresh Agglomerate

DESCRIPTION

Extremely broken core ¼" Pieces

Fairly good core 18" pieces

Fairly broken 5" pieces
Slicken-sided fracture zone 80° to core axis at 39'

Broken core 8" pieces

Fairly good core 12" pieces

Some small cavities

Fairly broken 5" pieces

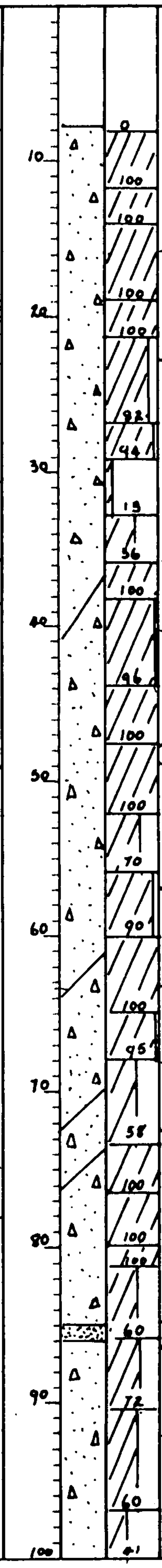
Clay-filled steep irregular fractures at 64' and 72'6"

Fairly broken 75'–78'
Clay-filled fractures

Fairly broken 5" pieces

Very broken, high water loss during drilling

DEPTH & SIZE OF CORE · **LOG** · **LIFT & CORE RECOVERY**



STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

Med. gr. size
Aggl. components 2" dia

Fine gr. size
Aggl. components 1" diam.

Coarse gr. size
Aggl. components 5"
Poorly sorted
Inverted graded bedding

Med. gr. size
Aggl. components 1½" diam.

Fine gr. size
Agglomerate Components ½" diam.

Coarse gr. size
Aggl. Components 4½" diam

Med. gr. size
Aggl. Components 1½" diam.
Small cavities present

Fine gr. size
Aggl. comp. ¾" diam.
Med. gr. size
Aggl. comp. 1" diam.

Fine gr. size
Aggl. comp. 1½" diam.

Coarse gr. size
Aggl. comp. 3" diam.
Matrix coarse

Med. gr. size
Aggl. comp. 1½" diam.
poorly sorted

Tuff
Med. gr. size

Med. gr. size
Aggl. comp. 1½" diam.

Fine gr. size
Aggl. comp. ½" diam.

DRILL NO.
TYPE NMLC
DRILLER Pearce & Reed
COMMENCED 7-3-61
COMPLETED

▨ Tuff
Δ Agglomerate

LOGGED L. Hamilton
Sheet 1 of 2
VERTICAL SCALE 100' : 1"

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Hydro-electric Scheme N° Power House HOLE NO. R18 R.L. 1474.3

LOCATION ROUNA FALLS Port Moresby ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS, VEINS, SEAMS FAULTS CRUSHED ZONES	
	Fairly broken core 6" pieces	110		79	Tuff 100'7" – 101'1" Fine gr. size Aggl. components 1" dia.	
Weathered Agglomerate					Med. gr. size Graded bedding Tuff band 114'0" – 114'4"	
	Very broken core 2" pieces High water loss in drilling 119' – 126'	120		Core lifts not recorded 71	Coarse gr. size Graded bedding Medium. gr. size Aggl. comp. 1" – 2" dia.	
Moderately Fresh Agglomerate	Fairly broken core 6" pieces	130		94	At 134' matrix extremely fine below a porous zone	
	Clay-filled fractures 134'6" – 140'2" Close fracture zones at 136'6" and 140' at 80° to axis	140		81	Fine gr. size Aggl. comp. ¾" dia.	
Weathered 153' – 155'	Very broken core 1½" pieces Broken core 9" pieces	150 160		17 18 10	Med. gr. size	
	Extremely broken ½" pieces Clay-filled Very broken 1½" pieces Broken 7" pieces			100 72	Bands of fine and med. grained Aggl. fair sorting	
	END OF HOLE	170			Fractures generally much more weathered in matrix than in elements. Most are sub-horizontal with irregular surfaces. Weathering is more intense along joints.	

DRILL NO.

TYPE NMLC

DRILLER W. Pearce & M. Reid

COMMENCED 7-3-61

COMPLETED

LOGGED L. Hamilton

Sheet 2 of 2

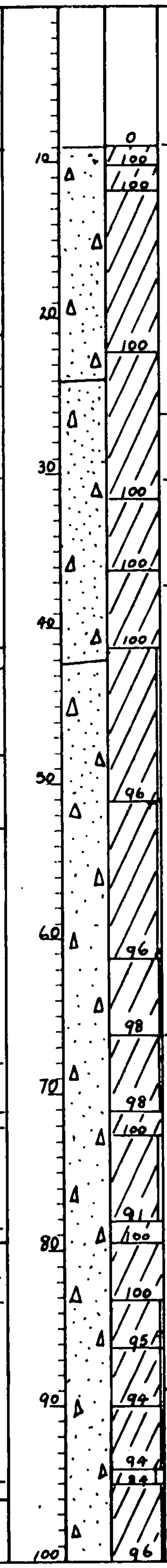
VERTICAL SCALE 10 feet : 1 inch

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA FALLS Hydro-electric Scheme N°2 HOLE NO R19 R.L. 1422·6

LOCATION Port Moresby (Tunnel line) ANGLE FROM HORIZONTAL 90° DIRECTION



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	STRUCTURES. JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
	Soil and Scree		
Fresh Agglomerate	Broken core 8" pieces	Fine gr. size Aggl. component 7/8" dia. mainly of vesicular lava.	
Weathered Agglomerate	Very broken 2½" pieces		
	Extremely broken ½" pieces		
Fresh Agglomerate	Fairly good 18" pieces	Fine and med. grained Aggl. comp. 1½" dia. poorly sorted.	
	Broken 7" pieces Broken 9" pieces	Coarse gr. size Aggl. comp. 3½" dia.	
	Very broken 2" pieces, Irregular	Fine to medium grain size Very poorly sorted med. to coarse matrix	
	Broken 9" pieces		
	Very broken 1½" pieces		
	Broken 8" pieces Very broken 3" pieces Fairly broken 4" pieces		
Moderately Weathered Agglomerate	Very broken 1½" pieces	Fine to coarse grain size Aggl. comp. 2" dia. med. to coarse Matrix	
	Extremely broken ¾ "		
	Very broken 2" pieces		
	Fairly broken 4"		
	Very broken 1¼" pieces.		
Fresh Agglomerate	Broken 9" pieces	Med. gr. size some fine bands med. to coarse matrix	
	Extremely broken 1" pieces	Fine gr. size Aggl. comp. ¾" dia.	water level 7am. 9/5/61
	Broken 9" pieces		

DRILL NO.
TYPE NMLC
DRILLER N. Pearce & M. Reid
COMMENCED
COMPLETED

⁙	Tuff
⁙△	Agglomerate
⁙○	Conglomerate

LOGGED L. Hamilton
Sheet 1 of 6
VERTICAL SCALE 10 feet : 1 inch

5

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Hydro-electric Power House No 2 Scheme HOLE NO. R19 R.L. 1422·6

LOCATION Rouna Falls Port Moresby ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LIFT & CORE RECOVERY	STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	
	Broken core 8" pieces		100	Coarse gr. size Aggl. comp. unsorted av. 3" dia to max. of 10" very fine matrix	
				Med. gr. size Aggl. comp. av. 1½" dia.	
		110		Fine gr. size av. ¾" dia.	Fair sorting
	Some cavities present			Med. gr size	Poorly sorted
				112'6"	Water level 7am 29/9/61
			100	Fine gr. size 114'	" " 7.15am 23/9/61
	Some small cavities			Aggl. comp. av. ¾" dia.	
		120		Med. to coarse gr. size Aggl. comp. av. 1" to a max. of 1' 10"	
			100	Fine gr. size av. ¾" dia.	
	Broken core 9" pieces				
		130		Fine gr. size av. ¾" dia very poorly sorted Coarse matrix	
	1½" band of tuff at 131'6"				
			100		
Fresh				Med. gr. size Aggl comp. av. ¾" dia. Coarse matrix	
		140			
			100		
Agglomerate					
				Tuff band with 5" vesicular lava fragment	
		150			
			100	Fine to coarse gr. size poorly sorted size range ½" – 9"	Green secondary mineral in matrix
				Coarse gr. size Aggl. comp. av. 3" dia.	
		160		Fine to coarse gr. size Aggl. comp. av. 1" dia. coarse matrix	
			100 100	green mineral present /	
		170		Medium gr. size Aggl. comp. av. 1" dia. very coarse matrix Porous zone 173'-175'	
			100		
		180		Coarse gr. size Aggl. comp. av. 2½" dia.	
				Fine gr. size	Well sorted
	Cavity bearing		100	Fine to coarse gr. size av. 1" dia. range 0 – 12" dia.	
		190			
	Porous zone		100		
	Tuff band 196'6" – 197'0"			Coarse gr. size av. 2" dia. fine matrix	
		200			

DRILL NO.

TYPE NMLC

DRILLER Pearce & Reid

COMMENCED

COMPLETED

LOGGED L. Hamilton

Sheet 2 of 6

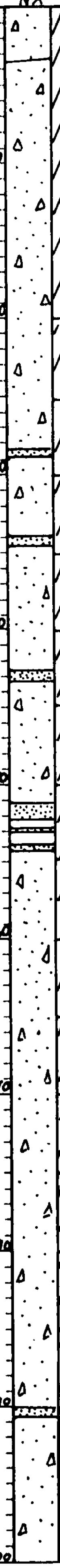
VERTICAL SCALE 10 feet : 1 inch

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT *Rouna Hydro-Electric Scheme* HOLE NO. *R19* R.L. *1422·6*

LOCATION *Tunnel line* ANGLE FROM HORIZONTAL *90°* DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
		NX				
Fresh agglomerate	Fine gr. size poorly sorted			Lifts not recorded	Extremely broken (½") at 203'6" - 204'	
	Coarse gr. size agglomerate components average 3" dia.	210				
	Coarse gr. size aggl. comp. av. 2" dia. poorly sorted, coarse matrix	220		100	Cavity bearing	
Fresh to moderately fresh agglomerate	Fairly good to fairly broken core Aggl. composed of vesicular basalt, andesite and fine grained porphyritic rocks embedded in a medium to coarse grained tuffaceous matrix			100	Irreg. fracture 70° 70 80° Fractures Tuff, coarse to medium grained	
	Brown andesitic tuff	230		100 100	Irreg. fractures Fract. 70° coated yellow	
	Fairly broken core	240		100 100	Irreg. fractures Sub-horiz. fracture Irreg. fractures Joint 80°	
Mod. fresh to weathered agglomerate	Coarse gr. size 3" to 8" dia. Aggl. comp. ½" to 1" dia. Med. gr. tuffaceous matrix	250		100	Irreg. fractures	weathered surface
	Broken to fairly broken core Aggl. interbedded with tuff			98	Joints coated with a brown mineral Fracture zone Fractures (45°, 90°, 80°)	(65°, 55°, 85°)
Fresh to mod. fresh agglomerate	Med. to coarse gr. size to a max. size of 14" coarse matrix	260		100	Fract. 50°	
Mod. fresh to weathered Aggl.	Fairly broken to broken cores			96	Irreg. fract. weathered surface Sub-horizontal fract. Fract. 60° coated and weathered Fractured zone	
Fresh to mod. fresh agglomerate	Aggl. poorly sorted, consisting of vesicular basalt intermediate rocks and 'red basalt'. 2"-3" dia.	270		100	Joint at 55° Irreg. fract. Fract. 90° Joint 55°	
Mod. fresh to weath. aggl.					Weathered irreg. fract.	
Fresh to mod. fresh aggl.				96	Joint 40° Fract. 70° stained Mn Vert. fract.	
Mod. fresh to weathered aggl.		280		98	Fract. zone Vert. fract. stained Fract. 40° Fract. 70° Joint 30°	yellow
Fresh to mod. fresh aggl.	Fine to med. gr size av. size ½" - 1" dia.				Irreg. fract.	
	Core broken to fairly broken Aggl. comp. av. size 4"-6"			98	Joint 80° Fractures Fractured zone	
Mod. fresh to weathered agglomerate	Brown tuffaceous band.	290		95	Fractures (50°, irreg, 50°, irreg) Irreg. fract.	
	Poorly sorted Aggl.			100	Clay coated horiz. fracture	
Fresh to mod. fresh agglomerate		300		96	Joint, stained yellow at 65°	

DRILL NO

TYPE *Mindrill E1000*

DRILLER *W. Pearce*

COMMENCED

COMPLETED

LOGGED *L. Hamilton and G. Brouxhon*

Sheet 3 of 6

VERTICAL SCALE *1 inch : 10 feet*

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R19 R.L. 1422·6'

LOCATION Tunnel line ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES, JOINTS, VEINS, SEAMS FAULTS CRUSHED ZONES
Fresh to moderately fresh agglomerate	Broken to fairly broken cores Aggl. components to 6" in size. Vesicular basalt fragments are abundant	NX 310		96 98	Joints (60, horiz., 80, 70) Vert. fract. coated with Mn Fractured zone Irreg. fract.
Moderately fresh to weathered agglomerate	Cores broken to fairly broken. Agglomerate components average 1" to 2" dia. poorly sorted	320		98 98 95	Irreg. fract. Fract. 20° Vert. and horiz. fract. coated Mn Irreg. fract. Broken and weathered zone Broken zone Joint 80° Very broken zone Irreg. fract. coated with Mn Irreg fract. coated with limonite
	Core fairly broken to broken Large fragments of augite porphyrite	330		93	Joint 40° Irreg. fract. weathered surface Weathered and broken zone
	Fairly broken to broken cores aggl. comp. av. ½" to 1"				Fract. 70° weathered surface
	Very broken cores			93	Broken zone fragments < 3"
Fresh to moderately fresh agglomerate	Poorly sorted aggl. av. size 2" to a maximum of 1' 2"	340		100	Joint 30° Fract. 50°
	Fairly broken to broken cores	350		100 100	Fract. 45° coated with Mn Irreg. fract Fract. 50° Fract. 45° Mn coated Irreg. fract. Joint 50° Vert. fract. Joints at 55° and 30°
Moderately fresh to weathered agglomerate	Very broken cores			93	Joint 60° Irreg. fract.
	Tuff band Fairly broken to broken core	360		100	Joint (70°, 60°) Irreg. fract.
	Core generally very broken to 2"-3" pieces	370		93	Fragmental zone
Fresh to moderately fresh agglomerate	Fairly broken core Agglomerate consists of vesicular basalt, fine grained porphyritic rock, fine grained basalt, and andesites set in an andesitic tuffaceous matrix	380 390 400		93 98 98 100 100 100	Joints (45°, 40°, 45°, 40°, 43°, 90°, 25°) Clay filled fracture Broken and weathered zone Joints (45°, 75°, 45°) Joints (40°, 47°) Joints (50°, 40°, 60°, vert)

DRILL NO Mindrill E1000

TYPE

DRILLER W. Pearce

COMMENCED

COMPLETED

LOGGED G Brouxhon

Sheet 4 of 6

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT *ROUNA HYDRO-ELECTRIC SCHEME*

HOLE NO. *R19*

R.L. *1422·6*

LOCATION *Tunnel line*

ANGLE FROM HORIZONTAL *90°*

DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	
Fresh to mod. fresh agglomerate	Fairly broken to broken core Fragments of vesicular lava abundant. av. size 1"-3"			100		
Moderately fresh agglomerate	Very broken core Matrix coarse to ¼" size aggl. comp. av. 1" to 3" dia.	410		98 98		
	Very broken core Matrix coarse and scoriaceous	420		98		
	Very broken core	430		97	Granulated and weathered zone	
	Very broken core Aggl. components consist of vesicular basalt and various porphyritic rocks with an av. size ½" to 2" dia. Matrix scoriaceous, fairly coarse ⅛" to ¼" size	440		100	Joints (25°, 10°, 15°) Joint clay coated Joint 25°	
	Very broken core, much grinding. Descr. of aggl. as above.			89	Joint 80° clay coated Joint 10° clay coated	
	Very broken cores, much grinding, much clay clay sludge. Matrix coarse and scoriaceous.	450		85 87	Joints (5°, 4°) Jaint 3°	
Weathered Conglomerate	Cores very broken Pebbles sub-angular to rounded ½" size. Of heterogeneous composition including quartz, porphyritic, and volcanic rocks set in a greenish talcose ground-mass. Much clay sludge present.	460		100 66	Striated fract. with 'soapy' coating. Fractures numerous Numerous joints at 70°, 27°, 40° coated with a greenish material. (Epidote or chlorite ?)	
	Very broken core - containing pebbles and cobbles of various igneous porphyritic and occasional metamorphic rock.	470		73		
Weathered to mod. fresh conglomerate	Very broken core, granulated in parts	480		95	Numerous joints and fractures at 45° ÷ 75° generally coated with chlorite or epidote.	
Moderately fresh conglomerate	Fairly broken to broken core. Igneous porphyritic rocks common. Pebbles coated with talcose material Coarse grained greenish matrix.	490		97 97	Joints (70°, 40, 45, 45, 45) Joint 20° coated with red soft micaceous mineral. Joint 28° Joint 5° Fractures and joints follow shape of pebbles often smoothly curved.	
	Fairly broken core			96	Joints (75°, 75°, 78°, 65°)	
Fresh to mod. fresh conglomerate	Fairly broken core Aggl. components, smaller and are of quartz, shale, & porph.	500		100	Joint 15°	

DRILL NO

TYPE *Mindrill E1000*

DRILLER *W. Pearce*

COMMENCED

COMPLETED

LOGGED *G Brouxhon*

Sheet 5 of 6

VERTICAL SCALE *1 inch : 10 feet*

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R19 R.L. 1422·6

LOCATION Tunnel line ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	
Moderately fresh to fresh Conglomerate	Fairly broken core Conglomerate matrix contains sub-angular fragments			100	Joint 60° Joint 55° coated	
	Fairly broken core Igneous porphyritic rocks set in a matrix of quartz frags, metamorphics and frags of igneous rocks.	510		100 95	Joints (35°, 0, 30, 40) Granulated zone Joint 40° Joint 15° coated with calcite Joints (73°, 45°)	
	Fairly broken to very broken core. Pebbles of porphyritic rock to a size of 6" Matrix fairly soft and green	520		73		
	Very broken cores The conglomerate also contains phyllite, slate and quartz grains, all set in a med. fresh matrix.	530		96 93	Joint 34° Joint 20° coated white	
	END OF HOLE					

DRILL NO

TYPE Mindrill E1000

DRILLER W. Pearce

COMMENCED

COMPLETED

LOGGED G Brouxhon

Sheet 6 of 6

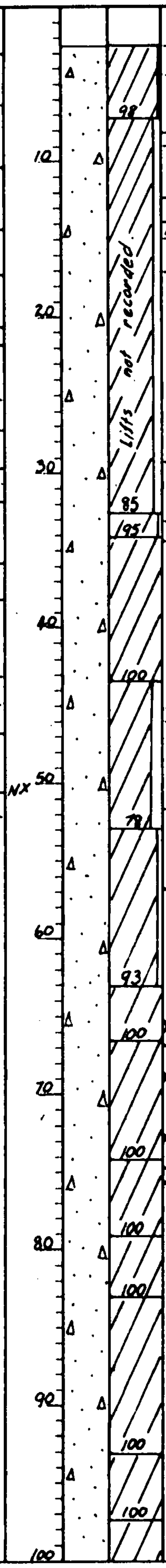
VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Rouna Hydro-Electric Scheme
HOLE NO. R20
R.L. 1363·1
LOCATION Underground Tail Race, under Laloki River (d/s)
ANGLE FROM HORIZONTAL 45°
DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	Grain Size	DESCRIPTION	Av. size elements
		Soil and scree	
Moderately weathered agglomerate	C	Poor sorting Medium matrix.	7"
	F	Very poor sorting Medium matrix.	7/8"
	C	Coarse matrix.	8
	F	Unsorted Coarse matrix.	3/4"
	M	Very poor sorting.	1 1/8"
	F	Well sorted. Med. matrix	
	M	Poor sorting Med. matrix.	7/8"
	F	Well sorted. fine matrix	1/2"
	M	Fair sorting. Med. matrix	1 1/4"
	M	Poor sorting. Med. matrix	1 1/4"
	F	Fine to coarse matrix	3/4
	M	Med. to coarse matrix	2 1/2"
Fresh agglomerate.	M	Vesicular agglom. components. Med. matrix.	1 1/8"
	F	Med. matrix.	1"
	M	High proportion of matrix.	2 1/2"
	F	Unsorted. Med. matrix	3/4"
	M	Poor sorting.	1 1/2"
Moderately fresh agglomerate.		Broken core Agglomerate mostly vesicular black and red basalt, andesites embedded in a brown tuffaceous matrix which is fine grained. Grinding is frequent. Averge size of elements 1"	



STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

Fairly broken 4" pieces
Fracture zone (1/2" frags.)
Some small cavities
Very broken 1"
Very broken 2 1/2"
Fairly broken 4"
Extremely broken 1/2" & weathered
Fairly broken and clay-filled at 16' 6", 60° to core axis
Broken 6" pieces. 3" of close fracturing at 23' 8" and 27'
Some small cavities
Broken 10" pieces.
Some small cavities.
Very broken 2" pieces.
Fairly broken 5" pieces
Extremely broken 1"
Fairly broken 5" pieces.
Joint 45°
Broken zone
Joint 45°
Broken zone.
Broken zone.
Joint 45°
Irreg. fracture.

DRILL NO.
TYPE Mindrill E1000
DRILLER W. Pearce & Reid
COMMENCED
COMPLETED

▒ Tuff
Δ Agglomerate

C = Coarse
M = Medium
F = Fine

LOGGED L. Hamilton & G. Brouxhon.
VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

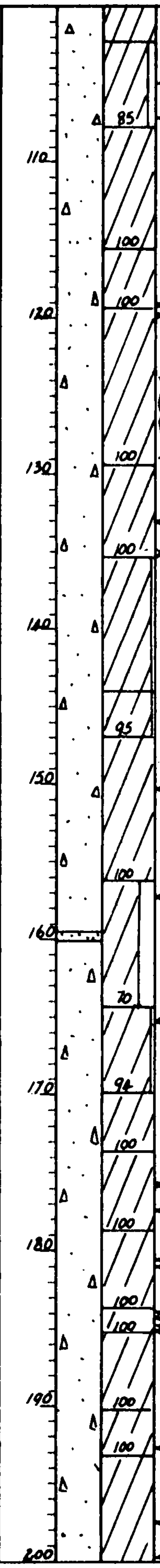
GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME
HOLE NO. R20
R.L. 1363·1

LOCATION Underground Tail Race, under Laloki River (d/s)
ANGLE FROM HORIZONTAL 45°
DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION
Moderately fresh agglomerate	Fairly broken cores Agglom. components of vesicular basalt, andesites, augite-porphyritic rocks Average size of elements 1" From 110' to 119', components increase in size to 2" - 3" in a matrix of medium grained andesitic tuff. Grinding of core common.
	Fairly good to fairly broken core.
	Fairly broken to broken core Description of agglom. as above
	Cores fairly good to fairly broken. Agglom. components of fine grained porphyritic rocks 2" to 3" across set in a fairly coarse tuffaceous matrix.
Fresh to mod. fresh agglomerate.	Cores - fairly good to fairly broken. Agglom. description as above. Average size of components 1" consisting of vesicular basalt andesites, and porphyritic rock embedded in a fairly coarse tuffaceous matrix.
	Cores - fairly good to fairly broken. Agglom. description as above. Tuff occupies a greater proportion of the rock.

DEPTH & SIZE OF CORE · LOG · LIFT & CORE RECOVERY



STRUCTURES
JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

- Irreg. fracture.
- joint 20°
- Frag. zone
- Broken zone fragment 2" to 3" long.
- Joint 15°
- Broken zone.
- 45°
- Joint 30°
- Clay filling 1"
- Clay filling 3"
- Clay filled fracture
- Fracture (50,46)
- Irreg. fractures
- Fracture 45°
- Vertical fracture
- 40° Joint.

DRILL NO.
TYPE Mindrill E1000.

DRILLER W. Pearce & Reid.
COMMENCED
COMPLETED

LOGGED G. Brouxhen.

VERTICAL SCALE 1 inch : 10 feet.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Rouna Hydro-Electric Scheme

HOLE NO. R20

R.L. 1363·1

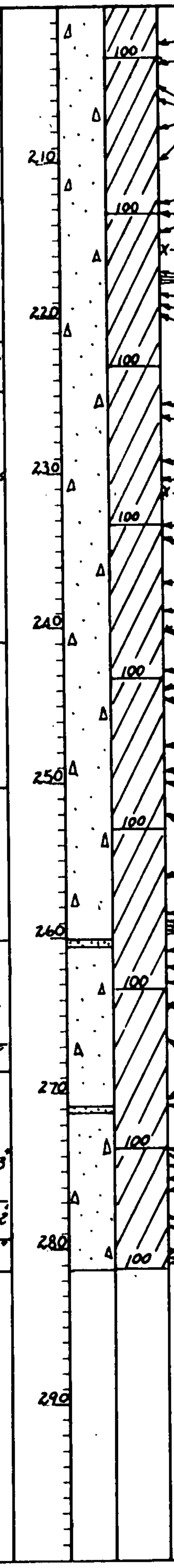
LOCATION Underground Tail Race, under Laloki River (d/s)

ANGLE FROM HORIZONTAL 45°

DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION
Fresh to mod. fresh agglomerate	Fairly good to fairly broken cores Aggl. description as above.
	Agglom. components larger 3" to 4" across consisting mostly of vesicular basalt and andesites.
	Agglom. components smaller ½" across.
	Fairly good cores Component layer 2" to 3" across consisting of andesites, vesicular basalt and fine grained porphyritic rocks. Embedded in a brownish tuffaceous matrix.
Mod. fresh aggl.	Cores fairly good.
Fresh to mod. fresh agglomerate	
	Fairly good to fairly broken cores Agglom. unsorted. Components vary in size from 6" to ¼"
Moderately fresh agglomerate.	Fairly good to fairly broken cores Components are 5" to 6" dia. Tuff coarse to fine.
	Agglom. components ¼" to ½"
	Fairly good to fairly broken cores. Agglom. components 1" to 3"
	Aggl. comp. have av. size 1" to 2"
	" " " " " 4" to 5"
	End of Hole.

DEPTH & SIZE OF CORE — LOG — LIFT & CORE RECOVERY



STRUCTURES
JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

- F. 50°
- Vertical irregular fracture
- Fractures (70°, 35°, 70°, 40°)
- F. 45°
- Joints (45°, 80°)
- Broken zone.
- Zone of close fractures
- Joint 50°
- Flat fracture with secondary mineral coating.
- Fract. 70° clay coated
- Joint 40° Mn. bloom.
- Joint 45° clay coated
- Joint 70° Mn coating.
- Joint 45° Mn coating.
- Fractured zone.
- 60° clay coated fracture.
- 80° fract. coated with yellow sec. minerals.
- Joint 45°
- Vertical fracture irregular
- Large fracture sub-vertical 7" long.
- Irreg. fracture
- Joint 45°
- Joint 20° coated black
- Irreg. fracture
- Joint 35°
- Irreg. fractures
- Fracture 80°
- Clay coated fractures
- Joint 45° clay coated
- 45°
- 45° weathered fractures.
- Sub-vertical fracture
- Irreg. fractures
- Joint 45°
- Broken zone.
- Irreg. fractures.
- Fracture 45°
- Irreg. fracture.
- Irreg. fractures coated with black minerals.

DRILL NO.

TYPE Mindrill E1000

DRILLER Pearce & Reid

COMMENCED

COMPLETED

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet

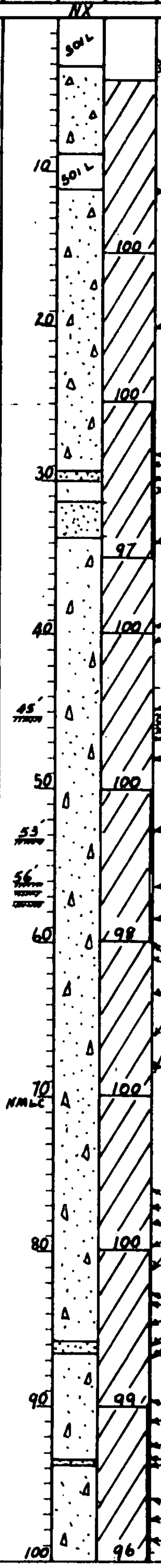
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R21 R.L. 1458.8

LOCATION Machine Hall U/g Power Station. ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LIFT & CORE RECOVERY	STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
		NX		
Lateritic soil and rubble				
Moderately fresh agglomerate	Boulder of agglomerate			Broken zone and weathered
Lateritic soil and rubble		10		Broken zone and weathered
Mod. fresh agglomerate	Cores fairly broken to good.		100	
Fresh agglomerate	Aggl. consists of unsorted elements of vesicular lava & fine grained porphyritic rocks set in a brown tuffaceous matrix	20	100	Joint 45°
Mod. fresh tuff		30		Fracture (45°, 80°, 80°) Broken zone
Mod. fresh to weath. tuff	Yellowish brown arenitic tuff		97	Joint 45°
Moderately fresh to fresh agglomerate	Fairly good core Grey arenitic tuffaceous matrix.	40	100	Joint (38°, 45°)
	Fairly good core broken in parts. Aggl. components av. 1" to 2" in size 8am 2/11/61	45'		Joint 35° coated with a green secondary mineral. Broken zone Joint 70°
	Fairly good core 8am 13/11/61	50 53'	100	Joint 80° coated with a 'metallic sheen'.
	8am 15/11/61 8.30 am 16/11/61 10 am 18/11/61	56'		Joint 70° coated with secondary mineral Joint 25° coated with sec. mineral.
	Fairly good cores to fairly broken. Aggl. comp. to a max. size of 10"	60	98	Fractures (70°, 20°, 45°, 45°, 70°)
	Fairly good to fairly broken cores. Element of aggl. poorly sorted.	70 NMLC	100	Fractures (40°, 75°, 65°, 75°, 75°)
		80	100	Fractures (80°, 85°, 80°, 45°, 65°, 78°)
Mod. fresh tuff	grey to greyish brown			
Moderately fresh to fresh agglomerate	Fairly good to fairly broken cores. Aggl. comp. range in composition from intermediate to basic lavas; are poorly sorted set in a medium to coarse grained greyish brown matrix.	90	99	Fractures (69°, 45°) Irreg. fract. Fractures (85°, 63°) Fractures (55°, 80°) Irreg. fract. 80° Mn coated.
		100	96	



DRILL NO.

TYPE Mindrill E1000

DRILLER T. Hughes

COMMENCED

COMPLETED

⛶ Tuff

△ Agglomerate

LOGGED G. Brouxhon

Sheet 1 of 7

VERTICAL SCALE 1 inch : 10 feet

16

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R21 R.L. 1459·8

LOCATION Machine Hall U/G Power Station ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
Moderately fresh to fresh agglomerate	Bands of brownish grey tuff, medium grain size. Fairly good to fairly broken core.	NMLC 110		99	Irregular fracture 30° Fractures (70, 90, 20, 70) Irregular fracture
	Fairly broken core	120		97	Fracture (85°, 90°) Fracture 60° Joint 70° Fractures (85°, 74°, 45°)
	Greyish tuff band Fairly good to fairly broken cores. Aggl. components consist of vesicular basalt and andesite set in a greyish brown tuffaceous matrix. Poorly sorted.	130		100	Irreg. fract. Joint 43° Fract. 20° coated with green material. Horiz. fracture Fract. 35° clay filled
		140		98	Fract. 30° clay filled Joints at 40° Fract. 20° coated with green material. Joint 50° " " " " Joint 45° coated blue secondary mineral. Crushed zone
	Fairly broken core	150		100	Irreg. fracture Joint (60°, 70°) coated with black bloom: Irreg. fracture 70° Fract. 40° Crushed zone Joint 60°
	Fairly broken to broken core. Description as above with a greater proportion of tuff in aggl.	160		99	Crushed zone Joint 65° Irreg. fract. Joints (65°, 62°) Fracture 55° Broken or crushed zone
	Fairly broken to fairly good cores. Tuff becomes more predominant.	170		100	Irreg. fractures Horizontal fract. Joint (65°, 55°) Fracture 55° coated with blue material. Fract. (50°, 45°)
	Fairly broken to fairly good cores. Intermediate to basic lavas set in a greyish brown tuffaceous matrix.	180		99	Irreg. fractures Joints (65°, 45°)
	Fairly good core Description as above but in addition contains augite porphyritic rocks in a fine grained tuffaceous matrix.	190		99	Joint 56° Fracture 70° Irreg. fract.
	Fairly broken core.	200			Broken zone Joints (27°, 45°) Irreg. fractures.

DRILL NO.

TYPE Mindrill E1000

DRILLER I. Hughes

COMMENCED

COMPLETED

LOGGED G. Brouxhon

Sheet 2 of 7

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R21 R.L. 1459·9

LOCATION Machine Hall U/g Power Station ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING | DESCRIPTION | DEPTH & SIZE OF CORE | LOG | LIFT & CORE RECOVERY | STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

ROCK TYPE & DEGREE OF WEATHERING

Fresh to moderately fresh agglomerate

Moderately fresh agglomerate

Mod. fresh to weath.

Mod. fresh agglomerate.

DESCRIPTION

Fairly broken core. Aggl. consists of layered fragments of vesicular basalt and augite-porphyritic rocks. Fragments are unsorted.

Fairly broken to fairly good core.

Description as above.

Fairly broken core

Rocks of intermediate composition more abundant.

Fairly good to fairly broken cores.

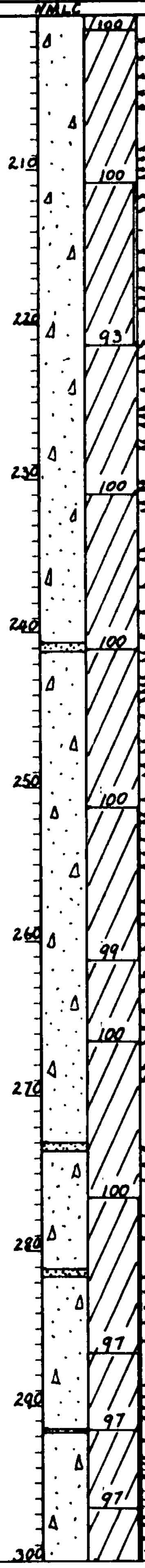
Vesicular basalt, andesite and various porphyritic rocks ranging in composition from basic to intermediate are embedded in a greyish-brown tuffaceous matrix.

Fairly broken core. Aggl. composed of andesite and red & black vesicular basalt set in a greyish brown arenitic tuffaceous matrix.

Fairly broken cores. Aggl. in general is layered. 4" to 6" of porphyritic rocks.

Aggl. components have an average size of 1"

Fairly broken to broken core.



STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

Irreg. fractures
Fract. 20° coated with secondary mineral
Irreg. fractures
Irreg. fract. 20°
Joint 85°
Irreg. fractures
Broken zone
Irreg. fract.
Joint 75°
Irreg. fractures
Fract. 40°
Irreg. fract. horiz.
Irreg. fract.
Fract.
Fract. 45° coated with secondary mineral.
Irreg. fract.
Fractures (60,50)
Fractures (46°, 5°) clay coated.
Irreg. fractures
Fract. 50°
Joints (77°, 67°)
Irreg. fract.
Fract. 85°
Joints (30°, 70°)
Irreg. fractures
Fractures (40°, 25°, 75°)
Irreg. fractures
Fract. 60°
Irreg. fractures
Fractures (50°, 45°)
Joint 85° coated with limonitic material,
Joint 65°
Irreg. fractures
Fracture 50°
Irreg. fractures
Joints (70, 60)
Vertical fract. in broken zone.
Joint 50°
Irreg. fract.
Joint 80°
Fract. 45°
Irreg. fractures
Curved fract. weathered on surface.
Horiz. fract. clay filled.
Irreg. fract with clay mineral.
Joint 35° coated black.
Fract. coated brown.
Joint 70°
Irreg. fract.
Joint 45° coated yellow.
Joint 45°
Broken zone
Joints 60°
Irreg. fract.

DRILL NO.
TYPE Mindrill E1000
DRILLER T. Hughes
COMMENCED
COMPLETED

LOGGED G. Breuxhan
Sheet 3 of 7
VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Rouna Hydro-Electric Scheme
HOLE NO. R21
R.L. 1458·8
LOCATION Machine Hall u/g Power Station
ANGLE FROM HORIZONTAL 90°
DIRECTION

ROCK TYPE & DEGREE OF WEATHERING

Moderately fresh agglomerate

Fresh to moderately fresh agglomerate

Moderately fresh to weathered agglomerate.

Moderately fresh agglomerate

Moderately fresh to weathered agglomerate

Weathered to mod. fresh agglomerate

Weathered agglomerate

Moderately fresh to fresh agglomerate

Slightly weath. aggl.

Moderately fresh agglomerate

DESCRIPTION

Fairly broken to fairly good core.

Med. to coarse gr. arenitic tuff.

Aggl. contains abundant fragments of vesicular basalt 2" to 3" in size

Med. to coarse gr. arenitic tuff shows graded bedding.

Fairly broken to broken cores.

Very broken cores - frags. 2" to 3"

Broken cores

Aggl. consists of augite-porphyritic rocks, andesites, vesicular basalt. Aggl. poorly sorted, max. size of components 1"2".

Very broken cores of 1" to 2" size.

Broken core

Very broken cores

Broken to fairly broken cores

Very broken cores

Broken to very broken core.

Very broken core.

Cores broken to fairly broken. Aggl. components consists mostly of andesite and vesicular andesite, size 1

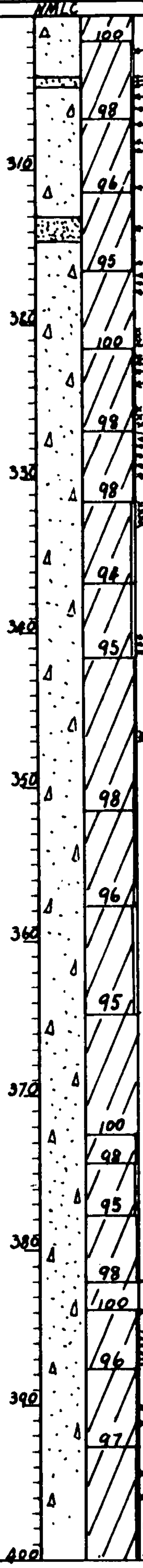
Very broken to broken cores

Broken to fairly broken cores

Cores fairly broken to broken. Aggl. comp. unsorted and to a size 8"

Cores broken to fairly broken. Average size of components 1" to 2".

DEPTH & SIZE OF CORE · **LOG** · **LIFT & CORE RECOVERY**



STRUCTURES. JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

Irreg. fract. coated blue.
Horiz. fractures
Fract. 45°
Irreg. fract.
Joint 45°
Irreg. fract.
Joint 70°
Sub horiz. fract.
Fract. 45° weathered surface.
Vert. fract weathered surface.
Fract. 45° clay coated.
Irreg. fract.
Broken zone weathered fragments.
Irreg. fract. weathered surface.
Irreg. fractured clay coated.
Broken zone fragments 1"-2" long. much clay material.
Irreg. fractures weathered surface.
Joint 85° " "
Fractures (0°, 70°) coated with brown mineral
Broken zone.
Broken zone
Numerous fractures with weathered surfaces.
Fractures (0°, 90°, 20°) with weathered surface
Broken zone
Numerous fractures the surface of which are either weathered or coated with secondary minerals and clay. No slickensides seen.
Numerous fractures with weathered surfaces.
Numerous fractures with weathered surfaces.
Fract. 45°
Fragmented zone
Joints (70°, 70°, 65°)
Irreg. fractures
Fragmented zones
Irreg. fractures coated with Mn bloom.

DRILL NO.
TYPE Mindrill E1000
DRILLER T. Hughes
COMMENCED
COMPLETED

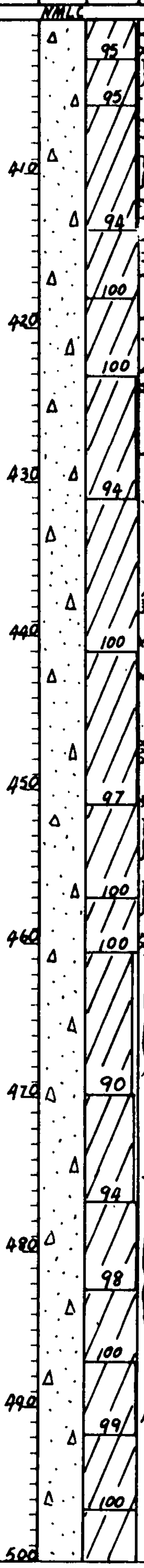
LOGGED G. Brouxhon
Sheet 4 of 7
VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R21 R.L. 1458.8

LOCATION Machine Hall U/G Power Station ANGLE FROM HORIZONTAL 90° DIRECTION



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	STRUCTURES JOINTS, VEINS, SEAMS FAULTS CRUSHED ZONES
		Irreg. fract. Very framented zone Frequent fractures sub-horizontal and coated with Mn bloom.
Mod. fresh to slightly weath. Aggl.	Broken cores Aggl. components consists of unsorted fragments of andesiles and vesicular andes.	Fragmented zones
Weathered aggl.	Broken to very broken cores.	Numerous irregular and vuggy fractures; some are clay coated.
Slightly weath. to mod fresh	Cavities or vugs in the cores.	Fragmented zones
Moderately fresh agglomerate	Fairly broken core.	Horizontal joint Irreg. fract. Joint 80° Vertical fracture
Mod. fresh aggl.	Broken core, Aggl. components consist of unsorted red andesite and augite porphyritic rocks to a size of 6".	Weathered cores, vuggy fractures Fragmented zones Irreg. vuggy fractures with green secondary mineral.
Slightly weathered agglomerate.	Very broken core.	Extremely broken zone - fragments friable
Moderately fresh to slightly weathered agglomerate.	Broken to fairly broken core with small cavities on the surface. Aggl. comp. have av. size of ½".	Fractures are generally sub-horizontal, sometimes irregular, usually fresh but may be coated with a green secondary mineral.
	Very broken core.	Fragmented zone.
	Broken core. Aggl. comp. unsorted & to size 3"	Fragmented zone, fractures coated with a green secondary mineral.
	Broken to fairly broken core.	Fragmented zone; fract. usually fresh but a few are coated with Mn bloom. Very broken zone to 3" pieces. Fractures irregular & fresh although sometimes coated with Mn bloom.
Moderately fresh agglomerate	Very broken cores < 3"	
	Broken cores 3" - 6"	Fractures generally irreg. sometimes vuggy and coated with secondary minerals.
	Very broken core.	
	Broken core	
	Very broken core.	Numerous irregular fractures generally fresh, some coated with secondary minerals.
Slightly weath. to mod. fresh.	Broken to very broken.	
	Extremely broken core.	Very fragmented zone - soft and friable
Slightly weathered agglomerate	Very broken to extremely broken core. Surface of cores vuggy. Aggl. components small. Average size is ½" but may range to 6".	Fractures irregular, often vuggy and slightly weathered.
	Very broken core. Vesicular component are coated with a blue secondary mineral. Cores are generally friable.	Fractures irregular, sometimes coated with green secondary minerals and sometimes limonitic. Vuggy in places.
Slightly weath. to mod. fresh.	Very broken core.	Numerous fractures irregular and with blue secondary mineral.
Slightly weath.		
Slightly weath. to mod. fresh aggl.		
Moderately fresh agglomerate	Very broken to fairly broken core. Vesicular components are coated with blue secondary mineral.	

DRILL NO.

TYPE Mindrill E1000

DRILLER T. Hughes, W. Pearce

COMMENCED

COMPLETED

LOGGED G. Brauxhon

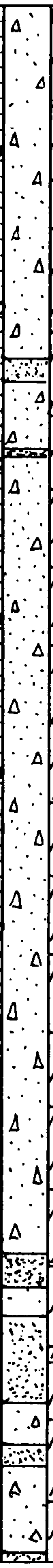
Sheet 5 of 7

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Rouna Hydro-Electric Project
HOLE NO. R21
R.L. 1458.8
LOCATION Machine Hall u/g Power Station
ANGLE FROM HORIZONTAL 90°
DIRECTION



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS, SEAMS, FAULTS, CRUSHED ZONES
Moderately fresh agglomerate	Very broken cores		100	Fractures sub-horizontal and usually coated with a blue secondary mineral.
	Broken to fairly good cores. Average size of aggl. componants ½"	510	100 100	Fragmented zone
	Average size comp. 4"			
Moderately fresh to slightly weath. agglomerate	Very broken cores	520	93	Clay material – sludge. (core loss) Fractures numerous and coated with secondary blue minerals.
Mod. fresh tuff.	Broken cores.			
Mod. fresh to slightly weath.	Very broken cores 3" pieces.		98	
Volcanic ash.	Cores very broken.	530		
Moderately fresh agglomerate.	Very broken cores. Aggl. consists of unsorted frags. of augite-porphyritic andesites vesicular andesites in a coarse arenitic tuffaceous matrix. Vesicles often coated with blue secondary mineral.		100 100	
	Broken to very broken cores. Max. size aggl. comp. 4½" Agglomerate unsorted.	540	100 94	Numerous sub-horizontal fractures some coated with secondary blue mineral, otherwise fresh.
	Fairly broken to broken core			
	Very broken cores.	550		
	Broken cores Aggl. components large up to 7" and generally unsorted. Vesicles in andesites coated with blue secondary mineral.		100 99	Fractures usually sub-horizontal with blue secondary minerals. Curved fracture
	Very broken cores 3" pieces	560	99	Sub-horizontal fractures, usually fresh.
Mod. fresh to slightly weath. agglomerate.	Broken cores.			
	very broken cores.		95	Irreg. fractures coated with a grey secondary mineral.
Moderately fresh to fresh aggl.	Broken to fairly broken cores. Aggl. components mainly of vesicular andesite av. size 2½"	570	97	Sub-horizontal fractures usually fresh and irregular.
	Broken to fairly broken core			
	Very broken core			
	Fairly broken core		97	Fractures generally sub-horizontal.
Mod. fresh to slighty weath. agglomerate	Very broken core. 3" pieces and friable	580		
Slightly weath. Tuff.	Broken to fairly broken cores		99	Graded bedding
Mod. fresh aggl	Fairly broken cores.			
Mod. fresh to slightly weath. tuff.	Broken to very broken core. Dark grey pelitic tuff. Fine grained.		100 100	Clay like and friable
Mod. fresh tuff.				
Mod. fresh to fresh aggl.		590	96	
Mod. fresh tuff	Grey pelitic tuff.			Fragmented zone.
Mod. fresh. aggl.	Fairly broken cores.	600	99	

DRILL NO.
TYPE Mindrill E1000
DRILLER W. Pearce, T. Hughes
COMMENCED
COMPLETED

LOGGED G. Brouxhon
Sheet 6 of 7
VERTICAL SCALE 1 inch : 10 feet.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME

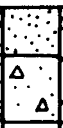
HOLE NO. R21

R.L. 1458·8

LOCATION Machine Hall u/g Power Station

ANGLE FROM HORIZONTAL 90°

DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS CRUSHED ZONES	
Mod. fresh tuff	Fairly broken to broken core. Dark grey pelitic tuff.	600		100	Sub-horizontal fractures generally fresh, some have blue secondary minerals as a coating.	
Mod. fresh agglomerate.	Fairly broken to broken core.	60		100		
	END OF HOLE					

DRILL NO.

TYPE Mindrill E1000

DRILLER W. Pearce, T. Hughes

COMMENCED

COMPLETED

LOGGED G Brouxhon

Sheet 7 of 7

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R22 R.L. 1423·9

LOCATION Tailrace Tunnel below Laloki River ANGLE FROM HORIZONTAL 63° DIRECTION 94° M

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES. JOINTS, VEINS, SEAMS FAULTS CRUSHED ZONES	
	Scree and rubble					30·1·62
Fresh to Moderately fresh agglomerate	Core pieces 1'10" to 6" Agglomerate consists of vesicular andesite, and porphyritic andesite rocks	10			Broken zone Core ground	
	Core pieces 4" to 5"			95		
	Core pieces 6" to 1'9" Aggl. consists of vesicular andesite, augite porphyritic andesites embedded in a tuffaceous matrix which in places is friable.	20		100	Joint 50° coated with blue secondary mineral.	
	Core pieces 8" to 1'	30				
	Core pieces 1" to 3" Tuffaceous matrix fairly friable				Fractures coated with secondary minerals.	
	Core pieces 6" – 1' aggl. unsorted.					
	Core pieces < 3"			100	Broken zone, clay coated fractures.	
Moderately fresh agglomerate.	Core pieces 3" to 5" Av. size of aggl. components 1".	40		100	Sub-horizontal joint coated with clay. Broken zone with clay coated fractures.	
	Core pieces 8" to 4" Aggl. comp. av. ½" in size.				Fractures irregular and fairly fresh.	
	Aggl. comp. to a max. of 2"			98		
	Core pieces 4" to 9"				Joint 60°	
	Core pieces 2' – 3'	50			Fractures are fresh and coated with a thin film of black secondary mineral.	
Fresh to moderately fresh agglomerate	Core pieces 1' to 2' 10"			100		
	Core pieces average 7" Agglomerate consists of unsorted fragments of red and black vesicular andesite, also porphyritic andesites in a matrix of arenitic tuff.	60 70		100 100	Joints 45° Sub-vertical joint. Joint 45° Broken zone, clay coated fragments. Fracture 50° Set of irregular fractures coated with clay.	
Med. fresh	Brown arenitic tuff.				Sub-horizontal joint, mainly coated with secondary minerals	
Fresh to mod. fresh agglomerate	Core pieces 1' to 2'8" Aggl. generally unsorted Average size of aggl. components ½" – 1" to a maximum of 5".	80 90		100 100	Irreg. fracture Few fractures generally fresh and irregular	
	Core pieces 1' – 2' Aggl. components av. 2" in size. and consist of fine grained andesites and vesicular andesites	100		98	Few fractures, irregular and fresh some coated with a thin film of secondary minerals	

DRILL NO

TYPE Mindrill E1000

DRILLER Pearse, Ziebarth

COMMENCED 23-1-62

COMPLETED 15-2-62

▨ Tuff

▨ Agglomerate

LOGGED G Brouxhon

Sheet 1 of 6

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R22 R.L. 1423·9

LOCATION Tailrace Tunnel below Laloki River ANGLE FROM HORIZONTAL 63° DIRECTION 94° M.

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
Moderately fresh agglomerate	Core pieces 9". Agglomerate unsorted. Components vary in size from 1" to 1' as a boulder of coarsly vesicular andesite Brown arenitic tuff. matrix.	110		100	Fractures irregular and fresh in appearance.	
Mod. fresh	Greyish brown tuff.				Sub-horizontal joint.	
Moderately fresh agglomerate	Core pieces 6" to 1'.					
	Core pieces 3" to 6"	120		100	Irregular fractures clay coated. Broken zone. coated with secondary minerals.	
	Core pieces 8" Agglomerate components are ½" to 1" in size and consist mainly of fine grained andesites.	130		100	Fractures generally coated with Mn. bloom.	
	Core pieces 3" to 6"				Sub-vertical fracture coated with clay.	
	Core pieces 1'.	140		100	Broken zone, fragments coated with blue secondary minerals.	
	Core pieces 8" Agglomerate coarser Components consists of vesicular andesites, porphyritic andesites some of which show flow textures.	150		98	Joint 45° coated with sec. minerals. Joints 45°, 30° Broken zone 2", fragments coated with clay or secondary minerals along plane of fracture.	
Fresh to moderately fresh agglomerate	Core pieces 1' Aggl. components ¼" in size up to 10"				Irreg. fracture coated with secondary minerals.	
	Core pieces < 3"				Broken zone, fragments clay coated.	
	weathered zone, friable fragments. Core < 3"	160		100		
Moderately fresh agglomerate	Core pieces 6" Aggl. unsorted gr. size 1"-9"				Fractures generally slightly weathered and irregular. Broken zone 2"	
	porous zone.					
	Core pieces 8"	170		97	Joint 20° Various fractures coated with blue secondary minerals.	
	Core pieces 6" - 8" Aggl. components have an average size ¼" - ½"				Broken zone Narrow broken zone, clay coated and blue secondary mineral on fractures.	
	Core pieces 1'	180		100	Fracture, clay coated. thin broken zone, blue secondary mineral along fractures.	
	Core pieces 6" Aggl. unsorted ⅛" to 2½" size of components.	190		100 99	Fractures irregular usually coated with a blue secondary mineral. Joint coated with clay, 75°	
	Core pieces 3" to 4"				Broken zone 2"	
	Core pieces 10"	200			Narrow broken zone Fractures generally slightly weathered and irregular.	

DRILL NO

TYPE Mindrill E1000

DRILLER Pearse, Ziebarth

COMMENCED

COMPLETED

LOGGED G. Brouxhon

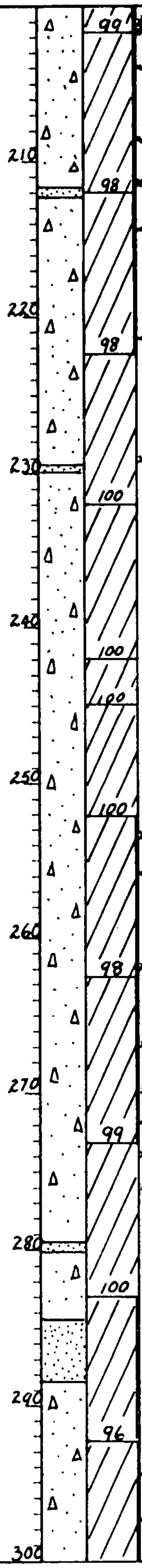
Sheet 2 of 6

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT *Rouna Hydro-Electric Scheme*
HOLE NO. *R22*
R.L. *1423·9*
LOCATION *Tailrace Tunnel below Laloki River*
ANGLE FROM HORIZONTAL *63°*
DIRECTION *94° M*



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION
Moderately fresh agglomerate	Core pieces 6" Aggl. unsorted, components range in size from 1/8" to 7". Largest comp. are coarse vesicular andesites, otherwise fine grained andesites
Mod. fresh tuff	Unsorted Brownish grey Tuff
Moderately fresh agglomerate	Core pieces 5" Abundance of porous tuff. Core pieces 8" Aggl components ½" in size.
Slightly weath.	Vuggy cores.
Moderately fresh agglomerate.	Core pieces 9" Aggl. components ½" Core pieces 3" Core pieces 1" Cores slightly vuggy Cores 3" Core pieces up to 2' Core pieces 5"
weath. aggl.	core pieces < 3"
Moderately fresh agglomerate	Core pieces 10" Aggl. components ¼"-½" in size. Cores < 3" porous + friable Core pieces 6" Andesitic vesicular rocks common in aggl.
Slightly weath tuff	Yellowish grey arenitic
Mod. fresh to slightly weath. agglomerate	Core pieces approx. 3"
Slightly weath. to mod fresh tuff	Core pieces 5" tuff grades from coarse near the top to fine near the bottom of the bed
Slightly weath agglomerate	Core pieces < 3", friable and porous. Core pieces 4", friable slightly less porous.
Mod. fresh agglomerate.	Core pieces 8"

STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

- Broken zone, thin film of clay on fragments.
- large irreg. sub-vertical fracture crumbly surface.
- Broken zone.
- Broken zone 3" wide.
- Fracture, thin clay coating.
- Vuggy irreg. fracture.
- Fractures irreg. sometimes coated with secondary minerals.
- Broken zone - weathered surface on fragments or coated with secondary minerals.
- Fractures irregular, coated with blue secondary minerals.
- Fragments weathered and vuggy
- Thin broken zone.
- Weathered fracture along weak section of core.
- Broken zone, fragments coated with secondary minerals.
- Otherwise fractures irregular.
- Broken zone with friable fragments. Fractures either fresh or coated with secondary minerals.
- Narrow broken zone.
- Irreg. fracture.
- Narrow broken zone 1", clay coated fragments.
- Broke zone 2"
- Cores sometimes vuggy, fracturos. Thin clay coatings, also secondary minerals.
- Fractures irregular.
- Irregular fractures, clay coated.
- Sub-vertical fracture clay filled.

DRILL NO
TYPE *Mindrill E1000*
DRILLER *Pearse, Ziebarth*
COMMENCED
COMPLETED

LOGGED *G. Brauxhon*
Sheet 3 of 6
VERTICAL SCALE *1 inch : 10 feet*

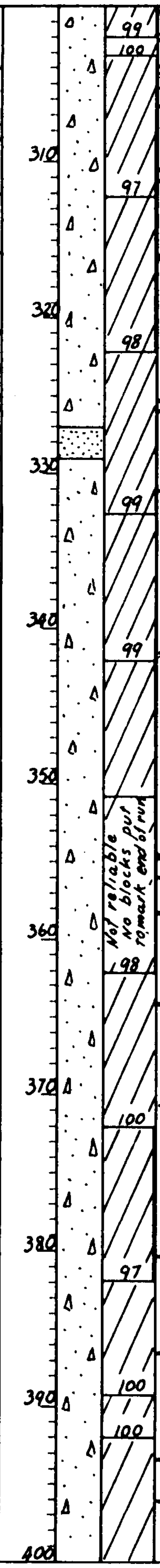
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R22 R.L. 1423·9

LOCATION Tailrace Tunnel below Laloki River. ANGLE FROM HORIZONTAL 63° DIRECTION 94°M

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION
Mod. fresh agglomerate	Core pieces 8"
Mod. fresh to fresh aggl.	Core pieces 6"-3" Aggl. components ¼" in size.
Slightly altered	Cores friable & porous.
Moderately fresh agglomerate	Core pieces 6"
	Core pieces 4" Vesicular andesitic rocks abundant.
	Core pieces 8"-2"
Mod. fresh to slightly altered	Core pieces 2"-3" Aggl. porous, cores friable.
	Cores 6"-7"
	Cores < 3"
Mod. fresh to slightly weath.	Tuff, fine to fairly coarse gr. Locally porous and friable.
as above.	Cores vuggy in places, generally porous & friable.
Mod. fresh agglomerate.	Core pieces 5"-6".
Moderately fresh to slightly weath. agglomerate.	Core pieces 3"
	Core pieces 8", slightly porous and friable.
	Cores vuggy and friable.
	Core pieces up to 2'
	Aggl. unsorted frags. to ½" in size.
	Core pieces 4"-1'
	" " 6"
	" " < 3"
	" " 3"
Moderately fresh to fresh agglomerate.	Core pieces 10" Aggl. unsorted.
	Core pieces 6" and slightly vuggy. Aggl. components consisted of vesicular andesites & fine grained andesites to a size of 2"-3".
	Core pieces 7", Aggl. components 1" in size mostly of fine grained andesites.
	Core pieces. 6"
	Core pieces generally >1'



STRUCTURES JOINTS VEINS, SEAMS FAULTS CRUSHED ZONES

Irregular fracture, clay filled.

Broken zone 2", fragments clay coated.

Irregular fractures, thin clay coated.

Joint 45°

Irreg. fractures coated with green clay material.

Fractures 40°, irregular sometimes coated with secondary minerals.

Broken zone with some scratches on fragments suggestive of movement.

A 2" piece of hardened clay minerals.

Fractures generally irregular sometimes coated with secondary minerals.

Clay coated fragments.

Sub-horizontal fractures coated with clay minerals.

Fractures generally irregular and coated with limonitic material.

Broken zone, fragments coated with limonitic material.

Fractures irregular coated with limonitic material.

Broken zone, fragments coated with limonitic material.

Irreg. fractures coated with limonitic material.

Sub-horizontal coated iron compound.

(This broken zone contains weathered fragments coated with clay.)

Irregular fract. sub-horizontal coated with clay and limonite.

Other fractures fairly fresh sometimes coated with secondary Mn. minerals.

Set of fractures coated black with secondary minerals.

Fractures generally fresh & irregular.

Joint 50° coated with secondary minerals.

Fractures fresh and irregular.

Large sub-vertical fracture 5" long.

Fractures fresh

Large irreg. fracture.

Joint 70°.

DRILL NO

TYPE Mindrill E1000

DRILLER Pearse, Ziebarth.

COMMENCED 23·1·62

COMPLETED 15·2·62

LOGGED G. Brouxhon

Sheet 4 of 6

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Rouna Hydro-Electric Scheme
HOLE NO R22
R.L. 1423.9
LOCATION Tailrace Tunnel below Laloki River.
ANGLE FROM HORIZONTAL 63°
DIRECTION 94°M

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
Fresh to mod. fresh aggl. Mod. fresh agglomerate	Core pieces 8" – 1'9" Aggl. unsorted.		100	Fractures coated with limonitic material. Joint 75° coated with blue secondary minerals.	
Mod. fresh tuff.				Irreg. fractures coated with blue secondary minerals. Joint 80° coated with iron compound.	
Moderately fresh agglomerate.	Core pieces 6", vuggy and pitted. Aggl. consists mainly of vesicular andesites and fine grained andesitic rocks.	410	99	Broken zone, friable & porous. Otherwise fractures fresh sometimes coated with secondary minerals.	
	Core pieces >1' Aggl. components have a size ½" – 1"	420 430 440	98 100 100	Broken zone 6", fragments coated with Mn. bloom.	
Slightly weathered to mod. fresh agglomerate.	Core pieces 6" Some of the cores are vuggy. Agglomerate unsorted.	450	100	Fractures irregular and slightly weathered. Narrow broken zone. Broken zone - weathered fragments	
	Core pieces < 3"		100	Fractures irregular, friable on surface and often coated with black Mn bloom.	
	Core pieces average 1'	460			
	Core pieces < 3", friable & porous				
Moderately fresh agglomerate.	Core pieces 5" Aggl. unsorted.		100	Fracture sub-vertical 3" long. Joints 50°, 45° Fractures irregular and friable on surface. Broken zone 3".	
	Core pieces 3"	470		Broken zone 4"	
	" " 4"				
	Core pieces 5" Aggl. comp. unsorted.		98	Fractures irregular coated with Mn bloom.	
	Core pieces < 3"	480			
			99	Fractures irregular coated with black secondary minerals.	
	Core pieces 7"	490			
	" " 4"				
	" " 7" to 2'6" Cores pitted and vuggy.				
	core pieces 4"		97	Irreg. fracture coated with blue sec. minerals.	
		500			

DRILL NO.
TYPE Mindrill E1000
DRILLER Paarse, Ziebarth
COMMENCED 23·1·62
COMPLETED 15·2·62

LOGGED G. Brouxhon
Sheet 6 of 6
VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R22 R.L. 1423·9

LOCATION Tailrace Tunnel below Laloki River. ANGLE FROM HORIZONTAL 63° DIRECTION 94° M

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS, VEINS SEAMS FAULTS CRUSHED ZONES
Moderately fresh agglomerate	Core pieces 4"				Large fracture 4" long, coated with black secondary minerals.
	Core 1' length				Broken zone 2", fragments coated with secondary minerals.
	Core pieces 4"			100	Joint 60°
	" " 4" to 5"	510			Broken zone 4" " " fragments coated with black secondary minerals. Broken zone. Otherwise fractures sub-horizontal.
	Core pieces 6" Aggl. unsorted.	520		100 100	Irreg. fracture coated with clay like material Fracture 3" long, coated Mn bloom. Large fracture sub-vertical coated with secondary minerals.
Moderately fresh agglomerate	Core pieces 1'7" – 3' Agglomerate unsorted.	530		100	Large fracture 40° - 7" long coated with blue secondary mineral. Vuggy on surface.
	Core pieces 6"				Irregular fracture sub-horizontal coated with blue secondary minerals.
	" " 7"				
	" " 4"			100	Vuggy irreg. fractures coated with blue secondary minerals. Joint 45° coated with black secondary mineral.
	Core pieces 8"	540			Fractures coated with blue secondary mineral vuggy on surface. Sub-horiz. fracture coated blue.
	Core pieces 4"-5" last 7" of core vuggy.			99	Broken zone, fragments coated with secondary minerals.
Slightly weath. to mod. fresh. aggl.	Core pieces 4"	550			Fractures irregular and coated black.
Mod. fresh aggl.	Core pieces 7"- 8" up to 2'				Irregular fracture coated with blue and black secondary minerals.
Mod. fresh tuff to slightly wea	Core pieces 4"			100	
Mod. fresh aggl.	" " 1'2"	560			Joint 70° coated with secondary minerals. Large sub-vertical fracture 5" long, coated with secondary minerals.
Mod. fresh tuff.	Coarse tuff or fine aggl, size ⅛"				
Mod. fresh aggl.	Aggl. unsorted.			99	Otherwise fractures sub-horiz. generally coated with these sec. minerals.
Moderately fresh agglomerate	Core pieces 6" Aggl." unsorted Core porous in the first foot of the run.	570		100	Irregular fracture coated with black secondary minerals. large irreg. fracture 6" long coated blue. Irregular fractures (30°, 30°, 40°) Large fracture coated with sec. mineral. " " sub-vertical.
Mod. fresh tuff dark grey.	Core pieces 1' Fairly coarse tuff				Fractures in tuff coated with black sec. minerals.
	core pieces 3"	580		100	
Mod. fresh agglomerate.	" " 8"				Joint coated black. Joint 45° coated blue secondary mineral. Irreg. fracture Joint 45° coated blue.
	Core pieces > 1'3"				Large fracture 4" long coated with secondary minerals.
	" " 6"	590		99	Fracture 80° coated with black secondary minerals.
	End of Hole				

DRILL NO

TYPE Mindrill E1000

DRILLER Pearse, Ziebarth

COMMENCED 23·1·62

COMPLETED 15·2·62

LOGGED G. Broukhon

Sheet 6 of 6

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

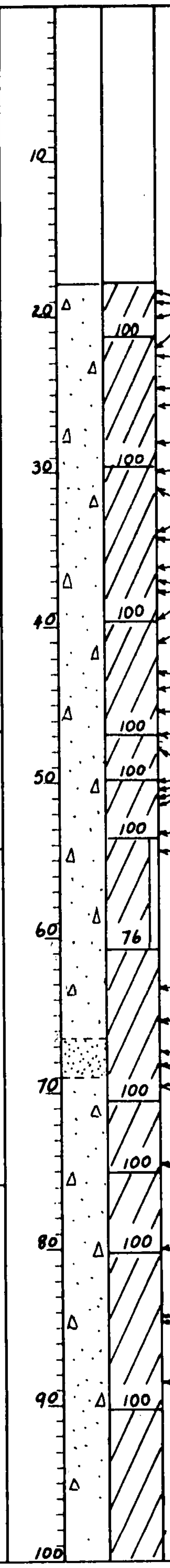
PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R23 R.L. 1494.12

LOCATION Machine Hall, u/g Power Station ANGLE FROM HORIZONTAL 71° DIRECTION 320° M.

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

Fracture spacing including joints, excluding broken zones.

Angles measured with respect to core-axis.



Slightly weathered (yellowish colour)

5°
2"

Irregular (20°, 70°, 45°, 0°), clay filled.

20° clay filled.

Moderately fresh agglomerate

Medium grained aggl. Agglomerate components poorly sorted, average size 1"

7"

Flat surface 80°

Irregular 30°

Irregular 80° clay filled.

2"

Very irregular 0° clay filled Broken zone 1"

Very irregular (90°, 80°)

Flat surface 80°

Irregular 30°, clay filled.

Very irregular (70°, 70°, 20°)

7"

Irregular 30° clay filled.

Irregular 60°.

Very irregular 20°, coated with black mineral.

Flat polished black surface 30°.

Slightly weathered to moderately fresh aggl.

Aggl. components (not matrix) strongly jointed.

3"

Irregular (0°, 80°, 80°, 30°, 70°)

Flat polished black surface 5° slickensided.

Flat surface 80°

Lava boulder in agglomerate.

Bit blocked, core ground away.

Agglomerate with medium gr. size and coarse matrix. Components strongly jointed.

7"

Very irregular 90°

Polished irregular 70°

Med.-coarse gr. tuff band.

Flat surface (70°, 30°)

Contacts not distinct.

Broken core 1", 0°

Components strongly jointed.

Flat surface 70°

Moderately fresh agglomerate

Agglomerate poorly sorted medium grain size. Medium matrix.

Irregular 60°

Irregular 0°

10"

Polished flat surface 80°

DRILL NO.

TYPE Mindrill E1000

DRILLER Pearce, Zeebarth

COMMENCED 21·3·62

COMPLETED 30·4·62

▨ Tuff

[Δ] Agglomerate

LOGGED L. Hamilton

Sheet 1 of 7

VERTICAL SCALE 1 inch : 10 feet

3

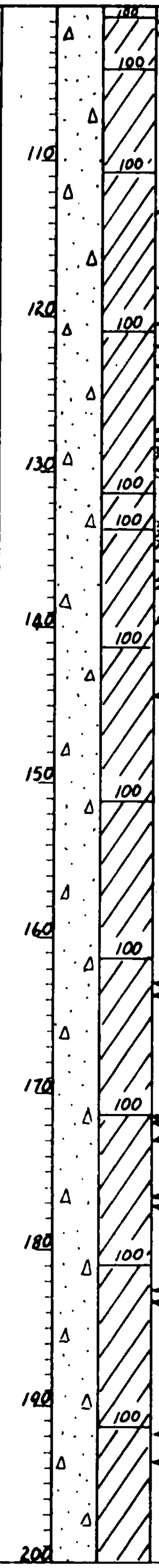
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R23 R.L. 1494·12

LOCATION Machine Hall U/G Power Station ANGLE FROM HORIZONTAL 71° DIRECTION 320 M

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	Fracture spacing	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	
Moderately fresh agglomerate.	Agglomerate medium grain size, poor sorting. Medium gr. matrix	10" 18" 1" 10"				Broken zone 4" Irregular 30° clay filled. Irregular 0° Very irregular 0°, clay filled. Flat surface 45° Irregular (45°, 30°) Irregular 30° clay filled. Very irregular 5° Very irregular 5° coated with black mineral. Broken zone with clay. Flat polished surface 10°. Broken zone, flakey rock and clay, joints 0°. Very irregular clay filled. (0°,0°,0°,5°)	
	Coarse grained aggl. average size of comp. 2". in medium gr. matrix.					Regular 20°, clay filled.	
	Medium grained agglomerate Matrix med. gr.	13"				Irregular (30°, 5°) Flat surface (45°, 30, 30°) Very irregular 0° Flat surface 80° Irregular 5° Irregular 5°, clay filled. Very irregular 0° Irregular 70°	



DRILL NO

TYPE Mindrill E1000

DRILLER Pearce, Zeebarth

COMMENCED 21·3·62

COMPLETED 30·4·62

LOGGED L. Hamilton

Sheet 2 of 7

VERTICAL SCALE 1 inch : 10 feet

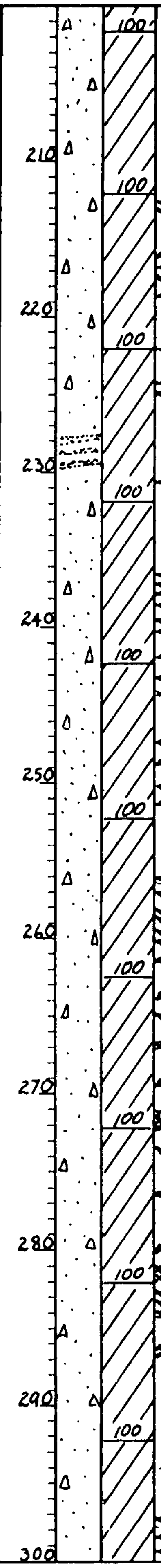
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME   HOLE NO. R23   R.L. 1494.12

LOCATION Machine Hall ~~/~~ Power Station   ANGLE FROM HORIZONTAL 71°   DIRECTION 320 M.

ROCK TYPE & DEGREE OF WEATHERING | DESCRIPTION | Fracture Spacing | DEPTH & SIZE OF CORE | LOG | LIFT & CORE RECOVERY | STRUCTURES JOINTS VEINS, SEAMS FAULTS CRUSHED ZONES



ROCK TYPE & DEGREE OF WEATHERING

Moderately fresh agglomerate.

DESCRIPTION

Agglomerate, medium grain size, med. matrix. — 11"

Thin irregular tuff bands and fine agglom. of varying gr. size, some graded bedding. — 7"

Medium grained aggl. with some large boulders (>12") Med. gr. matrix. — 4"

Medium grained aggl. — 10"

24"

7"

Coarse aggl. tuff frags 2"

Medium grained aggl. — 7"

STRUCTURES

Irregular (40°, 5°, 0°)

Flat surface 90°

Irregular 5° blue bloom on surface.

Irregular 5°

Flat surface 60°

Irregular 5°

Bedding approx. 70° to core axis.

Flat surface 45°

Irregular (5°, 70°, 5°)

Very irregular 0°, green bloom.

Irregular (10°, 5°)

Flat, black polished surface 80°

Flat polished surface 5°

Very irregular 20° clay filled.

Irregular (5°, 45°)

Very irregular, clay filled (0° 60°).

Irregular, clay filled (5°, 30°)

Broken core 4" clay filled.

Irregular, clay filled (5°, 5°, 0°, 30°, 30°, 0°)

Irregular, clay filled (5°, 0°, 0°)

Broken core, clay filled 0°.

Irregular, clay filled 30°.

Broken core, clay filled.

Irregular (30°, 80°, 30°, 0°, 45°, 30°.)

Irregular, clay filled 30°.

Broken zone 4" clay filled.

Very irregular 50° clay filled.

DRILL NO

TYPE Mindrill E1000

DRILLER Pearce, Zeebarth

COMMENCED 21·3·62

COMPLETED 30·4·62

LOGGED L. Hamilton

Sheet 3 of 7

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA FALLS HYDRO-ELECTRIC SCHEME
HOLE NO. R 23
R.L. 1494·12
LOCATION Machine Hall U/G Power Station
ANGLE FROM HORIZONTAL 71°
DIRECTION 320 M.

ROCK TYPE & DEGREE OF WEATHERING

Moderately fresh agglomerate

Slightly weathered aggl.

Moderately fresh agglomerate

Slightly weathered agglomerate.

Moderately fresh aggl.

DESCRIPTION

Fine graded bedding.
Medium grained aggl. average size 1½".
Med. to coarse matrix poorly sorted.

Fine graded bedding.

Fine graded bedding.

Agglomerate medium grain size.
Unsorted.

Fracture Spacing

7"

24"

10"

6"

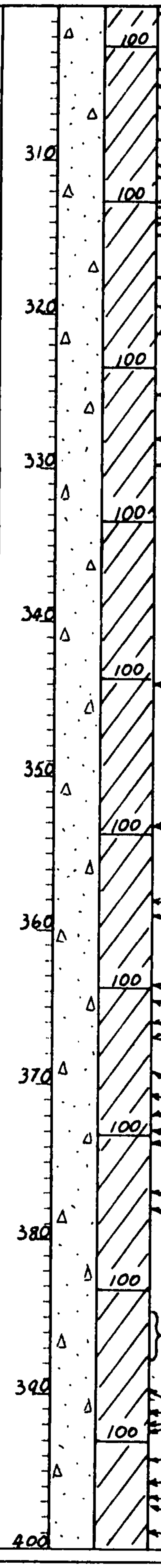
2"

9"

3"

9"

DEPTH & SIZE OF CORE | **LOG** | **LIFT & CORE RECOVERY**



STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

Irregular, clay filled 30°
Clay filled (15° 0°).
Irregular 10°.
Flat surface 45°.
Irregular (80°, 70°, 60°, 80°, 60°, 60°)
Some slickensides
Irregular 90°
Irregular 90°, porous zone.
Irregular (40°, 90°)
Flat polished surface 60°
Clay filled 70°, ¼" clay
Flat 30°
Irregular 30°
Very porous weak rock.
Irregular
Irregular 70°
Fairly flat 70° porous zone
Flat surface
Irregular 60°
Flat surface (60°, 48°)
Irregular 80°
Flat 40°
Irregular weathered fractures at angles between 0° & 90°.
Irregular fractures clay filled 70°
Flat slickensided surface 45°
Irregular.
Irregular 80°
Flat surface 20°
Irregular 10°

DRILL NO.
TYPE Mindrill E1000
DRILLER Pearce, Zeebarth
COMMENCED 21·3·62
COMPLETED 30·4·62

LOGGED L. Hamilton
Sheet 4 of 7
VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R23 R.L. 1494·12

LOCATION Machine Hall U/G Power Station ANGLE FROM HORIZONTAL 71° DIRECTION 320°M

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	Fracture Spacing	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES
	Medium grained aggl.	8"			100	80°
			410			
	Coarse grained aggl. Av. grain size 2" Matrix of compactable tuff.				100	
		4"				
	Medium grained aggl. poorly sorted.		420			90°
		8"			100	
		4"				Flat surface 10°, blue bloom.
			430			
					100	90°
	Fine grained aggl. Components average ¼" moderately sorted.	8"				90° porous zone.
			440			
					100	
Moderately fresh agglomerate	Medium grained aggl.					90°
						45° contains ¼" secondary filling. 90° broken zone
			450			
	Coarse grained aggl.	4"			100	Broken zone (probable due to drilling)
						90° 80° thin coating 90°
			460			
	Medium grained aggl.				100	Broken zone (probably due to drilling).
			470			
						Very porous zone.
					100	
		8"				5° irregular.
	Fine to coarse bands of tuff.					0° irregular .
	Bedding 70° to core axis.		480			1 ft. of irregular 0°, fractures.
					100	60° flat.
	Medium grained aggl.					
			490			
					100	5° irregular.
			500			

DRILL NO

TYPE Mindrill E1000

DRILLER Pearce, Zeebarth

COMMENCED 21·3·62

COMPLETED 30·4·62

LOGGED L. Hamilton

Sheet 5 of 7

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

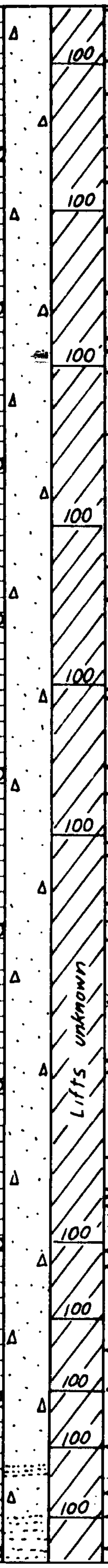
GEOLOGICAL LOG OF DRILL HOLE

PROJECT *ROUNA HYDRO-ELECTRIC SCHEME* HOLE NO *R23* R.L. *1494·12*

LOCATION *Machine Hall U/g Power Station.* ANGLE FROM HORIZONTAL *71°* DIRECTION *320 M.*

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	Fracture spacing	DEPTH & SIZE OF CORE	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
Fresh agglomerate.	Medium grained aggl. with a few larger boulders or cobbles.	6"		80° clay filled and	weathered.
				90° irregular.	
				60° Flat.	
				60° clay filled.	
			510	60° irregular.	
				70° flat.	
		10"		80° flat	
			520	70° flat	
				50° flat	
		16"		30° to 20° flat.	
				20° flat.	
			530		
				20° flat.	
				70° flat	
			540		
		4"		5° irregular.	
				20° flat.	
			550	30° irregular.	
				5° irregular.	
	Medium grained aggl. with a few boulders	7"		20° flat.	
				70° flat.	
				20° flat.	
			560	5 parallel flat fractures	at 20°
				20° flat.	
				1ft of broken fragments	1" dia. fresh.
				20° flat.	
			570		
				45° flat.	
				5° irregular.	
				Grinding of core evident.	
				1' 6" broken zone due to	low angle fractures and drilling.
	Medium grained aggl. completely unsorted.	8"	580	30° flat	
				90° flat.	
				60° flat	
			590	20° flat.	
		14"		90° irregular.	
	~~Band of tuff~~				
	Medium grained aggl.			30° flat	
	Coarse to fine tuff bands load casts present.			90° flat	
			600	30° flat.	

LOG · LIFT & CORE RECOVERY



DRILL NO

TYPE *Mindrill E1000*

DRILLER *Pearce, Zeebarth*

COMMENCED *21·3·62*

COMPLETED *30·4·62*

LOGGED *L. Hamilton*

Sheet 6 of 7

VERTICAL SCALE *1 inch : 10 feet*

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME
HOLE NO. R23
R.L. 1494·12
LOCATION Machine Hall U/G Power Station.
ANGLE FROM HORIZONTAL 71°
DIRECTION 320 M.

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	Fracture Spacing	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS, FAULTS CRUSHED ZONES
Fresh agglomerate	Tuff.	14"			100	30° flat
	Fine grained aggl. with large cobbles				100	
	Very fine aggl. with coarse matrix. gr: size average ¼" A few boulders. Completely unsorted.	4"	610		100	80° flat Core grinding evident.
					100	30° flat.
			620		100	
		8"			100	
			630		100	20° irregular 80° flat
	Fine grained aggl. av. size ½", very coarse matrix. Calcite veinlets become more compact near bottom of hole				100	30° flat Core grinding. 10° very irregular, calcite filled.
		5"	640		100	30° irregular
	End of Hole.					

DRILL NO.
TYPE Mindrill E1000
DRILLER Pearce, Zeebarth
COMMENCED 21·3·62
COMPLETED 30·4·62

LOGGED L. Hamilton
Sheet 7 of 7
VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

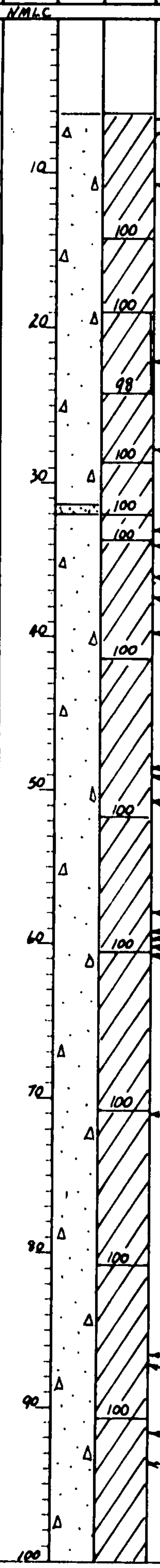
GEOLOGICAL LOG OF DRILL HOLE

PROJECT *ROUNA HYDRO-ELECTRIC SCHEME* HOLE NO. *R2A* R.L. *1417·2'*

LOCATION *Underground tail race, under Laloki River (U/S)* ANGLE FROM HORIZONTAL *74° 18'* DIRECTION *280 M.*

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION
	Scree & Rubble Material.
M.F. agglomerate.	F.G cores Components of aggl, fine grained augite & vesicular andesites. Size to 2'
S.W. to W.	Broken to very broken cores.
Moderately fresh agglomerate	Fairly good core.
M.F. to S.W. aggl.	Broken to very broken cores
M.F. to F aggl.	Fairly broken cores.
Tuff Band.	
Fresh to mod. fresh. agglomerate.	Components of vesicular andesites more common.
	Very broken cores.
	Fairly broken cores.
	Fairly broken to fairly good cores. Aggl. unsorted.
	Broken cores 4" pieces.
	Fairly good cores upto 3' long. Aggl. fairly well sorted.
M.F. to S.W.	
Fresh to mod. fresh agglomerate.	

DEPTH & SIZE OF CORE · LOG · LIFT & CORE RECOVERY



STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

I.F. - W. surfaces 45°
C.F - " 45°
I.F. clay filled 1" thick.
Water table
Cavity in rock ± 6"
Associated fractures with weathered surfaces.
2" broken zone, fractures coated with black friable material.
Small frag. zone
Large sub-vertical fracture 5" long.
I.F. coated black - friable.
I.F. friable.
I.F.
J 45°
I.F.
4" thick broken zone
Otherwise few irregular fractures
S.H. fracture coated clay.
S.H. " " "
S.H. fracture weathered surface.
and coating of secondary minerals.
I.F. weathered surface.
S.H. fracture - weathered surface.
I.F. " "
I.F. - coated with secondary minerals.
S.H. joint coated with secondary minerals.

DRILL NO *1*
TYPE *Mindrill E1000*
DRILLER *N. Pearse.*
COMMENCED *8-5-62*
COMPLETED *1-6-62*

⁙	Tuff
Δ	Agglomerate

LOGGED *G. Brouxhon*

VERTICAL SCALE *1 inch : 10 feet.*

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R 24 R.L. 1417·2′

LOCATION Underground Tail Race, under Laloki River (4/3) ANGLE FROM HORIZONTAL 74°18′ DIRECTION 280 M.

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
		NMLC			
	Very broken cores. Aggl. tuffaceous				I.F. friable surface, coated with secondary minerals.
	Fairly good core Aggl. - vesicular andesite with zone of dominantly tuffaceous material.	110		100	
					I.Fracture
					S.V. joint 4" long.
Fresh to mod fresh agglomerate					S.H. fracture coated with secondary minerals.
		120		100	Joint 45°
					I.F.
					I.F. coated thin with clay.
					F. 45° coated S.M.
					Core ground.
	Fairly broken cores	130		100	
	Very broken cores - vuggy	140		100	Fractures coated with secondary minerals.
	Fairly good cores.				
		150		100	Otherwise fractures coated with sec. minerals
	broken to very broken cores			100	
				Runs not recorded - likely 100% recovery	6" long S.V. fracture coated with secondary minerals.
	core slightly vuggy.				
	Appearance of red component of andesites	160			J 45°
	Aggl. as usual - rather unsorted.				
	Fairly good to good core.				otherwise few fractures with slightly weathered surfaces.
Moderately fresh agglomerate.		170			
		180			4" crushed zone, slickensides developed also gouge material.
					I.F.
	Fairly broken cores slightly vuggy in places.				2" thick fragmented zone.
		190		100	40° joint coated with blue secondary minerals
	Fairly good core.				Large I.F. coated with blue sec. minerals.
		200		100	45° fracture coated with clay.

DRILL NO

TYPE Mindrill E1000

DRILLER W. Pearce

COMMENCED 8-5-62

COMPLETED 1-6-62

LOGGED G. Brauxhon

VERTICAL SCALE 1 inch : 10 feet.

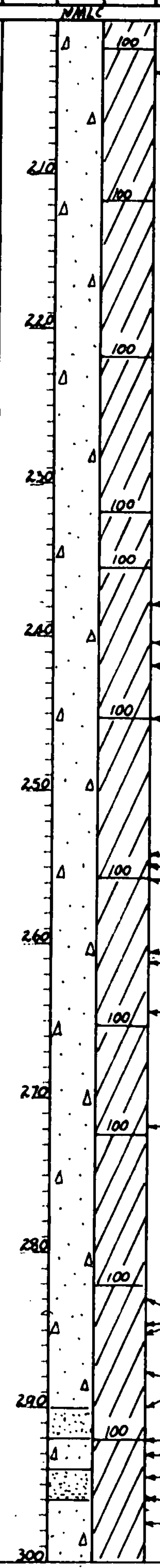
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT *ROUNA HYDRO-ELECTRIC SCHEME* HOLE NO. *R24* R.L. *1417·2*

LOCATION *Underground Tail Race, under Laloki River (U/S)* ANGLE FROM HORIZONTAL *74° 18'* DIRECTION *280° M.*

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
Mod. fresh agglomerate.	*Core slightly vuggy.*	NMLC		100	*2" fragmented zone - fractures with weathered surfaces.*
Fresh to mod. fresh agglomerate	*Fairly good core throughout.* *Aggl. fairly well sorted.*	210 220		100 100	*Fractures clean or slightly coated with secondary minerals.*
M.F. → S.W.					
Fresh to mod. fresh agglomerate.	*Core vuggy.*	230 240		100 100 100	*Vuggy fracture.* *I.F. clay coated.* *I. fracture - clay coated & weathered.* *I. fracture - clay coated & weathered.*
	Fairly good core	250		100	*Frag. zone 2" wide* *I.F. coated with secondary minerals.* *50° joint.*
	Broken to very broken core				
	Fairly good to fairly broken core.	260		100	*Clay coated fracture* *Fract. clay coated thinly & with weathered surface.* *I.F.*
	Fairly good core.	270 280		100	*45° Fracture coated sec. minerals & weathered.*
	Fairly broken to fairly good core.	290		100	*Irreg. fract. weathered surface.* *Irreg. fract. weathered surface*
	Dominantly tuffaceous aggl.			100	*S.H. fract clay coated & weathered.* *I.F. weathered surface.*
MF - S.W. tuff.	*Fairly broken cores* *Aggl. unsorted.*	300			*S.H. fract. weathered surface.* *F. coated black secondary mineral.* *60° Fract. weathered surface.*



DRILL NO

TYPE *Mindrill E1000*

DRILLER *W. Pearce*

COMMENCED *8-5-62*

COMPLETED *1-6-62*

LOGGED *G. Brouxhon.*

VERTICAL SCALE *1 inch : 10 feet.*

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R2A R.L. 1417·2

LOCATION UNDERGROUND TAIL RACE, under Laloki River (U/S) ANGLE FROM HORIZONTAL 74° 18' DIRECTION 280° M

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
		NMLC			
Fresh to mod. fresh agglomerate	Fairly Broken cores.			100	4" wide frag. zone
	cores pitted Broken cores				Compound fracture
					6" wide frag. zone
		310		100	
	Fairly broken cores.				Otherwise fractures slightly coated with secondary minerals.
		320			
M.F. to SW. Aggl.	Broken cores.			99	2" wide frag. zone
Mod. fresh to fresh agglomerate	Fairly broken to broken cores.				I.F.
					80° clay coated fracture.
		330		100	
				100	I.F. in S.W. core piece.
		340		100	
Mod. fresh agglomerate.	Broken cores dominantly tuffaceous.				Large I.F. weathered surface Small frag. zone - weathered core pieces I.F. slightly weathered in surface.
	Cores pitted. Fairly broken cores				Large I.F. weathered surface.
		350			Weathered fracture.
				100	45° joint - weathered surface.
SW. to W.					Weathered fracture.
Mod. fresh agglomerate.					I.F. weathered surface.
					Large fract. coated with secondary mineral.
		360		100	
SW. to W.					Large sub-vertical fracture clay filled.
Mod. fresh agglomerate					4" wide fragmented zone I.F. coated secondary minerals.
		370		100	
					4" wide fragmented zone.
		380			I.F. with joint striations & coated with sec. minera I.F. coated with sec. minerals.
Mod. fresh to slightly w. aggl.	Fairly broken to broken cores.				Otherwise fractures irregular & coated with sec. minerals.
	Friable cores Very broken cores mostly <3"			100	Small frag. zone, fractures coated with secondary minerals.
		390			
	Fairly broken cores. cores pitted.				45° joint - possible faint striations - on surface yellow secondary minerals.
				100	
	Broken cores.	400			

DRILL NO 1

TYPE Mindrill E1000

DRILLER W. Pearce

COMMENCED 8-5-62

COMPLETED 1-6-62

LOGGED G. Brouxhon.

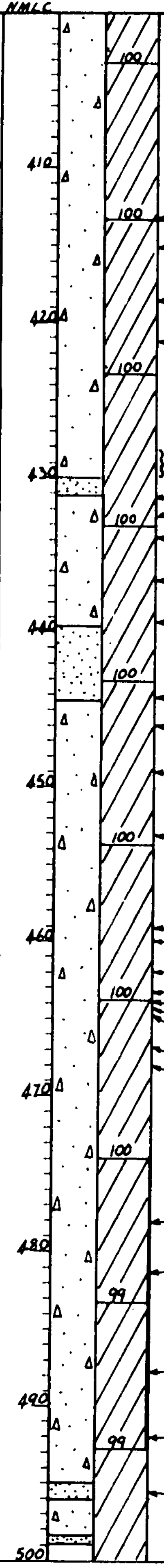
VERTICAL SCALE 1 inch : 10 feet.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO R24 R.L. 1617·2'

LOCATION Underground Tail Race, under Laloki River (C/L) ANGLE FROM HORIZONTAL 74° 18' DIRECTION 280° M



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES
Moderately fresh agglomerate	Fairly broken cores Aggl. unsorted. Components of vesicular and augite andesites.	Fractures irregular & slightly coated with secondary minerals.
MF. to SW. agglomerate	Broken cores	I.F. Frag. zone 1" thick weathered pieces.
Moderately fresh agglomerate	Fairly broken cores Aggl. unsorted.	Frag. zone 6" wide, fragments coated with secondary minerals (chlorite & epidote) Large I.F. - weathered surface.
	Very broken cores.	Numerous fractures coated with sec. minerals.
	Fairly broken cores.	I.F. large 45° joint 4" wide fragmented zone. Small fragmented zone.
Mod. fresh tuff.		6" wide fragmented zone, frag. coated with secondary minerals. 2" broken zone.
Moderately fresh agglomerate	6" of core vuggy	I.F. coated with sec. minerals. I.F. coated with blue sec. minerals.
	Broken cores	Compound fracture coated with sec. minerals.
Mod. fresh to fresh agglomerate.	6" core piece, very tuffaceous Fairly broken cores throughout. Aggl. unsorted with a dominance of fairly large components 2" to 3" across. Some of the fragments of andesite show yellow rim of oxidation.	Sub-horiz. fracture with weathered surface. Large sub-horiz. fract 9" long coated with sec. minerals. I.F. 2" frag. zone Large compound fracture 45° joint. IF coated with sec. minerals Large I.F. weathered surface. Curved fracture coated with sec. minerals. I.F. coated with blue sec. minerals. I.F. 45° joint coated with sec. minerals. Joint 60° coated sec. minerals.

DRILL NO 1
TYPE Mindrill E1000
DRILLER W. Pearse
COMMENCED 8-5-62
COMPLETED 1-6-62

LOGGED G. Brouxhan

VERTICAL SCALE 1 inch : 10 feet.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME

HOLE NO R 24

R.L. 1417·2'

LOCATION Underground Tail Race, under Laloki River (U/S)

ANGLE FROM HORIZONTAL 76°18'

DIRECTION 280° M

ROCK TYPE & DEGREE OF WEATHERING

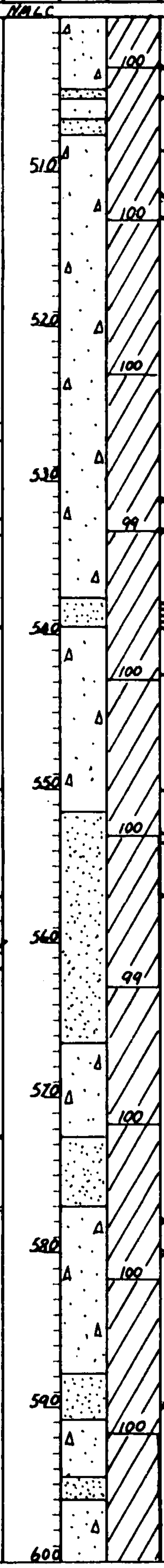
- MF to F aggl.
- M.F. tuff band
- M.F. tuff band.
- Moderately fresh agglomerate.
- Mod fresh tuff band
- Moderatoly fresh agglomerate
- Moderately fresh tuff.
- Moderately fresh agglomerate
- MF - SW. tuff
- Mod. fresh agglomerate
- M.F. tuff band
- M.F. aggl.
- M.F. tuff band.
- M.F. aggl.

DESCRIPTION

- Fairly broken cores throughout
- Broken cores 4" friable pieces
- Fairly broken core.
- Very broken core
- Fairly good to fairly broken core.
- Broken to very broken cores
- Fairly good to fairly broken cores.
- Fairly broken to broken core.
- Tuff - fine grained, coarser towards the base.
- Zone of coarse grained tuff
- Broken to very broken cores.
- Fairly broken cores
- Tuff progressively finer towards base
- Very broken zone
- Fairly broken cores
- Broken to fairly broken cores throughout.
- Broken to fairly broken cores
  Here, core surface of aggl. more rugged - not as tough as usual.

DEPTH & SIZE OF CORE | LOG | LIFT & CORE RECOVERY

NMLC



STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

- 2" wide frag. zone
- Narrow frag. zone
- Compound fract coated with blue sec. minerals.
- I.F. coated blue sec. mineral.
- Compound fract. coated blue sec. mineral.
- Otherwise fractures irregular & coated with blue sec. minerals.
- 2" wide frag. zone.
- 6" broken zone.
- Oblique fract.
- Compound fract. coated with clay band 2" wide.
- Green clay band 1" thick.
- Otherwise fract. irreg. & coated blue with sec. minerals.
- I.F.
- 40 joint coated with sec. minerals.
- Small frag. zone.
- Frag. zone
- Otherwise fractures 60° to 70° clean or slightly coated with sec. minerals.
- In aggl. fractures irregular often coated with blue sec. minerals.
- 4" wide frag. zone
- 2" wide frag. zone.
- 2" wide frag. zone

DRILL NO. 1

TYPE Mindrill E1000

DRILLER W. Pearse

COMMENCED 8-5-62

COMPLETED 1-6-62

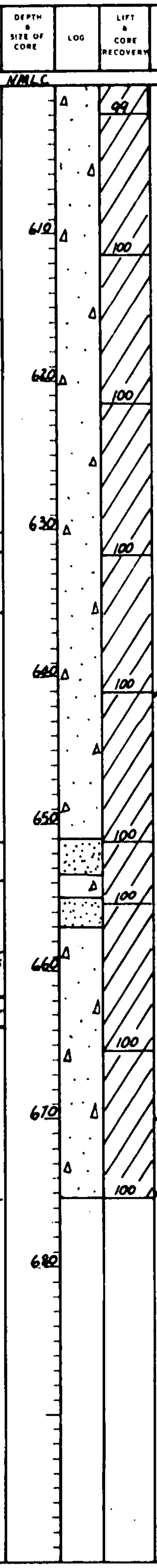
LOGGED G. Brouxhon.

VERTICAL SCALE 1 inch : 10 feet.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME
HOLE NO. R24
R.L. 1417·2′
LOCATION Underground Tail Race, under Laloki River (U/S)
ANGLE FROM HORIZONTAL 74° 12′
DIRECTION 280 M



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	STRUCTURES. JOINTS, VEINS, SEAMS FAULTS, CRUSHED ZONES
Mod. fresh to slightly W. agglomerate.	Broken to fairly broken core	
Moderately fresh agglomerate	Fairly broken cores Core surface still vuggy but but less so than previously.	
	Fairly broken to fairly good core. Agglomerate unsorted.	Irregular fractures throughout generally subhorizontal and coated with white and blue sec minerals.
Fresh to Mod. fresh agglomerate.	Broken to very broken cores	
	Fairly good core	
	Fairly good to good cores. Aggl. contains fossil wood	2" wide frag. zone - material friable.
Moderately fresh agglomerate and tuff	Unsorted tuff, fairly friable and soft.	
	Fairly good core.	Fractures irregular & generally sub-horizontal and fresh.
	Broken to very broken cores Surface of core vuggy – not as tough as usual.	
	Fairly good core.	
	Very broken cores, friable	
	Broken to fairly broken cores.	I.F.
M.F to SW. agglomerate		2" frag. zone.
	End of Hole.	

DRILL NO. 1
TYPE Mindrill E1000
DRILLER W. Pearse
COMMENCED 8-5-62
COMPLETED 1-6-62

LOGGED G. Brauxhon

VERTICAL SCALE 1 inch : 10 feet.

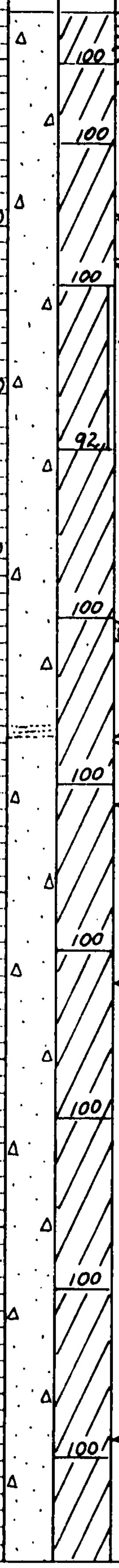
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Rouna Hydro-Electric Scheme HOLE NO R25 R.L. 1461·4.

LOCATION Weir Site ANGLE FROM HORIZONTAL 45° DIRECTION 13° 45′

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	Fracture Spacing	DEPTH & SIZE OF CORE	LIFT & CORE RECOVERY	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	
	Soil and scree.					
Slightly weathered aggl.		3"	NX		30° clay filled, regular.	
					Irregular (5°, 20°, 20°, 0°, 5°)	
Fresh agglomerate			10	100		
		4"		100		
			20		50° regular, polished.	
					Zone of 1" slickensided fragments Fault ?	
				100	70° regular, polished, slickensided.	
	Medium grained aggl.				6" zone containing 7 slightly irregular joints at 20° to core axis, some secondary mineral development.	
			30	92		
		10"	40	100		
					Core grinding.	
	Tuff band, brown med gr.		50		50° irregular, clay filled.	
					5° " " "	
				100		
		10"			core grinding.	
			60	100		
					45°	
	Medium grained aggl.		70	100		
			80	100		
			90	100	5° irregular.	
			100			



DRILL NO.

TYPE

DRILLER

COMMENCED

COMPLETED

⛆ Tuff

△ Agglomerate

LOGGED L. Hamilton.

Sheet 1 of 5

VERTICAL SCALE 1 inch : 10 feet.

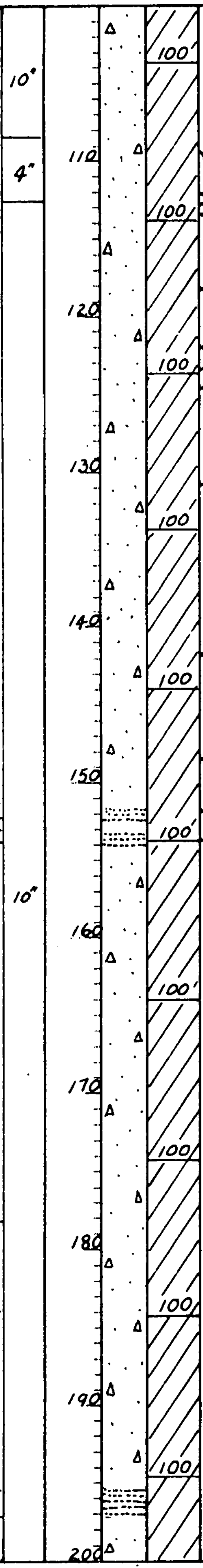
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT *ROUNA HYDRO-ELECTRIC SCHEME* HOLE NO *R25* R.L. *1461·4*

LOCATION *Weir Site* ANGLE FROM HORIZONTAL *45°* DIRECTION *13°45′*

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION		DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
Fresh agglomerate	*Medium grained aggl.*	*10"*	*110*		*100*	*Irregular (0°, 0°, 5°, 20°)*	
		4"	*120*		*100*	*40°*	
			130		*100*	*Irregular (10°, 0°)*	
			140		*100*	*Very irregular 0°,*	*clay filled.*
			150		*100*	*20° clay filled.*	
						10° clay filled.	
						5°	
	Grey bedded tuff					*Bedding 35° to axis*	
	Grey bedded tuff				*100*	*" 42° " "*	
	Medium grained aggl.	*10"*	*160*		*100*		
			170		*100*		
	Fine grained aggl.		*180*		*100*		
	Medium grained aggl.		*190*		*100*		
	Med. gr. grey tuff.						
	Medium grained aggl.		*200*				



DRILL NO

TYPE

DRILLER

COMMENCED

COMPLETED

LOGGED *L. Hamilton*

Sheet 2 of 5

VERTICAL SCALE *1 inch : 10 feet*

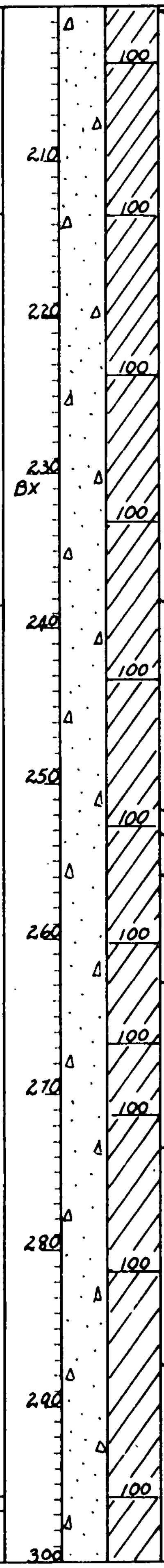
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO R25 R.L 1461·4

LOCATION Weir Site ANGLE FROM HORIZONTAL 45° DIRECTION 13°45'

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION		DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
Fresh agglomerate	Medium grained aggl.	10"				porous zone	
		8"				30°	
Slightly weathered agglomerate		6"				20° flat, polished 40° flat 90° clay filled, very irregular.	
	Coarse grained aggl.					80° flat polished.	
	Fine grained aggl.						
Fresh to slightly weathered agglomerate	Medium grained aggl.					porous zone 0° irregular.	
		2"					
		4"					



DRILL NO
TYPE
DRILLER
COMMENCED
COMPLETED

LOGGED L Hamilton

Sheet 3 of 5

VERTICAL SCALE 1 inch : 10 feet

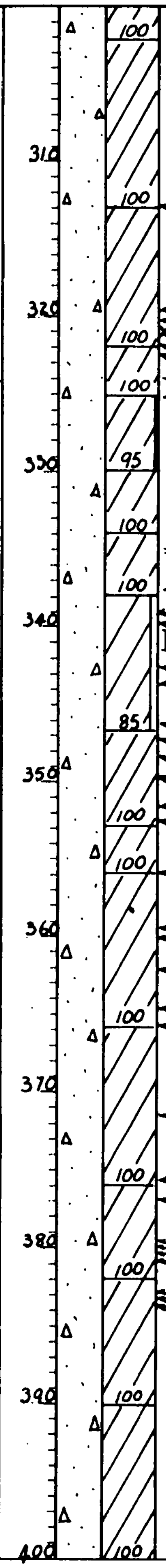
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R25 R.L. 1461·4

LOCATION Weir Site ANGLE FROM HORIZONTAL 45° DIRECTION 13°45'

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	Fracture spacing	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	
Fresh agglomerate	Medium grained aggl.	8"					
Moderately weathered. Matrix is a light brown colour, chalky in places.	Graded bedding in matrix. Medium grained aggl. fine to coarse matrix	4"					
	Fine grained aggl. coarse matrix.	3"					
Generally slightly weathered matrix, light grey-brown.	Fine grained aggl. medium matrix.	9"					
	Medium grained aggl.	4"					
Fresh to slightly weathered brownish grey colour.		5"					
		10"					



5° irregular.
20° irregular, weathered.
20° " , clay filled.
Broken zone 2" fragments.
clay and 5" of chert!
Irregular (20°, 10°)
Chalky, broken zone, 2" fragments
weathered irregular fractures
Broken zone, 2" fragments in places
very irregular, clay filled.
Broken zone 4" fragments irregular
clay filled fractures. Slickensides at 30° to core axis.
0° irreg. & weathered.
Core grinding.
Fractures 2" apart at 30°, irregular and clay filled.
Irregular, weathered (0°, 5°)
Irregular, clay filled 5°
Core grinding.
30° clay filled regular.
35 " " irregular.
5° Very irregular, clay filled.
5° Clay filled.
10° irregular.
30° clay filled.
0° clay filled irregular.
30° clay filled.
Core grinding.
30° clay filled, irregular.
0° clay filled, irregular.
30° " "
20° irregular, clay filled.
Weathered (30°, 60°)
90° irregular, weathered.

DRILL NO.
TYPE
DRILLER
COMMENCED
COMPLETED

LOGGED L. Hamilton

Sheet 4 of 5

VERTICAL SCALE 1 inch : 10 feet.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R25 R.L. 1461·4

LOCATION Weir Site ANGLE FROM HORIZONTAL 45° DIRECTION 13°45'

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	Fracture spacing	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS, SEAMS FAULTS CRUSHED ZONES	
Fresh agglomerate.	Medium grained aggl.	5"	400	Δ Δ	100	Core grinding	
	End of Hole.		410				

DRILL NO.

TYPE

DRILLER

COMMENCED

COMPLETED

LOGGED L. Hamilton

Sheet 5 of 5

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME

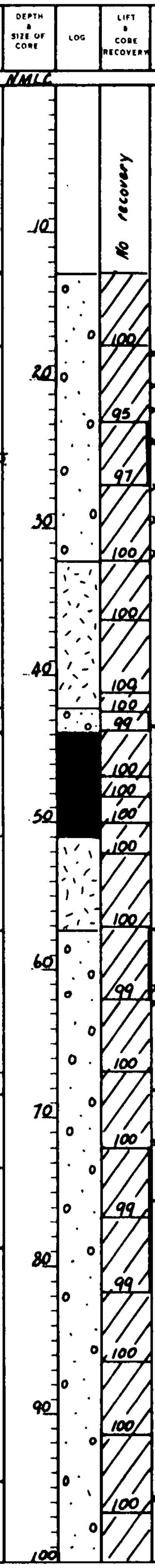
HOLE NO. R26

R.L. 1013·0 approx.

LOCATION Tailrace Tunnel to test "shear zone"

ANGLE FROM HORIZONTAL 23° 30′

DIRECTION 146° M



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	STRUCTURES. JOINTS, VEINS, SEAMS FAULTS. CRUSHED ZONES
Slightly weath. conglomerate	Core pieces 6" to 1′	
S.W. conglomerate	Core pieces 6" to <3" Components of conglomerate consisting of various igneous rock types (andesites) set in a greywacke groundmass. Frequent joints, generally irregular, dip 20° - 30° from vertical.	2" wide frag. zone 2" wide frag. zone. Very broken zone. 2" wide frag. zone Very broken zone Very broken zone Very broken zone
Moderately fresh to fresh greywacke	Core pieces 1′ to 2′ Crisscrossed by calcite veins.	
Fine conglom.	Core pieces 3" to 6"	½" clay filled fracture.
Clay.	Brown clay	
S.W. Greywacke.	Core pieces 3" to 6"	Joints irregular often steeply dipping 30° from vertical. Sub-vertical fracture.
Moderately fresh conglomerate.	Core pieces 3" to 6" Coarser components of conglomerate surrounded by pellicle of calcite. Joints in conglomerate often coated with calcite	Very broken zone, clay coated. Frag. zone.
	core pieces <3"	Numerous fractures weathered surfaces.
	Core pieces 1′ to 2′	1" wide frag. zone.
	Core pieces 3" to 6" Conglomerate coarse and unsorted.	Irregular fracture.
	Core pieces 1′ to 2′ Coarse conglomerate.	
	Core pieces 6" to 1′ Coarse conglomerate.	Fragmented zone 1" wide.

DRILL NO

TYPE Mindrill E1000

DRILLER

COMMENCED

COMPLETED

■ Clay

▨ Greywacke

⁘ Conglomerate.

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R26 R.L. 1013·0 approx

LOCATION Tailrace Tunnel, to test "shear zone". ANGLE FROM HORIZONTAL 23° 30' DIRECTION 146° M.

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
		NMLC			
Fresh to mod. fresh conglomerate	Core pieces 1' to 2' Coarse conglomerate.				Joints sub-horizontal.
	Core pieces < 3" friable			100	Irregular fract. clay coated.
	Core pieces 6" to 1'	110		100	Fragmented zone.
	Core pieces 1' to 2'	120		100 100	Few joints lined with calcite material. 45° fracture. Compound fracture coated with calcite.
	Core pieces 6" to 1'	130		100	1" wide frag. zone, weathered. 2" " " " "
	Core pieces 1' to 2'			100	
	Core pieces 2' to 4'	140			Fractures and joints generally fresh.
Fresh congl.	Average size of components 1/4"			100	
Fresh greywacke	Core pieces 2' to 4'	150		100	
Fresh to mod. fresh fine grained conglomerate.	Core pieces 6" to 1' Conglom. heterogeneous.- and unsorted. greywacke groundmass.	160		100	2" wide frag. zone, weathered.
S.W. to W.		170		100	Joints lined with calcite. (High water loss according to driller). 60° fracture weathered.
Fresh to mod. fresh conglomerate.	Core pieces 1' to 2' Conglomerate heterogeneous components of volcanic & metamorphic rocks.	180		100	Sub-horiz. joints & irregular fractures - generally fresh.
	Core pieces 3" to 6"				
S.W. to W.		190		100	Sub.-horiz. joint weathered surface. 70° joint weathered surface.
Moderately fresh conglomerate.	Core pieces 6" to 1'	200			

DRILL NO.

TYPE Mindrill E1000

DRILLER

COMMENCED

COMPLETED

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet

1

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME
HOLE NO. R26
R.L. 1013·0 approx
LOCATION Tailrace Tunnel, to test "shear zone"
ANGLE FROM HORIZONTAL 23° 30′
DIRECTION 146° M

ROCK TYPE & DEGREE OF WEATHERING

Mod. fresh to fresh conglomerate
W. Congl
Fresh to mod fresh conglomerate
Mod. fresh greywacke
Mod fresh conglomerate.
F. to Mod. fresh conglomerate.
F. to Mod. fresh greywacke.
F. to Mod. fresh conglomerate
F. to Mod. fresh greywacke.
Fresh to mod. fresh conglomerate
Mod. fresh conglomerate.

DESCRIPTION

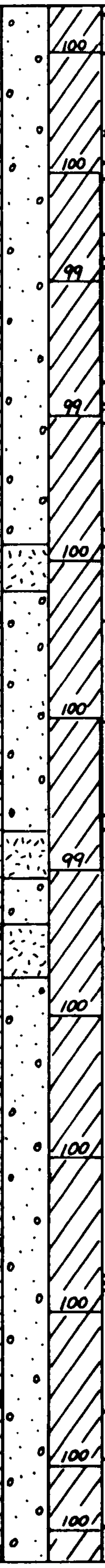
Core pieces 6" to 1'
Core pieces 3" to 6"
Core pieces 6" to 1' Conglomerate, unsorted and heterogeneous - volcanic and metamorphic components.
Core pieces 3" to 6" Conglomerate unsorted.
Cores pieces 1' to 2' Conglomerate unsorted. and heterogeneous.
Core pieces 2' to 3' Conglomerate unsorted and coarse.
Core pieces 6" to 2'
Core pieces < 3"

DEPTH & SIZE OF CORE

NMLC
210
220
230
240
250
260
270
280
290
300

LOG

LIFT & CORE RECOVERY



STRUCTURES JOINTS VEINS, SEAMS, FAULTS, CRUSHED ZONES

Small fract. zone.
30° joint lined with calcite faint striations.
Sub-horiz. joints coated with calcite.
Compound irreg. fractures
Compound joints, calcite coated.
Sub-horiz. fracture, weathered surface.
Small frag. + weathered zones.
Joints 70° - 80° from vertical, fresh.
2" wide jointed and weathered zone.
45° joint coated with sec. mineral.
2" wide frag. + weathered zone.
2" wide frag. zone.
2" wide frag. + weathered zone.
45° weathered joint
Compound fracture fresh.
large sub-vert. fracture coated with calcite.
Small fracture zone.
Irreg. fract. coated with calcite.
Sub-horiz. joint coated with calcite.
Few fractures fresh.
45° joints with slightly weathered surface.
Irregular fracture.
Compound fract. slightly coated with clay.
Irreg. fract thinly coated with waxy substance.

DRILL NO
TYPE Mindrill E1000
DRILLER
COMMENCED
COMPLETED

LOGGED G Brouxhon

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT: ROUNA HYDRO-ELECTRIC SCHEME
HOLE NO. R26
R.L. 1013·0' approx
LOCATION: Tailrace Tunnel, to test "shear zone"
ANGLE FROM HORIZONTAL: 23° 30'
DIRECTION: 146° M.

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES. JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
		NMLC			
Moderately fresh conglomerate	Core pieces 1' to 2'				6" wide frag. zone friable
	Core pieces 6" to 1' Unsorted congl. criss-crossed with small & irregular veins of calcite.			98	Sub-horiz. fracture - clay. 3" wide frag. zone. 45° fract. coated calcite mineral.
		310			
				100	Compound fract. clay coated. fragmented zone 2" wide.
Slightly weath. to weathered conglomerate.				97	5" wide frag. zone clay coated friable.
	Core pieces 6" to < 3"				Otherwise fractures generally coated with calcite.
	Core pieces 3" to 6"	320			
Moderately fresh conglomerate.	Core pieces 6" to < 3"			99	Large vertical fract - clay coated.
	Core pieces 6" to 2'				Sub-horiz. fracture clay coated. 60° joint - clay coated. Large S. vertical fracture, clay coated.
Weathered Conglomerate.	Core pieces, extremely broken - much clay material.	330 BMLC		100	
Slightly weathered conglomerate.	Matrix of conglo. often green with epidotic mineral.			99	Fractures numerous throughout clay coated.
		340			4" wide frag. zone. 1' wide frag. zone. 11" wide frag. zone.
				73	
	Core pieces < 3" and frag.				Numerous fractures coated with green epidotic material.
	core pieces 3" to 1'			100	
	Core pieces < 3"	350			
Mod. fresh conglomerate.	core pieces 6" to <3"			98	
As above	Core pieces 6" to 1' Groundmass of conglo. epidotic.			80	9" very broken zone.
Slightly weathered conglomerate.	Core pieces < 3" & fragmented. friable.	360		95	Very fractured throughout
	Fractures of corepieces show faint striations Fractures generally coated with black waxy substance.			95	
	Groundmass of conglo. is epidotic.	370		95	
	Core pieces 3" to 6"				45° joint coated sec. minerals
	Core pieces <3" Criss-crossed with secondary calcite veins.			99	Very broken zone. Sub-vertical & irreg. fracture, clay coated.
Mod. fresh congl.	Core pieces 3" to 6"				Irreg. compound fracture.
Weathered conglomerate.	Core pieces < 3" and fragmented.	380		100	
Mod. fresh congl.					Very broken and fragmented zone with clay material.
Weath. congl.	Core pieces < 3" and fragmented clay dust present			99	
Mod. fresh conglomerate	Core pieces 3" to 1'			99	45° joint clay coated Compound fracture. Irreg. fractures clay coated.
Weath. congl.	Core pieces < 3" with much clay material present	390		97	
Mod. fresh congl.	core pieces 6" to 1'				
Slightly weath. conglomerate	Core pieces < 3"				4" wide frag. zone
	" " 3" to 6"				
	" " < 3"			99	
				100	
	core pieces <3" & fragmented.				
Mod. fresh congl.	core pieces 6" to 1'	400			Compound fracture coated calcite

End of Hole 401' 2"

DRILL NO.
TYPE Mindrill E1000
DRILLER
COMMENCED
COMPLETED

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

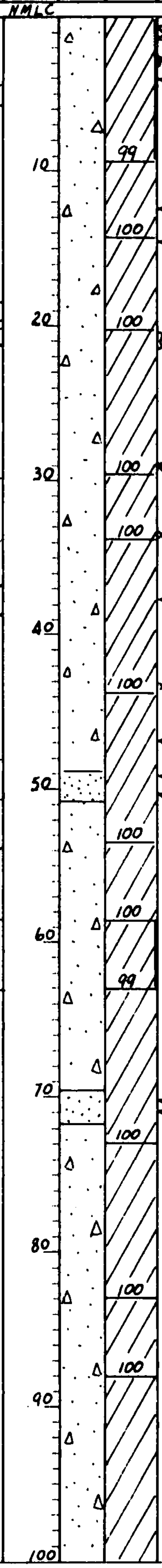
GEOLOGICAL LOG OF DRILL HOLE

PROJECT Rouna Hydro-Electric Scheme HOLE NO R27 R.L. 1497·33'

LOCATION Access shaft of u/g power station. ANGLE FROM HORIZONTAL 90 DIRECTION

ROCK TYPE & DEGREE OF WEATHERING | DESCRIPTION | DEPTH & SIZE OF CORE | LOG | LIFT & CORE RECOVERY | STRUCTURES JOINTS VEINS, SEAMS FAULTS CRUSHED ZONES

NMLC



ROCK TYPE & DEGREE OF WEATHERING

- Moderately fresh agglomerate
- S.W. to W. tuff
- Mod. fresh agglomerate
- Mod. fresh to fresh aggl.
- S. weath. tuff
- Mod: fresh aggl.
- M. fresh to S.W.
- Fresh to slightly weath. agglom.

DESCRIPTION

- Core pieces 3" to 6" Agglomerate fairly well sorted.
- Core pieces <3"
- Core pieces 6" to 1'
- Core pieces <3"
- Core pieces <3"
- Core pieces 6" to 2' Aggl. containing coarse components of augite-andesites up to 2' 3" across.
- Core pieces 3" to 6"
- Core pieces 6" to 1'
- Aggl. predominantly tuffaceous.
- Core pieces 8" to 1'
- Core pieces <3"
- Core pieces 6" to 1' Aggl. unsorted.
- Core pieces 6" to 1'
- Core pieces 1' to 2' First 2' from beginning of run aggl. is fine grained.
- Core pieces 7" to 2' throughout. Aggl. generally unsorted- consisting of vesicular & augite andesites.

STRUCTURES

- Very broken zone, fragmentary in places.
- Frag. core
- Compound fracture.
- Small frag. zone.
- Numerous joints and fractures
- Very broken zone.
- 3" wide frag. zone
- Sub-horizontal compound fracture, weathered surfaces.
- Very broken zone.
- Irreg. fract. weathered.
- Sub-horizontal fracture, weathered.
- ½" wide clay band coated limonitic material.
- Otherwise fractures generally clean and sub-horizontal.
- Horiz. fracture, Weathered surface.
- Large irreg. fracture clay coated.
- Fractures fresh throughout.

DRILL NO

TYPE Mindrill E1000

DRILLER Papuan Buddy

COMMENCED

COMPLETED

According to the drillers, the water table stood at 85' below natural surface before the casing.

■ Clay

▨ Tuff

Δ Agglomerate.

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet

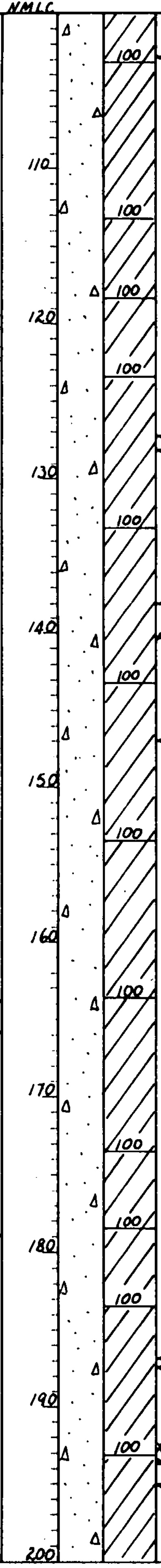
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R27 R.L. 1497·33'

LOCATION Access shaft of u/g power house ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
Fresh to moderately fresh agglomerate	Core pieces 1' to 2' throughout. Agglomerate essentially unsorted - coarse components consist of vesicular + augite andesite. Vuggy core pieces.	NMLC			Few fractures, generally sub-horizontal and clean.	Sometimes coated with blue secondary minerals.
	Core pieces 1' to 4' throughout.					
	Aggl. predominantly Tuffaceous.					
	Unsorted agglomerate.					
	Core pieces 6" to 1' Weathered core pieces.					



Vuggy fract.

20° joint thinly coated.

Irreg. compound fracture.

Large irreg. fract.

8' long sub-vertical + irreg fract. thinly clay coated.

Fractures clean throughout or slightly coated with secondary minerals.

Irreg. joint

Compound fracture

4" wide very broken zone.

2" " " " "

20° joint coated with blue sec. minerals.

DRILL NO.

TYPE Mindrill E1000

DRILLER Papuan Buddy

COMMENCED

COMPLETED

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT *ROUNA HYDRO-ELECTRIC SCHEME* HOLE NO *R27* R.L. *1497·33'*

LOCATION *Access shaft of U/g power station.* ANGLE FROM HORIZONTAL *90°* DIRECTION

ROCK TYPE & DEGREE OF WEATHERING

Moderately fresh agglomerate

Mod. fresh to slightly weathered agglomerate.

Coarse tuff

Moderately fresh agglomerate

Agglomerate mod. fresh to S.W. in patches

DESCRIPTION

Core pieces 6" to 1'
Vuggy core pieces 5"

Core pieces 6" to 2'
Agglomerate components coarse.

Core pieces < 3" to 6"

Aggl. dominantly tuffaceous

Core pieces 6" to 1'

Vuggy core pieces
Core pieces 6' to 1'

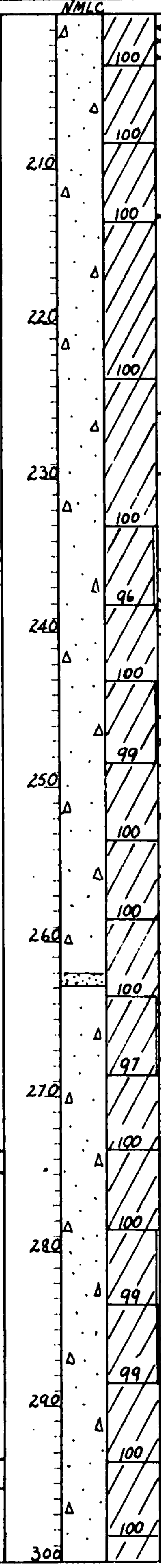
Core pieces 3" to 6"

Core pieces 6" to 1'

Core pieces < 3" to 6"

Broken core 3" to 6"
Vuggy cores.

DEPTH & SIZE OF CORE — LOG — LIFT & CORE RECOVERY



STRUCTURES
JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

Irreg. fractures
Small frag. zone
2" wide frag. zone.

2" frag. zone.

Otherwise fractures generally irregular and coated thinly with secondary minerals.

Irreg. fracture coated thinly with sec. minerals.

Irreg. fracture

Numerous fractures with weathered surfaces.
Irreg. fracture weathered surface.
Large irreg. fract. S.W.
Irreg. fract. S.W. coated with sec. minerals
Irreg. fractures W. surfaces

Irreg. fract.
6" wide - very broken zone.
Irreg. fract. S.W. surface.
8" long - sub-vert. fracture clay coated.
5" wide very broken zone.

Compound fract. W. surface.

85° joint W. Surface
Irreg. fract. "
45° joint S.W. surface coated limonitic material.
42° fract. W. surface
Irreg. fract. S.W. surface.
Sub. vert. & irreg. fracture.

Irreg. fract. coated sec. minerals & a slightly weathered surface.

Compound fracture, friable surface.

Compound fracture slightly weathered.

Large irreg. fracture S.W. surface.
45° joint.

Numerous irreg. fractures thinly coated with clay
Large sub-vert. fracture, vuggy surface & thinly coated with clay.
Vert. fracture clay coated.

DRILL NO
TYPE *Mindrill E1000*

DRILLER *Papuan Buddy*
COMMENCED
COMPLETED

LOGGED *G. Brouxhon*

VERTICAL SCALE *1 inch : 10 feet*

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO R27 R.L. 1497·33'

LOCATION Access shaft of U/g Power station ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES
		NMLC			
Moderately fresh to S.W. agglomerate	Core pieces 3" to 6"				Compound fracture, vuggy and clay coated (thin).
	Core pieces 6" to 2'	310		100	
	Core pieces 6" to 1' " " pitted.			100	Irreg. fracture coated with sec. minerals.
	Core pieces 6" to 1 Cores stained with yellow secondary minerals.	320		100	Irreg. fracture. Compound fracture, clay coated in parts.
	Core pieces 3" to 6"			100	Very broken cores, fractures coated with yellow sec. minerals. 2" wide fragmented zone.
Mod. fresh to fresh agglomerate	Core pieces 4" to 1'	330		99 100	Compound fracture, weathered surfaces coated with sec. minerals.
S.W. to Weath. agglomerate	Core pieces <3"				Numerous fractures clay coated and weathered.
S.W. aggl.	Core pieces 3" to 6" cores slightly pitted.			100	45° fracture weathered surface. Compound fracture coated with sec. minerals.
Mod. fresh agglomerate		340		100 99	7" wide fragmented zone surfaces coated with sec. minerals.
Fresh agglomerate	Core pieces 6" to 2' throughout.	350 360		100 100	45° joint. 6" long sub-vert fracture, thinly clay coated. Sub-vertical fracture - thinly clay coated.
S.W. aggl.				100	Compound fracture weathered surfaces.
Fresh agglomerate.		370 380		99	
S.W. aggl.	Core pieces <3" To 6"				Numerous fractures - clay coated.
	Core pieces 3" to 1' core pieces pitted and vuggy.				4" long irreg. fracture, weathered surface.
F. to M.F. aggl.					vert. fracture W. surface coated with clay.
M.F to S.W. aggl.					1' long irreg. fracture coated with chloritic material showing fine striations.
Mod. fresh aggl.		390		99	
Mod. fresh to slightly weath. agglomerate	Core pieces <3"				Numerous fractures, weathered surfaces. (limonitic material).
	Core pieces 6" to 1'	400		98	5" zone of very broken cores weathered. Irreg. fracture thinly clay coated. 4" wide fragmented & weathered zone. 3" " " "

DRILL NO

TYPE Mindrill E1000

DRILLER Papuan Buddy

COMMENCED

COMPLETED

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

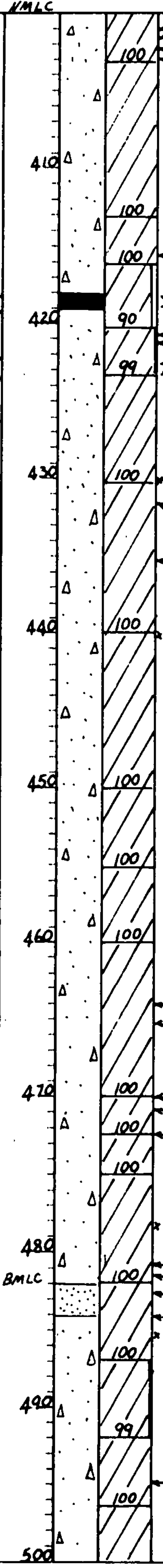
GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO R27 R.L. 1497·33'

LOCATION Access shaft of u/g power station ANGLE FROM HORIZONTAL 90° DIRECTION

NMLC

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION
Moderately fresh agglomerate	Core pieces 6" to 1'
	Massive clay band.
Slightly weath. to weathered agglomerate	Core pieces 3" to 6"
	Core pieces < 3"
	Core pieces 3" to 6"
Moderately fresh agglomerate.	Core pieces 6" to 1' core pitted.
	Core pieces 6" to 2'
Fresh agglomerate	Core pieces 1' to 2', aggl. unsorted.
Moderately fresh agglomerate	Core pieces 8"
	Core pieces 3" to 6"
Fresh agglomerate	Core pieces 6" to 1' aggl. unsorted.
Mod. fresh Tuff	fine grained tuff core 3" to 6"
Moderately fresh agglomerate.	Core pieces < 3" to 6" fine agglomerate.
	Core pieces < 3"



STRUCTURES
JOINTS VEINS SEAMS FAULTS CRUSHED ZONES

Irreg. fracture coated blue sec. minerals.
Compound fracture coated with limonite.
Irreg. fract thinly coated with clay.

Fractures & joints occurring 1' interval coated with limonitic material.

Compound fract. clay coated & containing limonitic material.
With limonitic material.
3" wide frag. zone & weathered.
Much limonitic material.

Fractures with weathered surfaces & coated with limonitic material.

6" wide broken zone, fract. coated with blue sec. minerals.
Large joint 50° coated with sec. minerals.
Irreg. fracture
2" wide frag zone

Few fractures - clean.

Fractures fresh due to drilling.

Sub-vert. fract. 20°
Large joint 45°

Sub-horiz. fract. weath. surface.
Irreg. fracture.
Compound joints coated with sec. minerals.

1" wide very broken zone.
Compound fracture coated sec. minerals.
Irreg. fract. " " "
Sub-vert. fract. thinly clay coated.
Vuggy irreg. fracture
4" wide very broken zone.

Numerous fractures throughout representing incipient joints & fractures opened up during drilling.

Compound fracture.

DRILL NO
TYPE Mindrill E1000
DRILLER
COMMENCED Papuan Buddy
COMPLETED

From 482' down apparent poorer rock conditions due to drilling with BMLC bits. Excess vibrations opened up tight incipient joints.

LOGGED G. Brauxhan

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME

HOLE NO R27

R.L. 1497·33'

LOCATION Access shaft of u/g power station.

ANGLE FROM HORIZONTAL 90°

DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES
		BMLC			
Mod. fresh to slightly weath. agglomerate	Core pieces <3" to 6" fine grained agglomerate.			100	6" wide frag. zone
					Irreg. fracture, weath. surface
				100	
Moderately fresh agglomerate	Core pieces 3" to 6"	510			Fractures numerous throughout, coated with sec. minerals
				100	
	Core pieces <3"				
	Core pieces 6"				
	Core pieces <3"			98	
	Core pieces 6"				
		520		100	Compound joints 45°
	Core pieces <3" to 5" fine grained agglomerate.				Frag. zone
					2" wide very broken zone.
	Core pieces 3" to 8"				1" frag. zone.
		530		98	2" frag. zone.
					10" frag. zone - some fragment show fine striations.
					2" wide frag. zone - frags coated with sec. minerals
					2" wide frag. zone
					5" " " "
		540		99	Otherwise fractures coated with secondary minerals.
					Sub-vert. fract thinly coated with clay.
	Core pieces 6" to <3"				
	Core pieces 6"				Very broken zon..
		550		100	
	Core pieces 6" to 1' fine grained agglom.				Fractures generally fresh or coated with secondary minerals.
					Sub-horiz. fracture.
					Compound vert. fractures - thinly clay coated.
Mod. fresh to slightly weath. agglomerate.	Core pieces 4" Pyrite abundant in core cores friable.				Irreg. fract. SW. surface.
					4" wide frag. zone.
					Sub-horiz. fractures
		560		99	3" wide frag. zone.
Moderately fresh agglomerate.	Core pieces 6" with pyrite Core friable				2" wide frag. zone
					1" wide very broken core
				100	
					Very frag. zone
					Fractures sub-horizontal.
		570			Fract. clay coated (thin)
				100	2" wide frag zone with clay material.
	End of Hole				
		580			
		590			
		600			

DRILL NO

TYPE Mindrill E1000

DRILLER Papuan Buddy

COMMENCED

COMPLETED

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R28 R.L. 1386′

LOCATION Tailrace Tunnel ("Rouna shear") ANGLE FROM HORIZONTAL 90° DIRECTION

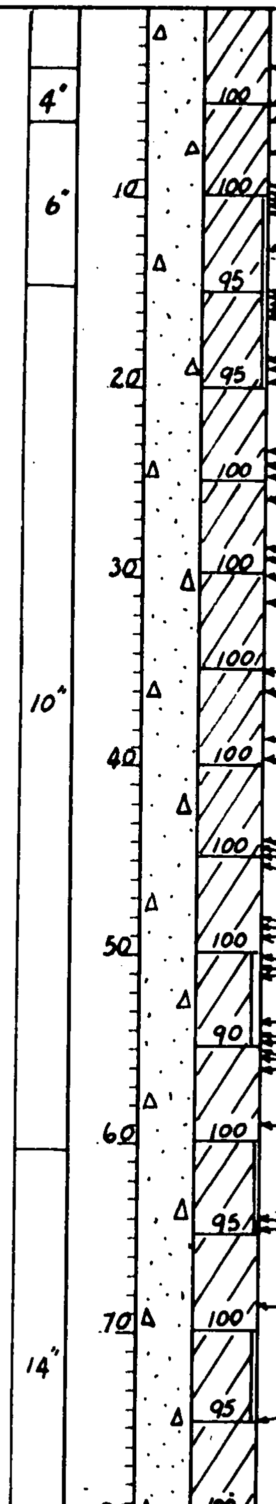
ROCK TYPE & DEGREE OF WEATHERING | DESCRIPTION | Fracture spacing | DEPTH & SIZE OF CORE | LOG | LIFT & CORE RECOVERY | STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES

Rock type & degree of weathering: Fresh agglomerate

Description: Medium grained agglomerate.

Andesite boulder.

Basalt boulder.



Structures:

Core grinding.

Irregular joint.

Irregular weathered joints at 20°

6 irregular weathered joints 20° - 80°

Irregular weathered joints at 80°

Irregular weathered joint at 80°
" " " " 20°
6" completely weathered.
Two irregular weathered joints 20°

Irregular weathered joints.
Regular " joint 30°
Core grinding

Regular joint weathered 0°
Irregular " " 30°

Regular joint 40°
6" broken by drilling.

Core grinding
Two weathered irregular joints.
Regular " joint 90°

Regular weathered joints 80°
Irregular " " 70°

Core grinding.
Two irregular weathered joints.
Three regular " " 5°

Weathered irregular joints 70°

Two irregular weathered joints 30°

Irregular weathered joint 5°

Irregular very weathered joint 5°

DRILL NO.

TYPE

DRILLER

COMMENCED

COMPLETED

⛆	Tuff
Δ	Agglomerate
○	Conglomerate

LOGGED L. Hamilton

Sheet 1 of 5

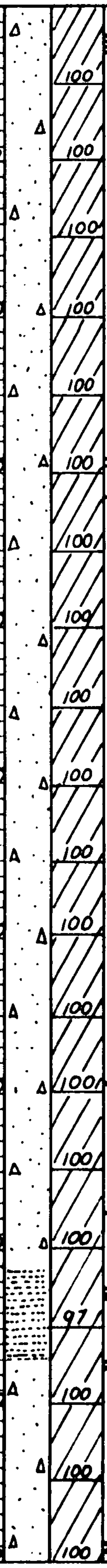
VERTICAL SCALE 1 inch : 10 feet.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R28 R.L. 1386'

LOCATION Tailrace Tunnel ("Rouna shear") ANGLE FROM HORIZONTAL 90° DIRECTION



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	Fracture spacing	DEPTH & SIZE OF CORE	LIFT & CORE RECOVERY	STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
Fresh agglomerate	Medium grained, agglomerate	12"		100	Irregular fractures (45°, 30°, 20°, 30°)
			110	100	
				100	
			120	100	
		18"		100	
			130	100	Irregular fractures
					Irregular fracture at 40°
				100	
			140	100	
				100	
			150	100	
		12"		100	
			160	100	
				100	
			170	100	30° irregular clay filled fracture
				100	45° irregular clay filled fracture.
		8"	180	100	
	Medium grained. tuff.			97	Clay filled regular fractures at (50°, 70° + 90°)
	Broken zone due to 0° fracture.	3"			Irregular fractures 0° shear zone.
	Medium grained agglomerate.	8"	190	100	
				100	
			200	100	Irregular (30°, 50°)

DRILL NO.

TYPE

DRILLER

COMMENCED

COMPLETED

LOGGED L. Hamilton

Sheet 2 of 5

VERTICAL SCALE 1 inch : 10 feet

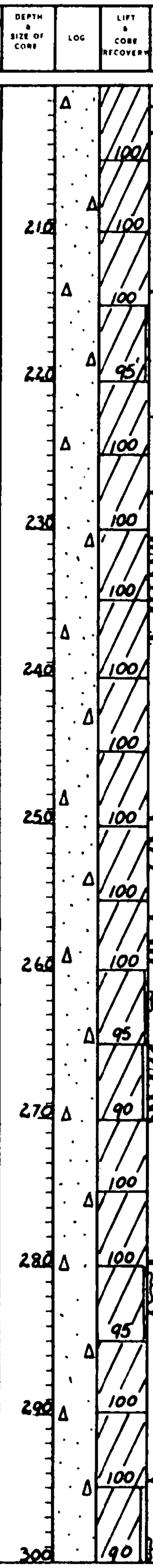
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R28 R.L. 1386'

LOCATION Tailrace Tunnel ("Rouna shear") ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	Fracture spacing	STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	
Fresh agglomerate	Medium grained agglomerate.	12"	Irregular. 30° regular.	
Slightly weathered agglomerate		7"	0° very irregular, limonitic coating, water loss during drilling. Irregular Irregular, clay filled.	
		5"	Irregular, clay filled (0°, 30°, 80°, 0°) Water loss. 45° regular. 5° irregular, clay filled.	
		7"	Regular, clay filled (20°, 40°)	
Agglomerate fresh except at joints.		12"	Irregular.	
		6"	20° regular, clay filled, ⅛" thickness of slickensiding. water loss. 20° irregular. Irregular, clay filled. 5° irregular, clay filled fracture; water loss. 0° " " " 40° regular. Irregular fractures. Water loss.	
		4"	Irregular, clay filled at (10°, 0°, 5°, 0°, 70°, 10°)	
		12"	Irregular, clay filled.	
		2"	Low angle irregular clay filled fracture Water loss.	
		8"	30° irregular, clay filled. 20° irregular, clay filled.	
		2"	0° + 5° irregular clay filled fractures.	



DRILL NO.
TYPE
DRILLER
COMMENCED
COMPLETED

LOGGED L. Hamilton

Sheet 3 of 5

VERTICAL SCALE 1 inch : 10 feet.

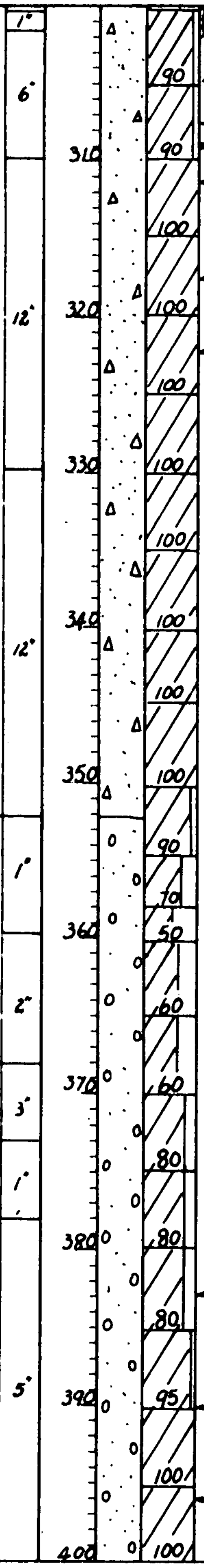
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R28 R.L. 1386'

LOCATION Tailrace Tunnel ("Rouna shear") ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	Fracture spacing	STRUCTURES. JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
Slightly weathered agglomerate	Medium grained agglomerate	1" 6"	0° irregular clay filled fractures, badly broken water loss. Broken zone 1" pieces, not clay filled. 0° 5° irregular, clay filled, water loss.
Fresh agglomerate		12" 12"	broken during drilling, plugged. 20° irregular clay filled. Broken, partly due to drilling. Calcite veinlets common.
Apparently fresh conglomerate	Conglomerate SHEAR ZONE. oblique to hole possibly 50°-60°	1" 2"	4" solid core then gravel and sand. Some grinding due to drilling. Pebbles generally rounded and slickensided. Slickensides strongly developed. As above but more solid core and less slickensiding.
Moderately fresh conglomerate.		3" 1" 5"	Slickensides and calcite veinlets generally common. 6" broken zone, fragments ¼" diameter Broken zone. 0° calcite filled joint.



DRILL NO.
TYPE
DRILLER
COMMENCED
COMPLETED

LOGGED L. Hamilton

Sheet 4 of 5

VERTICAL SCALE 1 inch : 10 feet

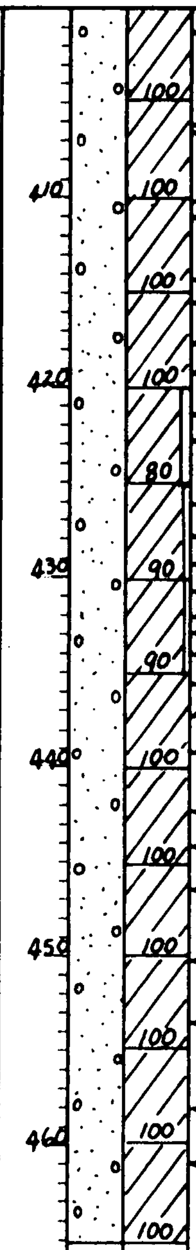
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R28 R.L. 1386'

LOCATION Tailrace Tunnel ("Rouna shear") ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	Fracture spacing	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES, JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
Fresh to moderately fresh conglomerate	Conglomerate. Rock appears to be stronger with depth.	6" 4" 7"				
	End of Hole					



6" broken zone, pieces ½" dia. Some slickensiding.
Irregular slickensided
40° flat polished slickensided.
60° " " "
30° flat polished + slickensided.
60° " " "
Irregular.
30° flat, strongly slickensided, pitch sub-horizontal.
Irregular fractures
Irregular 0°
Irregular.
Broken zone 6", ½" pieces. core grinding.
4° flat, polished.
1 ft broken zone, clay filled.
Irregular.
20°
Very strong slickenside development.
Irregular.
Irregular, clay filled.
30° irregular, calcite filled.
30° regular.
50° calcite filled.
Irregular fractures
Irregular, slickensided.
Regular slickensided.
Irregular, slickensided.
60° regular
30° regular, slickensided.

Note on conglomerate :-
the conglomerate appears to be much weaker than the agglomerate. Slickensides around the pebbles are very common. Secondary calcite also is very common and possibly chlorite. Larger diameter cores are necessary for an appreciation of the rock fracturing. The core should be much larger diameter than the average pebble size otherwise pebble-matrix contacts appear as joints unless curved. The conglomerate is polymictic and contains mostly lava fragments near the agglomerate with metamorphic fragments deeper down.

DRILL NO.
TYPE
DRILLER
COMMENCED
COMPLETED

LOGGED L. Hamilton
Sheet 5 of 5
VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R29 R.L. 1460 approx.

LOCATION Pressure shaft ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES
		NMLC		
	Overburden. Gravel and clayey soil no recovery.			
		10		
	core pieces 5"			Irregular fract. with friable surfaces.
				Joint 35° coated with green secondary minerals and clay.
	pitted core	20	97	
	Core pieces 1' Agglomerate unsorted			
		30	100	
	pitted core.			Irreg. fract.- friable surface. Sub-vertical fracture friable surface.
				Horiz. joint, friable surface.
		40	100	Compound fracture coated with blue secondary minerals.
				Vuggy fracture.
Fresh agglomerate.		50	100	
				Fractures fresh throughout, generally sub-horizontal.
		60	99	
				Compound fracture
		70	100	Compound fracture.
	Core pieces 6" - 1' Agglomerate unsorted.	80	100	
				Irreg. fractures slightly clay coated.
		90	100	
	Core pieces 6"			
				Clay coated fragments 2" wide frag. zone
	Very broken core	100	100	Numerous fractures coated with sec. minerals.

DRILL NO.

TYPE Mindrill E1000

DRILLER Papuan Buddy

COMMENCED

COMPLETED

░	Tuff
Δ	Agglomerate

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO R29 R.L. 1460 approx.

LOCATION Pressure shaft. ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS, SEAMS FAULTS CRUSHED ZONES	
		NMLC				
Fresh agglomerate	Core pieces 1'–1'6"				Sub-horiz. fract. S.W. surface	
					Irreg. fracture	
					Large irreg. fracture thin clay coated.	
		110		100		
					Comp. fract. clay coated.	
					Sub-vert. irreg. fracture clay coated.	
Mod. fresh aggl.	Friable cores.				Sub-vert. fracture.	
Mod. fresh tuff.	Core pieces 6"–1' Well graded tuff. containing clay filled vesicles in some cores.				45° irreg. "	
		120		100	45° joint clay filled.	
					Fragmented zone.	
	Broken cores 4" pieces					
					Fragmented zone.	
Moderately fresh agglomerate	Core pieces 1'–1'5"					
	Friable cores.	130		100	Sub-horiz. fracture	
					Numerous fractures filled with red material (Soil?)	
	Core pieces 6"–8" agglomerate unsorted				Sub-vert. fractures	
		140		100	Compound fracture	
					horiz. fracture	
					2" wide broken zone.	
Fresh agglomerate.					Sub-horiz. fracture	
					Irreg. fractures.	
		150		100	Sub-horiz. & irreg. fracture.	
					" " " thinly clay coated.	
Mod. fresh. to fresh agglomerate					" . fracture.	
					Irreg. fract.	
					45° irreg. fract. coated with sec. minerals.	
		160		100	Horiz. fracture, friable surface.	
					Sub-horiz. fractures, thinly clay coated	
Mod. fresh agglomerate.					Irreg. fracture.	
					Compound fract. coated with sec. minerals.	
	Core pieces 6"–1' agglomerate unsorted.				Very broken zone, fragments are clay coated & weathered.	
					3" wide V. broken zone, clay coated and weathered.	
		170		100	Large sub-vertical fract.	
					Sub-horiz. fracture	
Slightly weathered to weathered agglomerate					Joint 60°	
					Joint 50° thinly clay coated.	
					Sub-vert. joint " "	
					3" wide fragmented zone S.W. frags.	
		180		100	Sub. horiz. fract. clay coated.	
					Sub. " irreg. fracture.	
					4" wide V. broken & weathered frags.	
					45° irreg. fracture	
					Sub-horiz. joint clay coated.	
					Horiz. fract S.W. surface.	
Weathered aggl.	Core pieces 4"–2"				5" wide frag. zone.	
		190		100	Numerous fractures coated with clay material.	
Mod. fresh to slightly weathered agglomerate	Core pieces 3"–8"					
	Core pieces 3"–6" friable cores, appear porous.				Fractures clay coated.	
					Irreg. fractures S.W. surface.	
		200		100		

DRILL NO

TYPE Mindrill E1000

DRILLER Papuan Buddy

COMMENCED

COMPLETED

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Rouna Hydro-electric Scheme

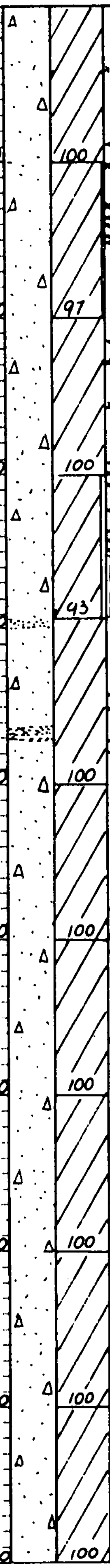
HOLE NO R29

R.L 1460 approx.

LOCATION Pressure shaft

ANGLE FROM HORIZONTAL 90°

DIRECTION



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES
		NMLC			
Mod. fresh to S.W. agglomerate.	Core pieces 6" - 1'				
	Very tuffaceous agglomerate				3" wide very broken zone, fragments friable.
	Core pieces 3"-6"				Numerous fractures with W. to S.W. surface.
Weathered to S.W. agglomerate.	Core pieces 3"				Sub-vert. fracture coated with limonitic material.
		210		100	Very frag. zone
	Core pieces 6" Agglomerate unsorted.				Very broken core weathered. S. horiz. fracture Irregular fracture.
					Fractures generally sub-horiz. surfaces friable and S. weathered.
		220		97	
Mod. fresh to S. weath. agglomerate.	Core pieces 3"-6"				Irregular fractures coated with sec. minerals. Very broken cores, weathered and clay coated.
		230		100	Comp. fract. clay coated. Horiz. fract. " " . Irreg. fract. weathered surface. Comp. fract. clay coated. Sub-vert. fract. " " . Irreg. fract. " " 3" wide V. broken cores coated with sec. minerals.
S.W. to weathered agglomerate.	Core pieces 3" Cores often pitted & vuggy			43	Fractures numerous throughout, weathered and clay coated.
Limonitic sand.	Finely granulated zone.	240			
	Core pieces 6"				
	" " <3"				
Mod. fresh aggl. S.W. to W. aggl. Mod. fresh "	Core pieces 6"				Weathered fractures.
" " Tuff.	Tuff band.				
Mod. fresh aggl.	Core pieces <3"				Irreg. fracture friable surfaces.
	Core pieces 6" agglomerate unsorted.	250		100	Fractures fresh or slightly coated with secondary minerals.
Fresh to mod. fresh agglomerate	Core pieces 8"	260		100	Horiz. fract. vuggy surface and coated with sec. minerals. 2" wide frag. zone, vuggy fragments. Comp. fract. coated blue sec. minerals. Compound fracture.
	Very broken section				
	Core pieces 6"	270		100	
	Core pieces 8" Agglomerate unsorted.				Sub-vertical fract. vuggy surface. Comp. fract.
Mod. fresh agglomerate.	Core pieces 3"-6"	280		100	Frag. zone due to large compound fracture Otherwise fractures are clean or slightly coated with secondary minerals.
	Core pieces 1'				Very broken cores Horiz. joints.
	Core pieces <3"				
	Granulated zone with clay				
	Very tuffaceous aggl.	290		100	
	Core pieces 8"				Very broken zone. 2" wide, very broken cores.
	Core pieces <3"	300		100	

DRILL NO

TYPE Mindrill E1000

DRILLER Papuan Buddy

COMMENCED

COMPLETED

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO R29 R.L. 1460 approx

LOCATION Pressure shaft ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
		NMLC				
Agglomerate fresh.	Core pieces 6" to >1' Aggl. finer grained Components are set in an unsorted tuffaceous matrix.	310		100	45° irreg. fracture Large sub-vert. fracture. compound fracture	
Mod. fresh tuff	Fine grained tuff.				45° comp. joints	
Mod. fresh to fresh agglomerate	Core pieces 5" - 8"				Irreg. fracture.	
	Core pieces 1' Agglomerate fairly well sorted - coarser components average 1" across.	320 330		100 96	45° irreg. fracture Otherwise fractures and joints are fresh throughout.	
	Core pieces 3" - 5"					
	Core pieces 1'	340		100		
Moderately fresh agglomerate	Very frag. zone & weathered					
	Core pieces 6" to 8" Aggl. unsorted.	350		95	Comp. fracture	
	Core pieces 1'				Comp. fracture Frag. zone 3" wide Sub-horiz. fracture coated sec. minerals. Fractures or joints are fresh or slightly coated with secondary minerals.	
S.W. aggl.	Core pitted very broken zone.	360		99		
Mod. fresh agglomerate	Core pieces 8"				3" wide very broken core 4" " fragmented zone	
	Core pieces 5" - 1' 6" long W. core pieces.	370		90	45° joint.	
	Core pieces <3"				4" wide frag. zone.	
S.W. to W. agglomerate	Very frag. zone & weathered				Much limonitic alteration.	
	Core pieces 4" to 6"	380		100	1' long vert. fract. coated with sec. minerals and limonite.	
Fresh agglomerate	Core piece 1'	390		87	Sub-horizontal fractures clean or slightly coated with sec. minerals.	
	Aggl. fresh and sound throughout.	400		98		

DRILL NO

TYPE Mindrill E1000

DRILLER Papuan Buddy

COMMENCED

COMPLETED

LOGGED G. Brouxhon

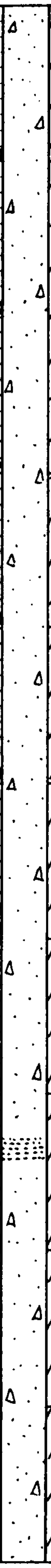
VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO R29 R.L. 1460 approx.

LOCATION Pressure shaft. ANGLE FROM HORIZONTAL 90° DIRECTION



ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	
		NMLC				
Fresh to mod. fresh agglomerate	Core pieces 6" to 1' Agglomerate unsorted.				2" wide very broken cores	Fractures & joints generally fresh or slightly coated with secondary minerals.
	Core pieces < 3"				8" long vert. fracture.	
	Core pieces 3" to 6"	410		100		
	Core pieces 1'				Fractures fresh or slightly coated with secondary minerals.	
	Core pieces 3"-6"					
	Core pieces 6" to 1'	420		100		
	Core pieces 3" to 5" core pitted.				Sub-vertical & compound fracture coated with clay. 3" wide very broken cores.	
	Core piece 8"					
	Core piece < 3"				Fragments are clay coated.	
	Core pieces 8"	430		97		
Moderately fresh agglomerate	Core pieces 6" to 8"					
	Core pieces 2" to 5" throughout Agglomerate more friable & less tough than usual. Undoubtedly a weak zone.	440		100	4" wide zone of very broken core. 4" wide frag. zone 6" wide frag. zone	Joints and fractures generally coated with blue sec. mineral.
	Core pieces 2"-5" fine grained agglomerate. Agglomerate weaker than usual – more friable.	450 460		100 100	4" wide frag. zone. 5" wide frag. zone. 9" wide frag. zone 4" wide frag. zone.	
	Frag. zone					
	Very broken core < 3"				Fragments coated with sec. minerals, vuggy in places.	
	Very frag. zone Vuggy fractures					
	Core pieces 1' Aggl. unsorted.	470		96		
Mod. fresh tuff.	Fine grained tuff.				4" wide frag. zone.	
Mod. fresh agglomerate.	Core pieces 3"-6"					
	Very broken to fragmented cores with clay material.					
	Core pieces 4" to 6"	480		100	Irreg. sub-vert. fracture.	
	Core pieces 1" to 3"				Sub-vert. fract. coated with green talcose material.	
	Core pieces 3" to 5"				Fractures coated with white secondary minerals.	
Mod. fresh agglomerate	Core pieces < 3" throughout with occasional core pieces 6" long.	490 500		100 100	Badly fractured & jointed throughout, but fract. & joints are clean or coated with white sec. minerals.	

DRILL NO

TYPE Mindrill E1000

DRILLER Papuan Buddy

COMMENCED

COMPLETED

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO R29 R L 1460 approx.

LOCATION Pressure shaft ANGLE FROM HORIZONTAL 90° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS SEAMS FAULTS CRUSHED ZONES	
		NMLC				
	Very broken cores < 3"	500				
Mod. fresh agglomerate	Core pieces 4" – 5"				Fractures & joints sub-horizontal & coated with secondary minerals.	
		510		100		
		520		100		
	End of Hole.					

DRILL NO

TYPE Mindrill E1000

DRILLER Papuan buddy

COMMENCED

COMPLETED

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT Rouna Hydro-Electric Scheme

HOLE NO. R 30

R.L. 1427 approx.

LOCATION Right Abutment of weir.

ANGLE FROM HORIZONTAL 30°

DIRECTION 330° M.

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES. JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES
Moderately fresh agglomerate	Core pieces 2" - 4" Agglomerate unsorted.	NMLC		100	Very broken cores Fractures slightly coated with limonitic material. Very broken cores.
	Core pieces 3" - 5"	10		100	Fractures irregular & sub-horizontal.
Fresh agglomerate	Core pieces 6" - 2'			100	
Mod. fresh to S.W.	Core pieces 2"	20		100	Fractures coated with limonite and clay material.
Fresh agglomerate	Core pieces 8" - 1'			100	Very broken cores coated blue secondary minerals.
	Core pieces 6" - 8" Aggl. unsorted.	30		100	Very broken cores Joints 50° 3" wide broken core.
	Core pieces 6" - 1' well sorted aggl. Good cores throughout.			100 100	Fractures sub-horizontal but irregular and clean.
Mod. fresh aggl.		40			S. W. compound fracture.
Fresh agglomerate		50		100 100	
	Core pieces 4" - 6"			100	Fractures clean and sub-horizontal throughout. 2" frag. zone.
	Core pieces 2" - 3"	60		100	Sometimes coated with secondary minerals. 1" wide frag. zone.
Mod. fresh aggl.	Core pieces 1" - 2"			100	
Fresh aggl.	Core pieces 3" - 7"				
S. W. aggl					
Mod. fresh aggl.	Core pieces 4" - 5"	70		100	
Fresh agglomerate				100	
	Core pieces 1" - 2"	80		100	2" wide frag. zone
	Core pieces 3" - 5"			100	3" wide frag. zone.
	Core pieces 1" - 3"	90		100	
	Core pieces 1/4"			100	
Mod. fresh to S.W. aggl.		100		100	Frag. zone, fragments weathered. 8" wide frag. zone.

DRILL RD

TYPE Mindrill E 500

DRILLER Atkinson

COMMENCED

COMPLETED

▨	Tuff
Δ	Agglomerate.

LOGGED G. Brauxhon

VERTICAL SCALE 1 inch : 10 feet.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R30 R.L. 1427 approx.

LOCATION Right Abutment of weir ANGLE FROM HORIZONTAL 30° DIRECTION 330° M.

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS VEINS, SEAMS FAULTS CRUSHED ZONES	
Mod. fresh agglomerate	Core pieces 2" - 3" Aggl. more friable than usual.	100			Fractures generally sub-horizontal. Clean or slightly coated with secondary minerals.	
	Very broken cores to frag.					
Fresh agglomerate	Core pieces 4" - 8"	110				
	End of Hole.					

DRILL NO.

TYPE Mindrill E500

DRILLER Atkinson.

COMMENCED

COMPLETED

LOGGED G. Brouxhon

VERTICAL SCALE 1 inch : 10 feet

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC PROJECT
HOLE NO. R 31
R.L. 1418·6
LOCATION Left Abutment of weir
ANGLE FROM HORIZONTAL 30°
DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	
		NMLC		No recovery		
Mod. fresh aggl	Core pieces 6"	10				
Weath. zone	" " 2"				Fractures coated with limonite.	
	Core pieces 3"-6"				Fractures generally irregular and moderately fresh.	
Moderately fresh agglomerate	Core pieces 6"-8"	20		100		
	Core pieces 6"				Broken zone 45° fracture clay coated. Otherwise fractures irregular and moderately fresh.	
	Core pieces 2"-3"					
	" " 3"-8" Vuggy core with thin clay coating.	30		100	Comp. fracture, clay coated. Irregular fracture, friable surface.	
	Core pieces 5"-1'	40		100	Hole plugged	
	Core pieces 3"-5" Agglomerate very tuffaceous in places.	50		98	Very broken zone Fractures slightly weathered - coated with limonite. Surface of fractures sometimes friable. 30° joint slightly weathered.	
	Core pieces 4"-1'2"	BMLC			4" wide fragmented zone.	
	Core pieces 1"-2"				Fract. generally fresh or slightly coated with secondary minerals.	
	" " >1'					
	" " 4"	60		100		
	Core pieces 6"-1'					
Moderately fresh agglomerate.	Core pieces variable but good, average 6" in length.	70 80 90		100 100 100	30° joint, slightly clay coated.	
S. W. Tuff.						
S. W. Tuff.					Very broken zone. Fractures vertical or oblique - lightly weathered.	
Mod. fresh agglomerate.	Predominantly tuffaceous agglomerate.	100		100		

DRILL NO.
TYPE Mindrill E1000
DRILLER
COMMENCED
COMPLETED

▨ Tuff
Δ Agglomerate

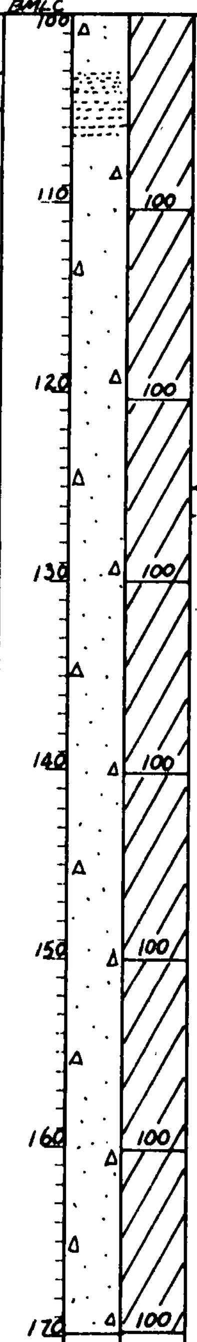
LOGGED G. Brauxhan
VERTICAL SCALE 1 inch : 10 feet.

BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS

GEOLOGICAL LOG OF DRILL HOLE

PROJECT ROUNA HYDRO-ELECTRIC SCHEME HOLE NO. R31 R.L. 1418·6

LOCATION Left Abutment of weir ANGLE FROM HORIZONTAL 30° DIRECTION

ROCK TYPE & DEGREE OF WEATHERING	DESCRIPTION	DEPTH & SIZE OF CORE	LOG	LIFT & CORE RECOVERY	STRUCTURES JOINTS, VEINS, SEAMS, FAULTS, CRUSHED ZONES	
Mod. fresh agglomerate		BMLC 100				
Mod. fresh to slightly weath tuff	Cores 2" - 3" average.					
Mod. fresh to fresh agglomerate	Good core throughout often exceeding 1 ft in length and in places up to 2 ft Fractures are usually sub. horizontal and weathered along the fractures to the same degree as that of the cores. Often fractures coated with secondary minerals probably of hydrothermal origin. In places the agglomerate is dominantly tuffaceous.	110 120 130 140		100 100 100 100	Fractures vertical & oblique, weathered to the same degree as the cores. Jointed & fractured. Very broken thinly clay coated.	
Fresh agglomerate.		150 160 170		100 100 100	Fractures sub-horizontal Sometimes thinly coated with white clay. This clay is probably drilling sludge derived from elsewhere.	
	End of Hole.					

DRILL NO.

TYPE Mindrill E1000

DRILLER

COMMENCED

COMPLETED

LOGGED G. Brauxhan

VERTICAL SCALE 1 inch : 10 feet

APPENDIX 2 - WATER PRESSURE TEST RESULTS AND COMPUTATIONS

The key to the symbols in the column headings of the Table is as follows:

* measured along the inclination of the hole.
‡ Use (1) when water table is below the test section.
Use (2) when water table is above the test section.

† factor e for head loss is read from standard graphs.

BUREAU OF MINERAL RESOURCES

PORT MORESBY NO. 2 UNDERGROUND HYDRO-ELECTRIC SCHEME

WATER PRESSURE TEST RESULTS

For explanatory notes, see page 1 of Appendix.

DATE	SECTION TESTED FROM (feet)	SECTION TESTED TO (feet)	TIME OF START OF TEST	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i)	WATER METER READINGS START (gall.)	WATER METER READINGS FINISH (gall.)	WATER LOSS (gall.)	LEAKAGE RATE (g.p.m.)	SEALING PROPERTIES	LENGTH OF SECTION (Feet)	DEPTH OF STANDING WATER (ft.)	SIZE OF ROD	WATER COLUMN PRESSURE (p.s.i.) w	FRICTION HEAD LOSS (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per ft.)
	a	b		t	p	k	l	l-k = m	$\frac{m}{t}$		b-a = c	d*		‡0·44 sin θ(a+h) 1. 0·44 sin θ(d+h) 2.	$\frac{(a+h)e^{\dagger}}{10}=f$	p+w-f = P	$\frac{m}{tc}$
Hole Nº :- R19					Feature :- Surge Tank						Height of Gauge above Hole (h)* :- 2 feet						
Inclination to Horizontal (θ) :- 90°					Packer type :- 'Triefus' NMLC + BMLC												
4·5·61	153	163	1347	5	60	11·0	15·5	4·5	0·9	Good	10	95	N	42·7	·46	102	0·09
"	153	163	1352	5	70	15·5	19·25	3·75	0·8	"					"	112	0·08
"	153	163	1357	5	80	19·25	23·0	3·75	0·8	"					"	122	0·08
"	130	163	1426	5	40	35·75	42·0	6·75	1·4	"	33	95	N	42·7	·53	82	0·04
"	130	163	1431	5	60	42·0	47·0	5·0	1·0	"					·39	102	0·03
"	130	163	1436	5	80	47·0	52·0	5·0	1·0	"					·39	122	0·03
"	100	163	1449	5	40	83·0	86·25	3·25	0·7	"	63	95	N	42·7	·30	82	0·01
"	100	163	1454	5	60	86·25	88·5	2·25	0·5	"					"	102	"
"	100	163	1459	5	80	88·5	90·5	2·0	0·4	"					"	122	"
9·5·61	160	184	09·20	5	20	90·0	99·8	9·8	2·0	"	24	95	N	42·7	·81	62	0·08
"	160	184	09·26	5	60	102·0	109·5	7·5	1·5	"					·65	102	0·06
"	160	184	09·33	5	80	111·0	118·4	7·4	1·5	"					·65	122	0·06
17·5·61	180	204	09·35	5	20	124·0	126·4	2·4	0·5	"	24	95	N	42·7	·55	62	0·02
"	180	204	09·44	5	60	130·0	132·7	2·7	0·5	"					"	102	0·02
"	180	204	09·51	5	80	137·0	139·8	2·8	0·6	"					"	122	0·03
19·5·61	200	220	10·00	5	20	147·0	152·3	5·3	1·1	"	20	95	N	42·7	·81	62	0·06
"	200	220	10·06	5	60	154·5	161·9	7·4	1·5	"					"	102	0·08
"	200	220	10·14	5	80	165·5	172·6	7·1	1·4	"					"	122	0·07
29·8·61	440	461	1420	5	20	1508·0	13·5	5·5		Good							
"	"	"	1425	"	"	13·5	17·5	4·0	0·8	"	21	112	A	50	Negligible	70	0·04
"	"	"	1430	"	"	17·5	21·5	4·0		"							
"	"	"	1435	"	"	21·5	24·75	3·75		"							
"	"	"	1440	"	40	25·0	29·0	4·0		"							
"	"	"	1445	"	"	29·0	32·75	3·75	0·7	"	"	"	"	"	"	90	0·04
"	"	"	1450	"	"	32·75	36·0	3·25		"							
"	"	"	1455	"	"	36·00	39·0	3·0		"							
"	"	"	1501	"	60	39·25	43·0	3·75		"							
"	"	"	1506	"	"	43·0	46·0	3·0	0·7	"	"	"	"	"	"	110	0·04
"	"	"	1511	"	"	46·0	49·5	3·5		"							
"	"	"	1516	"	"	49·5	53·0	3·5		"							
"	"	"	1521	"	80	53·5	57·5	4·0	0·8	"	"	"	"	"	"	130	0·04
"	"	"	1526	"	"	57·5	62·5										
"	"	"	1531	"	"												
"	"	"	1536	"	"	Gauge unserviceable											
23·9·61	460	530	1113	5	20	167·5	73·4	5·9		Good							
"	"	"	1118	"	"	73·4	78·5	5·1	1·0	"	70	114	A	51	·45	71	0·01
"	"	"	1123	"	"	78·5	83·5	5·0		"							
"	"	"	1128	"	"	83·5	88·2	4·7		"							
"	"	"	1133	"	40	88·2	94·1	5·9		"							
"	"	"	1138	"	"	94·1	202·4	8·3	1·5	"	"	"	"	"	1·4	90	0·02
"	"	"	1143	"	"	202·4	09·6	7·2		"							
"	"	"	1148	"	"	09·6	17·1	7·5		"							
"	"	"	1150	"	60	17·1	27·3	10·2		"							
"	"	"	1155	"	"	27·3	35·6	8·3	1·6	"	"	"	"	"	3·2	108	0·02
"	"	"	1200	"	"	35·6	43·7	8·1		"							
"	"	"	1205	"	"	43·7	52·0	8·3		"							
"	"	"	1210	"	80	52·0	61·5	9·5		"							
"	"	"	1215	"	"	61·5	71·4	9·9	1·8	"	"	"	"	"	1·4	130	0·03
"	"	"	1220	"	"	71·4	81·2	9·8		"							
"	"	"	1225	"	"	81·2	91·0	9·8		"							
"	"	"	1230	"	100	91·0	302·5	11·5	2·25	"	"	"	"	"	5·5	146	0·04
"	"	"	1235	"	"	302·5	13·6	11·1									

BUREAU OF MINERAL RESOURCES

PORT MORESBY NO. 2 UNDERGROUND HYDRO-ELECTRIC SCHEME

WATER PRESSURE TEST RESULTS

For explanatory notes, see page 1 of Appendix.

DATE	SECTION TESTED FROM (feet)	SECTION TESTED TO (feet)	TIME OF START OF TEST	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i)	WATER METER READINGS START (gall.)	WATER METER READINGS FINISH (gall.)	WATER LOSS (gall.)	LEAKAGE RATE (g.p.m.)	SEALING PROPERTIES	LENGTH OF SECTION (Feet)	DEPTH OF STANDING WATER (Ft.)	SIZE OF ROD	WATER COLUMN PRESSURE (p.s.i.) w	FRICTION HEAD LOSS (p.s.i.)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per Ft.)
	a	b		t	p	k	l	l − k = m	$\frac{m}{t}$		b − a = c	d*		‡ 0·44 sin θ(a+h) 1. 0·44 sin θ(d+h) 2.	$\frac{(a+h)e^{\dagger}}{10}=f$	p + w − f = P	$\frac{m}{tc}$
Hole Nº :- R20 **Inclination to Horizontal (θ) :- 45°**					**Feature :- Tunnel Line** **Packer type :- "Triefus" NMLC**						**Height of Gauge above Hole (h)* :- 2 feet**						
13·7·61	100	120	0822	5	20	290·0	305·5	15·5	3·1	Good	20	0	N	·62	·61	20	0·16
"	120	140	1408	5	20	318·5	323·75	5·25	1·05	"	20	0	N	·62	·49	20	0·05
"	120	140	1415	5	30	325·5	330·5	5·0	1·0	"			N		·49	30	0·05
14·7·61	140	160	1505	10	10	326·5	376·5	58·0	5·0	"	20	0	N	·62	1·4	9	0·25
"	140	160	1516	10	20	380·0	440·5	60·5	6·05	"			N		1·66	19	0·30
"	140	160	1527	10	30	446·0	514·0	68·0	6·8	"			N		2·2	28	0·34
17·7·61	160	180	0845	10	20	545·5	601·0	55·5	5·55	"	20	0	N	·62	1·6	19	0·28
"	160	180	0856	10	40	606·5	674·0	67·5	6·75	"			N	·62	2·3	38	0·34
"	160	180	0907	10	60	678·0	756·5	78·5	7·85	"			N		2·9	58	0·39
19·7·61	180	200	1150	10	20	792·0	810·0	18·0	1·8	"	20	0	N	·62	·73	20	0·09
"	180	200	1201	10	40	811·5	832·0	20·5	2·05	"			N		·73	40	0·10
"	180	200	1212	10	60	833·5	854·5	21·5	2·15	"			N		·90	60	0·11
20·7·61	200	220	1425	10	20	922·0	962·1	40·1	4·01	"	20	0	N	·62	·16	19	0·20
"	200	220	1437	10	40	968·0	1018·2	50·2	5·02	"			N		·20	39	0·25
"	200	220	1448	10	60	1020·0	1071·5	51·5	5·15	"			N		·20	59	0·26
"	220	240	1532	10	20	1067·5	1082·5	15·0	1·5	"	20	0	N	·62	·66	20	0·08
"	220	240	1542	10	40	1084·0	1100·0	16·0	1·6	"			N		·66	40	0·08
"	220	240	1553	10	60	1101·5	1117·0	15·5	1·55	"			N		·66	60	0·08
22·7·61	240	260	1533	10	20	1138·0	1176·5	38·5	3·9	"	20	0	N	·62	1·69	19	0·20
"	240	260	1544	10	50	1186·0	1231·0	45·0	4·5	"			N		2·18	48	0·23
"	240	260	1554	"	80	1234·0	1286·0	52·0	5·2	"			N		2·4	78	0·26
Hole Nº :- R21 **Inclination to Horizontal (θ) :- 90°**					**Feature :- Access Shaft to Power House** **Packer type :- 'Triefus' NMLC & BMLC**						**Height of Gauge above Hole (h)* :- 2 feet**						
2·11·61	200	377	1445	5	30	345·0	348·6	3·6	0·75		177	45	A	21·6	0	52	0
"	"	"		5	30	348·6	352·5	3·9									
"	"	"		5	60	354·0	362·0	8·0	1·6		177	45	A	21·6	1·41	84	0·01
"	"	"		5	60	362·0	370·2	8·2									
"	"	"		5	100	372·0	390·0	18·0	3·5		177	45	A	21·6	6·0	119	0·02
"	"	"		5	100	390·0	407·0	17·0									
13·11·61	375	403	0856	5	30	396·0	405·5	9·5	1·75		28	53	A	23·2	2·64	51	0·06
"	"	"	0901	5	30	405·5	413·25	7·75									
"	"	"	0906	5	60	413·25	435·5	22·25	3·0		28	53	A	23·2	8·6	75	0·11
"	"	"	0911	5	60	435·5	450·25	14·75									
"	"	"	0916	5	90	450·25	471·5	21·25	4·3		28	53	A	23·2	16·2	97	0·15
"	"	"	0921	5	90	471·5	493·0	21·50									
15·11·61	402·5	423	0930	5	30	545·0	550·0	5·0	0·8		20·5	55	A	25·0	0	55	0·04
"			0935	5	30	550·0	553·25	3·25									
"			0940	5	60	553·25	558·75	5·5	1·05		20·5	55	A	25·0	0	85	0·05
"			0945	5	60	558·75	563·75	5·0									
"			0950	5	90	563·75	570·0	6·25	1·25		20·5	55	A	25·0	0	115	0·06
"			0955	5	90	570·0	576·25	6·25									
16·11·61	420	440	0900	5	30	589·0	593·75	4·75	0·9		20	56·5	A	25·8	0	56	0·04
"	"	"	0905	5	30	593·75	598·0	4·25									
"	"	"	0910	5	60	598·0	603·5	5·5	1·05		20	56·5	A	25·8	0	86	0·05
"	"	"	0915	5	60	603·5	608·5	5·0									
"	"	"	0920	5	90	608·5	614·5	6·0	1·1		20	56·5	A	25·8	0	116	0·06
"	"	"	0225	5	90	614·5	619·25	4·75									
18·11·61	440	460·5	1111	5	30	660·0	664·75	4·75	0·95		20·5	57	A	26·0	0	56	0·05
"	"	"	1116	5	30	664·75	669·5	4·75									
"	"	"	1121	5	60	669·5	676·75	7·25	1·4		20·5	57	A	26·0	2·2	84	0·07
"	"	"	1126	5	60	676·75	683·5	6·75								continued	→

BUREAU OF MINERAL RESOURCES

PORT MORESBY NO. 2 UNDERGROUND HYDRO-ELECTRIC SCHEME

WATER PRESSURE TEST RESULTS

For explanatory notes, see page 1 of Appendix.

DATE	SECTION TESTED FROM (feet)	SECTION TESTED TO (feet)	TIME OF START OF TEST	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i)	WATER METER READINGS START (gall.)	WATER METER READINGS FINISH (gall.)	WATER LOSS (gall.)	LEAKAGE RATE (g.p.m.)	SEALING PROPERTIES	LENGTH OF SECTION (Feet)	DEPTH OF STANDING WATER (Ft.)	SIZE OF ROD	WATER COLUMN PRESSURE (p.s.i.) w	FRICTION HEAD LOSS (p.s.i)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per Ft.)
R21 continued	a	b		t	p	k	l	L-k = m	$\frac{m}{t}$		b - a = c	d*		$\ddagger\,0{\cdot}44\sin\theta(a+h)$ 1. $0{\cdot}44\sin\theta(d+h)$ 2.	$\frac{(a+h)e^{\dagger}}{10}=f$	p + w - f = P	$\frac{m}{tc}$
18·11·61	440	460·5	1131	5	90	683·5	691·5	8·0	1·6		20·5	57	A	26·0	3·0	113	0·08
"	"	"	1136	5	90	691·5	699·25	7·75									
1·12·61	460	480	1153	10	30	703·0	708·0	5·0	0·45		20	57·5	80'B 375'A	26·2	0·4	56	0·02
"	"	"	1203	10	30	708·0	712·2	4·2									
"	"	"	1214	10	60	712·7	718·2	5·5	0·5		20	57·5	80'B 375'A	26·2	0·49	86	0·02
"	"	"	1224	10	60	716·2	724·6	6·4									
"	"	"	1234	10	90	725·0	731·8	6·8	0·65		20	57·5	80'B 375'A	26·2	0·49	116	0·03
"	"	"	1244	10	90	731·8	737·9	6·1									
4·12·61	475	501	1632	10	30	753·0	761·0	8·0	0·75		26	57·5	80'B 395'A	26·2	0·49	56	0·03
"	"	"	1642	10	30	761·0	767·5	6·5									
"	"	"	1652	10	60	767·5	775·3	7·8	0·7		26	57·5	80'B 395'A	26·2	0·49	86	0·03
"	"	"	1702	10	60	775·3	781·0	5·7									
"	"	"	1712	10	90	781·0	786·8	5·8	0·6		26	57·5	80'B 395'A	26·2	0·45	116	0·02
"	"	"	1722	10	90	786·8	792·3	5·5									
Hole Nº :- R22 **Inclination to Horizontal (θ) :-63°**					**Feature :- Power House** **Packer type :-'Tricfus' NMLC**						**Height of Gauge above Hole (h)*:- 2 feet**						
12·2·62	450	518	1100	5	30	922·0	922·6	0·6	0·1	Good	68	90	80'B 370'A	36	0·41	66	0
"	"	"		5	30	922·6	923·3	0·7									
"	"	"		5	60	923·3	930·8	7·5	1·5	"	68	90	80'B 370'A	36	2·87	93	0·02
"	"	"		5	60	930·8	938·3	7·5									
12·2·62	510	530	0856	5	30	945·0	949·0	4·0	0·75	"	20	92	80'B 430'A	37	0·33	67	0·04
"	"	"		5	30	949·0	952·5	3·5									
"	"	"	0907	5	60	954·5	962·9	8·4	1·5	"	20	92	80'B 430'A	37	2·80	94	0·08
"	"	"		5	60	962·9	969·3	6·4									
13·2·62	530	548·6	0800	5	30	1017·6	1027·0	9·6	1·95	"	18·6	92	80'B 450'A	37	5·32	62	0·20
"	"	"		5	30	1027·0	1035·8	8·8									
"	"	"		5	60	1038·5	1058·7	20·2	3·95	"	18·6	92	80'B 450'A	37	20·7	76	0·40
"	"	"		5	60	1058·7	1078·4	19·7									
17·2·62	550	590	0900	5	30	1084·5	1090·0	5·5	1·25	"	40	92	80'B 470'A	25	1·59	53	0·03
"	"	"		5	30	1090·0	1096·8	6·8									
"	"	"		5	60	1099·0	1117·5	18·5	3·75	"	40	92	80'B 470'A	25	16·56	68	0·09
"	"	"		5	60	1117·5	1136·4	18·9									

BUREAU OF MINERAL RESOURCES

PORT MORESBY NO. 2 UNDERGROUND HYDRO-ELECTRIC SCHEME

WATER PRESSURE TEST RESULTS

For explanatory notes, see page 1 of Appendix.

DATE	SECTION TESTED FROM (feet)	SECTION TESTED TO (feet)	TIME OF START OF TEST	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i)	WATER METER READINGS START (gall.)	WATER METER READINGS FINISH (gall.)	WATER LOSS (gall.)	LEAKAGE RATE (g.p.m.)	SEALING PROPERTIES	LENGTH OF SECTION (Feet)	DEPTH OF STANDING WATER (Ft)	SIZE OF ROD	WATER COLUMN PRESSURE (p.s.i.) w	FRICTION HEAD LOSS (p.s.i)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per Ft)
	a	b		t	p	k	l	l-k = m	$\frac{m}{t}$		b - a = c	d*		‡0·44 sin θ(a+h) 1. 0·44 sin θ(d+h) 2.	$\frac{(a+h)e^t}{10}=f$	p + w - f = P	$\frac{m}{tc}$
Hole Nº :- R23 Inclination to Horizontal (θ) :- 71°					Feature :- Machine Hall Packer type :- 'Triefus' NMLC						Height of Gauge above Hole (h)*:- 2feet.						
28·3·62	50'	252'	1513	5	30	1146·5	1174·6	28·1	5·9	Good	202	90	B	21·3	3·2	48·1	0·03
					30	1174·6	1205·6	31·0									
					60	1206·6	1252·8	46·2	8·55	Good.	"	"	"	"	6·8	74·5	0·04
					60	1252·8	1292·5	39·7									
29·3·62	250'	302'7"	1600	5	30	1302·0	1324·5	22·5	4·4	Good	52·6	85	A	36	11·3	54·7	0·09
					30	1324·5	1346·0	21·5									
					60	1350·0	1380·5	30·5	5·9	Good	"	"	"	"	20·2	75·8	0·12
					60	1380·5	1409·0	28·5									
3·4·62	300'0"	353'0"	1625	5	30	1441·6	1461·5	19·9	4·15	Good	53	85	A	36	12·1	53·9	0·08
					30	1461·5	1482·8	21·3									
					60	1484·6	1520·4	35·8	6·15	Good	"	"	"	"	21·1	74·9	0·12
					60	1520·4	1545·8	25·4									
4·4·62	350'0"	403'7"	0830	5	30	1558·1	1579·8	21·7	4·2	Good	53·6	85		36	4·6	61·4	0·08
					30	1579·8	1600·3	20·5									
					60	1609·0	1642·9	33·9	6·2	Good	"	"		"	9·1	86·9	0·12
					60	1642·9	1671·0	28·1									
6·4·62	400'0"	453'6"	1112	5	30	1728·0	1739·2	11·2	2·1	Good	53·5	87	300'A 100'B	36	4·0	62	0·04
					30	1739·2	1749·0	9·8					"				
					60	1752·5	1766·5	14·0	2·7	Good.	"	"	"	"	6·9	89	0·05
					60	1766·5	1779·5	13·0					"				
12·4·62	450'0"	503'0"	2043	5	30	1792·0	1810·5	18·5	3·45	Good	53	80	350'A 100'B	34	12·3	51	0·07
					30	1810·5	1826·5	16·0					"				
					60	1831·0	1854·0	23·0	4·45	Good	"	"	"	"	18	76	0·09
					60	1854·0	1875·5	21·5					"				
14·4·62	500'0"	553'10"	0900	5	30	17·5	32·5	15·0	2·95	Good	53·8	110	420'A 80'B	46	10	66	0·06
					30	32·5	47·1	14·6					"				
					60	48·0	61·5	13·5	3·3	Good	"	"	"	"	12	94	0·07
					60	61·5	76·0	14·5					"				
1·5·62	540'0"	642'0"	0906	5	30	214·5	250·0	36·5	7·0	Good	102	110	440'A 100'B	46	62	14	0·07
					30	250·0	283·5	33·5					"				
					60	287·0	324·5	37·5	7·5	Good			"		67·6	38	0·08
					60	324·5	362·0	37·5					"				
Hole Nº R24 Inclination to Horizontal (θ) :- 74°18'					Feature :- Tailrace Tunnel Packer type :- 'Tricfus' NMLC						Height of Gauge above Hole (h)*:- 2 feet.						
18·5·62	57	321·4		5	17	375·5	426·3	50·8	10·8	Good	264·3	90	B	24	10·6	30·4	0·04
						426·3	467·5	41·2									
						467·5	524·1	57·0									
						524·1	580·5	56·4									
19·5·62	100	321·4	9 A.M.	5	30	786·0	801·5	14·5	2·7	"	221·3	90	B	38·9	1·7	67·2	0·01
						801·5	813·5	12·0									
					60	813·7	836·9	23·2	4·3	"	"	"	B	"	3·7	95·2	0·02
						836·9	856·8	20·0									
22·5·62	321·4	372·8	2 P.M.	5	30	860·4	872·6	12·2	2·3	"	51·4	90	130'A 190' B	38·6	4·2	64·4	0·04
						872·6	883·5	11·0									
					60	883·8	890·9	7·1	1·5	"	"	"	"	"	3·2	95·4	0·03
						890·9	899·1	8·2									
24·5·62	372·8	433·1	7 A.M.	5	30	905·5	916·0	10·5	1·65	"	60·3	90!	130'A 240 B	38·6	3·2	65·4	0·03
						916·0	922·3	6·3									
					60	922·5	927·8	5·3	1·0	"	"	"	"	"	1·03	97·6	0·02
						927·8	932·3	4·6									

continued →

BUREAU OF MINERAL RESOURCES

PORT MORESBY NO. 2 UNDERGROUND HYDRO-ELECTRIC SCHEME

WATER PRESSURE TEST RESULTS

For explanatory notes, see page 1 of Appendix.

DATE	SECTION TESTED FROM (feet)	SECTION TESTED TO (feet)	TIME OF START OF TEST	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i)	WATER METER READINGS START (gall.)	WATER METER READINGS FINISH (gall.)	WATER LOSS (gall.)	LEAKAGE RATE (g.p.m)	SEALING PROPERTIES	LENGTH OF SECTION (Feet)	DEPTH OF STANDING WATER (Ft.)	SIZE OF ROD	WATER COLUMN PRESSURE (p.s.i.) w	FRICTION HEAD LOSS (p.s.i)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per Ft.)
	a	b		t	p	k	l	l-k = m	$\frac{m}{t}$		b - a = c	d*		‡$0{\cdot}44\sin\theta(a+h)$ 1 ‡$0{\cdot}44\sin\theta(d+h)$ 2.	$\frac{(a+h)e^{\dagger}}{10}=f$	p + w - f = P	$\frac{m}{tc}$
R 24 continued.																	
25·5·62	433·1	483·3	10·15 A.M.	5	30	935·7	945·8	10·1	1·7	Good.	50·2	90 !	130' B 300' A	38·6	1·6	67·0	0·04
						945·8	953·4	7·6									
					60	953·4	960·1	6·7	1·25	"	"	"	"	"	1·35	97·3	0·03
						960·1	966·1	6·0									
28·5·62	482	543	1102	5	30	974·5	982·0	7·5	1·4	"	61	90	130' B 352' A	38·6	2·94	65·7	0·02
						982·0	988·75	6·8									
					60	990·5	997·5	7·0	1·2	"	"	"	"	"	2·46	96·1	0·02
						997·5	1002·75	5·3									
29·5·62	543	591' 8"	1332	5	30	1006·0	1011·0	5·0	1·05	"	48·8	90	130' B 413' A	38·6	2·2	66·4	0·02
						1011·0	1016·5	5·5									
					60	1017·0	1026·0	9·0	1·8	"	"	"	"	"	5·4	93·2	0·04
						1026·0	1035	9·0									
31·5·62	591·8	655·5	800 AM	5	30	1184·5	1203·0	18·5	3·7	"	63·7	90	160' B 430' A	38·6	19·8	48·8	0·06
						1203·0	1221·3	18·3									
					60	1221·3	1249·1	27·8	5·3	"	"	"	"	"	37·5	61·1	0·08
						1249·1	1274·5	25·4									
					90	1274·5	1307·1	32·5	6·5	"	"	"	"	"	55·3	73·3	0·10
						1307·1	1340·9	33·8									
Hole Nº :- R25 Inclination to 'Horizontal (θ) :- 45°					Feature :- Diversion Weir Site Packer type :- 'Triefus' NMLC									Height of Gauge above Hole (h)* :- 2 feet.			
26·6·62	50' 0"	164' 5"	12·20	5	30	1610·0	1623·1	13·1	2·5	Good	114·4	51	B	16·9	0·83	46·1	0·02
			12·70			1623·1	1634·5	11·4									
			12·12		60	1634·5	1652·5	18·0	3·5	"	"	"	B	"	1·46	75·4	0·03
			12·17			1652·5	1669·3	16·8									
			12·22		90	1669·3	168[illegible]·0	19·7	4·05	"	"	"	B	"	1·84	105·1	0·04
			12·27			1689·0	1709·[illegible]	20·1									
27·6·62	150' 0"	203' 10"	9·45	5	30	1717·3	1728·4	11·1	1·8	"	53·8	51	B	16·9	1·4	-	0·03
			9·50.			1728·4	1735·3	6·9									
			9·55		60	1735·3	1742·1	6·8	1·3	"	"	"	B	"	0·7	76	0·02
			10·00			1742·1	1748·3	6·2									
			10·5		90	1748·3	1756·3	8·0	1·5	"	"	"	B	"	1·2	106	0·03
			10·10			1756·3	1763·6	7·3	-								
2·7·62	253·5	312·8		5	30	1922·1	1933·1	11·0	1·9	"	59·3	51	B	16·9	2·3	46	0·03
						1933·1	1941·0	7·9									
					60	1941·0	1954·2	11·2	2·5	Not sealing	"	"	B	"	3·8	76	0·04
						1954·2	1967·6	13·4									
					90	1967·6	1983·3	14·7	3·0	"	"	"	B	"	5·1	106	0·05
						1983·3	1998·4	15·1									
3·7·62	312·8	329·8		5	30	2008·5	2019·4	10·9	2·1	Good	17·0	51	A & B	16·9	2·7	46	0·12
						2019·4	2029·2	9·8									
					60	2029·2	2041·1	11·9	3·5	Not sealing	"	"	A & B	"	4·6	76	0·20
						2041·1	2058·7	17·6									
	330	405·5			30		DATA		3·6	Good	75·5	51	A & B	16·9	11·0	46	0·05
					60		NOT		3·8	"		"	A & B	16·9	15·9	76	0·05
					90		AVAILABLE		5·0	"		"	A & B	16·9	20·6	106	0·07

BUREAU OF MINERAL RESOURCES

PORT MORESBY NO. 2 UNDERGROUND HYDRO-ELECTRIC SCHEME

WATER PRESSURE TEST RESULTS

For explanatory notes, see page 1 of Appendix.

DATE	SECTION TESTED FROM (feet)	SECTION TESTED TO (feet)	TIME OF START OF TEST	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i)	WATER METER READINGS START (gall.)	WATER METER READINGS FINISH (gall.)	WATER LOSS (gall.)	LEAKAGE RATE (g.p.m)	SEALING PROPERTIES	LENGTH OF SECTION (Feet)	DEPTH OF STANDING WATER (Ft.)	SIZE OF ROD	WATER COLUMN PRESSURE (p.s.i.) w	FRICTION HEAD LOSS (p.s.i)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per Ft.)
	a	b		t	p	k	l	l-k = m	$\frac{m}{t}$		b - a = c	d^*		‡0·44 sin θ(a+h) 1. 0·44 sin θ(d+h) 2.	$\frac{(a+h)e^{\dagger}}{10}=f$	p + w - f = P	$\frac{m}{tc}$
Hole Nº : R26					**Feature :- Tailrace Tunnel & Shear Zone**						**Height of Gauge above Hole (h)*:- 2 feet.**						
Inclination to Horizontal (θ) :- 25°					**Packer type :- 'Triefus' NMLC & BMLC**												
6·8·62	70	106·1	0905	5	30	2945·5	2952·7	7·2	1·35		46·1	9·5	B	2·3	0·58	27	0·03
"	"	"	0910	5	30	2952·7	2959·4	6·7									
"	"	"	0915	5	60	2959·4	2966·6	7·2	1·4		46·1	9·5	B	2·3	0·65	62	0·03
"	"	"	0920	5	60	2966·6	2973·7	7·1									
"	"	"	0925	5	90	2973·7	2982·5	8·8	1·7		46·1	9·5	B	2·3	0·72	92	0·04
"	"	"	0930	5	90	2982·5	2991·2	8·7									
8·8·62	100	157·7	1525	5	30	2992·7	3004·4	11·7	2·35		57·7	100	B	18·4	1·6	47	0·04
"	"	"	1530	5	30	3004·9	3016·5	12·1									
"	"	"	1535	5	60	3016·5	3031·6	15·1	2·9		57·7	100	B	18·4	2·0	76	0·05
"	"	"	1540	5	60	3031·6	3045·6	14·0									
8·8·62	332	401·2	0943	5	30	3510·3	3530·7	20·4	3·7		69·2	180	B	32·6	9·4	53	0·05
"	"	"	0948	5	30	3530·7	3546·8	16·1									
"	"	"	0953	5	60	3546·8	3569·5	22·7	4·45		69·2	180	B	32·6	10·5	82	0·06
"	"	"	0958	5	60	3569·5	3591·7	22·2									
15·8·62	200	255·6	1146	5	30	3295·1	3335·9	40·8	8·2		55·5	180	B	32·6	19·2	43	0·15
"	"	"	1151	5	30	3335·9	3377·5	41·7									
"	"	"	1156	5	60	3377·5	3437·2	59·7	11·75		55·5	180	B	32·6	48·5	44	0·21
"	"	"	1201	5	60	3437·2	3495·4	58·2									
10·9·62	170	202·8	1604	5	30	3149·5	3178·9	29·4	5·65		32·8	168	B	30·6	10·3	51	0·18
"	"	"	1609	5	30	3178·9	3206·4	27·5									
"	"	"	1614	5	60	3206·4	3241·0	34·6	6·8		32·8	168	B	30·6	13·9	77	0·21
"	"	"	1619	5	60	3241·0	3274·6	33·6									
Hole Nº :- R27					**Feature :- Access Shaft**						**Height of Gauge above Hole (h)*:- 2 feet.**						
Inclination to Horizontal (θ) :- 90°					**Packer type :- 'Triefus' NMLC & BMLC**												
20·7·62	50	103·2	1113	5	30	2292·4	2309·5	17·1	2·4		53·2	85	B	53·7	1	83	0·05
"	"	"	1118	5	30	2309·5	2320·8	11·3									
"	"	"	1123	5	60	2320·8	2335·0	14·2	2·9		53·2	85	B	53·7	1	113	0·06
"	"	"	1128	5	60	23350	2349·9	14·9									
23·7·62	100	153·3	1534	5	30	2359·0	2369·8	10·8	2·1		53·3	85	B	38·3	1·5	67	0·04
"	"	"	1539	5	30	2369·8	2380·2	10·4									
"	"	"	1544	5	60	2380·2	2393·8	13·6	2·5		53·3	85	B	38·3	1·6	97	0·05
"	"	"	1549	5	60	2393·8	2407·5	13·7									
"	"	"	1554	5	90	2407·5	2427·6	20·1	4·2		53·3	85	B	38·3	3·6	125	0·08
"	"	"	1559	5	90	2427·6	2448·5	20·9									
25·7·62	150	203·2	1606	5	30	2453·6	2467·4	13·8	2·7		53·2	85	B	38·3	2·7	66	0·05
"	"	"	1611	5	30	2467·4	2480·9	13·5									
"	"	"	1616	5	60	2480·9	2498·5	17·6	3·55		53·2	85	B	38·3	4·2	94	0·07
"	"	"	1621	5	60	2498·9	2516·6	18·1									
"	"	"	1626	5	90	2516·6	2538·3	21·7	4·25		53·2	85	B	38·3	5·3	123	0·08
"	"	"	1631	5	90	2538·3	2558·9	21·6									
27.7.62	200	250	1507	5	30	2564·0	2568·25	4·25	0·95		50	86	B A	38·7	0·4	68	0·02
"	"	"	1512	5	30	2568·25	2573·5	5·25									
"	"	"	1517·5	5	60	2576·5	2579·15	3·25	0·975		50	86	[illegible] A	38·7	0·4	98	0·02
"	"	"	1522·5	5	60	2579·75	2585·15	6·0									
"	"	"	1528	5	90	2586·5	2593·0	7·0	1·3		50	86	B A	38·7	0·6	128	0·03
"	"	"			90	2593·0	2599·5	6·5									
31·7·62	250	300	1600	5	30	2684·0	2699·5	15·5	3·2		50	86	B A	38·7	5·8	63	0·06
"	"	"	1605	5	30	2699·5	2716·0	16·5									
"	"	"	1610·5	5	60	2718·0	2735·5	17·5	3·8		50	86	B A	38·7	7·6	91	0·08
"	"	"			60	2735·5	2756·0	20·5									

continued →

BUREAU OF MINERAL RESOURCES

PORT MORESBY NO. 2 UNDERGROUND HYDRO-ELECTRIC SCHEME

WATER PRESSURE TEST RESULTS

For explanatory notes, see page 1 of Appendix.

DATE	SECTION TESTED FROM (feet)	SECTION TESTED TO (feet)	TIME OF START OF TEST	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i)	WATER METER READINGS START (gall.)	WATER METER READINGS FINISH (gall.)	WATER LOSS (gall.)	LEAKAGE RATE (g.p.m.)	SEALING PROPERTIES	LENGTH OF SECTION (Feet)	DEPTH OF STANDING WATER (Ft.)	SIZE OF ROD	WATER COLUMN PRESSURE (p.s.i.) w	FRICTION HEAD LOSS (p.s.i)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per Ft)
	a	b		t	p	k	l	L-k = m	$\frac{m}{t}$		b - a = c	d*		$^{\ddagger}0{\cdot}44\sin\theta(a+h)$ 1. $^{\ddagger}0{\cdot}44\sin\theta(d+h)$ 2.	$\frac{(a+h)e^{\dagger}}{10}=f$	p + w - f = P	$\frac{m}{tc}$
Hole Nº :- R29 Inclination to Horizontal :- 90°					Feature :- Pressure Shaft Packer type :- 'Triefus' NMLC & BMLC						Height of Gauge above Hole (h)* :- 2 feet						
13-10-62	12	100	0901	5	30	31·5	46·0	14·5	2·7	Good	88	15	N	7·5	0·1	37	0·03
			0906	5	30	46·0	58·1	12·1		"							
			0913	5	60	62·0	72·0	10·0	1·8	"				7·5	0·1	67	0·02
			0918	5	60	72·0	80·4	8·4		"							
19-10-62	100	200	0822	5	30	4424·0	4432·5	8·5	1·5	"	100	15	N	7·5	0·3	37	0·01
			0827	5	30	4432·5	4438·8	6·3		"							
			0832	5	60	4439·4	4449·0	9·6	2·0	"				7·5	0·5	67	0·02
			0837	5	60	4449·0	4469·5	10·5		"							
22-10-62	200	250	1427	5	30	4880·0	4889·0	9·0	1·9	"	50	30	N & B	14·1	3·0	41	0·04
			1432	5	30	4889·0	4898·6	9·6		"							
			1438	5	60	4900·5	4911·2	10·7	2·1	"				14·1	3·2	71	0·04
			1443	5	60	4911·2	4921·2	9·9		"							
26-10-62	300	350	0933	5	30	4930·0	4934·5	4·5	0·7	"	50	35	N	16·3	0·6	46	0·01
			0938	5	30	4934·5	4937·0	2·5		"							
			0944	5	60	4938·6	4942·5	3·9	0·9	"				16·3	0·9	75	0·02
			0949	5	60	4942·5	4947·1	4·6		"							
30-10-62	350	400	0854	5	30	5331·0	5341·3	10·3	1·9	"	50	33	B & A	15·4	3·5	42	0·03
			0859	5	30	5341·3	5349·5	8·2		"							
			0904	5	60	5350·5	5362·5	12·0	2·2	"				15·4	3·5	72	0·04
			0909	5	60	5362·5	5372·5	10·0		"							
2-11-62	400	450	0850	5	30	5424·5	5445·0	20·5	4·2	"	50	33	B & A	15·4	13·2	32	0·08
			0855	5	30	5445·0	5466·0	21·0		"							
			0901	5	60	5468·0	5496·0	26·0	6·1	"				15·4	32·0	43	0·12
			0906	5	60	5496·0	5529·0	35·0		"							
7-11-62	450	519	0850	5	30	5557·5	5560·5	3·0	0·5	"	69	35	B & A	16·3	1·3	44	0·01
			0855	5	30	5560·5	5562·8	2·3		"							
			0903	5	60	5563·5	5568·6	5·1	0·8	"				16·3	1·8	74	0·01
			0908	5	60	5568·6	5571·1	2·5		"							
Hole Nº :- R30 Inclination to Horizontal (θ) :- 30°					Feature :- Diversion Weir Site Packer type :- 'Triefus' BMLC						Height of Gauge above Hole (h)* :- 2 feet.						
16-10-62	15	25	1140	5	30	85·0	85·5	0·5	0·1	Good	10	15	A	3·7	0·0	34	0·00
			1145	5	30	85·5	85·5	0·0		"							
			1150	5	60	85·5	85·6	0·1	0·0	"				3·7	0·0	64	0·00
			1155	5	60	85·6	85·6	0·0		"							
17-10-62	25	35	1115	5	30	105·0	106·1	1·1	0·1	"	10	15	A	3·7	0·0	34	0·01
			1120	5	30	106·1	106·1	0·0		"							
			1125	5	60	106·1	106·2	0·1	0·1	"				3·7	0·0	64	0·01
			1130	5	60	106·2	106·8	0·6		"							
17-10-62	35	45	1520	5	30	119·0	120·2	1·2	0·3	"	10	15	A	3·7	0·0	34	0·03
			1525	5	30	120·2	122·0	1·8		"							
			1530	5	60	122·0	123·5	1·5	0·5	"				3·7	0·1	64	0·05
			1535	5	60	123·5	127·0	3·5		"							
22-10-62	65	75	1045	5	30	190·5	192·1	1·6	0·35	"	10	28	A	6·6	0·1	37	0·04
			1050	5	60	192·1	194·1	2·0		"							
			1102	5	30	200·0	202·5	2·5	0·5	"				6·6	0·1	67	0·05
			1107	5	60	202·5	205·0	2·5		"							
	75	85	1530	5	30	211·3	213·0	1·7	0·35	"	10	28	A	6·6	0·2	36	0·04
			1535	5	30	213·0	215·1	2·1		"							
			1545	5	60	218·0	220·3	2·3	0·45	"				6·6	0·2	66	0·05
			1550	5	60	220·3	222·7	2·4		"						continued	→

BUREAU OF MINERAL RESOURCES

PORT MORESBY NO. 2 UNDERGROUND HYDRO-ELECTRIC SCHEME

WATER PRÈSSURE TEST RESULTS

For explanatory notes, see page 1 of Appendix.

DATE	SECTION TESTED FROM (feet)	SECTION TESTED TO (feet)	TIME OF START OF TEST	TIME OF TEST (min.)	GAUGE PRESSURE (p.s.i)	WATER METER READINGS START (gall.)	WATER METER READINGS FINISH (gall.)	WATER LOSS (gall.)	LEAKAGE RATE (g.p.m.)	SEALING PROPERTIES	LENGTH OF SECTION (Feet)	DEPTH OF STANDING WATER (Ft.)	SIZE OF ROD	WATER COLUMN PRESSURE (p.s.i.) w	FRICTION HEAD LOSS (p.s.i)	EFFECTIVE TEST PRESSURE (p.s.i.)	WATER LOSS (g.p.m. per Ft.)
	a	b		t	p	k	l	l-k = m	$\frac{m}{t}$		b-a = c	d*		‡ 0·44 sin θ(a+h) 1. 0·44 sin θ(d+h) 2.	$\frac{(a+h)e^{\dagger}}{10}=f$	p+w-f = P	$\frac{m}{tc}$
R 30 continued.																	
23-10-62	85	95	1015	5	30	230·0	232·0	2·0		Good	10	30	A	7·0	0·2	37	0·04
			1020	5	30	232·0	234·1	2·1	0·40	"							
			1025	5	30	234·1	236·3	2·2		"							
			1031	5	60	240·0	242·3	2·3		"				7·0	0·2	67	0·05
			1036	5	60	242·3	244·7	2·4	0·45	"							
			1041	5	60	244·7	247·0	2·3		"							
25-10-62	90	110	1340	5	30	227·0	230·0	3·0		"	20	23	A	5·5	0·2	35	0·03
			1345	5	30	230·0	232·5	2·5	0·55	"							
			1350	5	30	232·5	235·0	2·5		"							
			1358	5	60	237·0	240·0	3·0		"				5·5	0·2	65	0·03
			1363	5	60	240·0	243·1	3·1	0·60	"							
			1368	5	60	243·1	246·0	2·9		"							
Hole No:- R31 Inclination to Horizontal (θ) :-30°					Feature :- Diversion Weir Site Packer type :- 'Triefus' NMLC & BMLC									Height of Gauge above Hole (h)* :- 2 feet.			
21-11-62	13	51·7	1030	5	30	0·3	4·7	4·3	0·90	Good	38·7	> 13	N	3·3	0·5	33	0·02
			1035	5	30	4·7	8·9	5·2		"							
			1040	5	60	8·9	15·9	7·0	1·40	"				3·3	0·6	63	0·04
			1045	5	60	15·9	22·7	6·8		"							
26-11-62	51·7	103·8	0823	5	30	38·0	56·2	18·2	3·60	"	52·1	23	B	5·5	1·6	34	0·07
			0828	5	30	56·2	74·0	17·8		"							
			0833	5	60	74·0	96·3	22·3	4·40	"				5·5	2·2	63	0·09
			0838	5	60	96·3	117·9	21·6		"							
28-11-62	100	153·7	0934	5	30	124·0	129·3	5·3	0·10	"	53·7	23	B	5·5	0·5	35	0·02
			0939	5	30	129·3	133·8	4·5		"							
			0944	5	60	133·8	143·2	9·4	1·75	"				5·5	1·0	65	0·04
			0949	5	60	143·2	151·2	8·0		"							

APPENDIX 3 - LABORATORY TESTS OF THE PROPERTIES OF SPECIMENS OF DRILL CORE

Adapted from two reports by L.T. Ryan, Officer-in-Charge, Central Testing and Research Laboratories, Department of Works, Melbourne.

Twenty-nine samples from drill cores, obtained during test drilling Port Moresby No.2 Hydro-Electric Scheme, were submitted for examination and determination of the physical properties of the rock. In addition to static and dynamic tests on each sample, many samples were combined and durability (wetting and drying) tests conducted on them. The results of all tests are shown in Tables 1 to 3.

STATIC AND DYNAMIC TESTS

The properties determined by the static methods are those consequent upon the relatively slow applications of physical stress and are normally determined by loading to destruction sections of the samples in a testing machine, recording the strain suffered by the specimen under investigation. The dynamic properties of a material are those exhibited when it is subjected to a rapid application of load. Such determinations may be made by sonic methods in which the velocity of propogation of sonic energy is determined. Laboratory techniques for sonic determinations include :

(a) Direct determination of the velocity of propogation of a wave through a specimen.

(b) Determination of the frequency of natural vibration of the specimen and consequent velocity determination. These two techniques normally give different results, (a) gives the velocity of the compressional wave (i.e. the longitudinal velocity) while (b) gives the velocity of the shear or transverse wave which at no time will be greater than 0.7 times the longitudinal wave velocity.

Formulae have been developed for the determination of the physical parameters of rocks based on these two velocities.

Further, results from laboratory determinations made on drill cores can be correlated with the similar type of determination in which seismic exploration techniques are used to investigate the material in situ. Such direct correlation between the properties determined in the laboratory and the in situ properties is not possible with the static methods, although by utilizing triaxial shear testing (with high lateral pressure techniques) an effort is made to partially simulate the in situ conditions.

This dynamic technique is non-destructive and consequently static determinations can subsequently be made upon the same sample.

For the design of machine halls and similar installations the dynamic properties of the surrounding rock may well be of greater importance than the static properties, as the structure will be required to tolerate the vibrations set up by the operating machinery.

Of the samples submitted Nos. 7-Q-43 and 7-Q-44 were from a volcanic material in which was incorporated water-worn boulders of various rock types and may thus be referred to as a volcanic conglomerate. The remainder of the samples were of a volcanic agglomerate, the fragments of which varied in rock type, were of a very wide size range and also varied in their state of assimilation by the matrix.

With heterogeneous material such as this it could not be considered that any overall correlation of consequence could be attained between the static and dynamic properties. Further, as it was desirable that sonic determinations should be done on specimens as large as possible while the static determinations (in this instance compression tests) should be on specimens in which the height of the specimen tested is twice the diameter. Thus after the sonic testing only selected portions of the samples are tested statically.

The sonic determinations were made by the staff of the Geophysical Laboratories of the Department of National Development who have recently acquired equipment to conduct such work. Unfortunately, it proved impossible to make critical determinations of the transverse wave velocities. However, of the results obtained, that which most probably represents the transverse wave velocity is included on the attached sheet of results with the consequent parameters computed.

The heterogeneous nature of the sections of cores submitted is indicated, viz. 7-Q-55 in which two pieces from the same section of core gave ultimate compressive stress results of 6,680 and 26,300 p.s.i. and corresponding values for E (Young's Modulus) of 1.6 and 3.0 x 10^{-6} p.s.i. The section which gave the high ultimate stress consisted almost wholly of an inclusion of biotite schist within the volcanic agglomerate, the planes of schistosity being parallel with the axis of loading.

The approximate specific gravity was determined for each of the samples as received; subsequent to this the samples were trimmed for sonic determinations and then cut into required specimens for compression testing. It was on these last specimens that accurate specific gravity determinations were made.

Compression tests were conducted on sections cut from the samples submitted so that the length of the test sample was twice the diameter where possible. Particular care was exercised in cutting the specimens to ensure that the cuts were square and planar. Due to the nature of the rock it was thought advisable to incorporate a piece of manilla folder between the rock and the metal platens of the compression machine. The deflections of the specimens were determined by using dial gauges mounted between the platens of the compression machine, thus permitting the plotting of the stress/strain relationship of each specimen tested for the determination of Young's Modulus (E).

It was thought initially that the deflection caused by the compression of the manilla would be eliminated after only a relatively small load; however subsequent investigations have indicated that the static Young's Modulus values obtained were slightly low because of the manilla and corrections have been made accordingly.

Some specimens were also submitted to the diametric (or indirect) tensile test, also known as the Brazilian Test. These tests were conducted upon appropriate offcut sections remaining after the cutting of the compression test specimens.

Because of the heterogeneous nature of most specimens electrical strain gauges were not used for the determination of the longitudinal and lateral strains, and consequently no determinations were made of Poisson's Ratio under static conditions.

The relationships used in the determination of the dynamic properties are as follows :

Longitudinal (compressional) wave velocity - C_B(ft/sec)

Transverse (shear) wave velocity C_S(ft/sec)

$$\text{Poisson's Ratio } \sigma = \frac{1 - 1/2\frac{(C_B)^2}{(C_S)^2}}{1 - \frac{(C_B)^2}{(C_S)^2}}$$

$$\text{Youngs Modulus } Eo = 1.34 \times 10^4 \times P \times \frac{(C_B)^2}{(1000)} \times \frac{(1+\sigma)(1-2\sigma)}{1 - \sigma}$$

(Not restrained) psi

Where P = SG

An examination of the results indicates a wide variation in the rock properties both dynamically and statically. As stated earlier this can be attributed to the heterogeneous nature of the material investigated. In many instances the longitudinal velocity is less than 1.43 times the transverse velocity, which in fact is not theoretically possible, and such transverse velocities may indicate the natural frequency of an inclusion within the section of a higher velocity material (thus, higher natural frequency). Where this ratio is less than 1.43 the results are of doubtful significance.

Where it is considered that the longitudinal and transverse velocities may bear a relationship to each other, the dynamic Young's Modulus and the Poisson Ratio have been computed. One feature is the overall higher value obtained for dynamic E that static E; this is normally the case.

The tests on samples 7-Q-70 and 7-Q-69 indicate that the conglomerate samples are far weaker than the agglomerate or tuff samples submitted. (See results of 7-Q-43 and 7-Q-44, however). The compressive strength recorded for Sample 7-Q-80(i) cannot be considered as representing the strength of the rock.

DURABILITY TESTS

To ascertain the durability of the material, a particular grading was selected and this subjected to a series of soaking and drying cycles. Each cycle consisted of soaking the material overnight in water, and then evaporating to dryness with gentle boiling, this procedure being repeated numerous times. The grading of the material was determined after a certain number of cycles as indicated in Table 3.

Many samples were combined for these tests, each durability sample representing a depth section within a drill hole. The results show the fraction retained by 3/16 inch and ¾ inch sieves after each series of cycles as a decimal of the original quantity retained on the 3/16 inch and ¾ inch sieves respectively.

In the first batch of samples, which were graded after 1, 5, 20 and 47 cycles, the samples most affected by the soaking and drying cycles were 7-Q-43 and 7-Q-54, 55, and 56. Sample 7-Q-56 yielded a low longitudinal velocity; it has a low ultimate compressive strength and a low value for Young's Modulus, and thus may contribute largely to the lower durability of the combined sample. Sample 7-Q-43 is conglomerate, and this suggests that the conglomerate would be more subject to weathering than the agglomerate.

In the second batch of samples which were graded after 1, 2, 10 and 31 cycles, the sample, which consists of principally conglomerate tuff, showed a greater breakdown under test than the sample consisting of agglomerate and tuff. This again indicates that the conglomerate would be more subject to weathering than the agglomerate or tuff.

TABLE 1 - RESULTS OF STATIC AND DYNAMIC TESTS ON SELECTED SPECIMENS OF DRILL CORE

SONIC DETERMINATIONS											STATIC DETERMINATIONS					
Sample No.	Hole	Depth	Rock Type	Core Dia.	Approx S.G.	Longitudinal Velocity C_B ft/sec.	Transverse Velocity C_S ft/sec.	C_B/C_S	Poisson's Ratio σ	Young's Modulus E p.s.i x 10^{-6}	App.S.G.	Absorption %	E 10^{-6} P.s.i.	Ultimate stress P.s.i.	Tensile stress (Brasilian) p.s.i.	Sample No.
7-Q-43	R14	22'6"-23'6"	Slightly weathered conglomerate	2"	2.54	15,400	11280	(1.37)			–	–	1.1	5,430	–	7-Q-43
					(2.52)		(2300)				2.717	1.31	–	–	1,270	
7-Q-44	R15	21'0"-21'9"	Slightly weathered conglomerate	2"	2.44	11,200	9250	(1.21)			–	–	1.1	8,120	–	7-Q-44
							5720	1.54	0.14	4.0	2.512	2.75	–	–	950	
7-Q-45	R21	52'3"-52'10"	Fresh agglomerate	2"	2.36	13,800	6790	2.03	0.34	4.2	–	–	0.8	4,350	–	7-Q-45
							(3540)									
7-Q-46	R21	151'7"-152'4"	Moderately fresh agglomerate	2"	2.27	11,800	8530	(1.38)			–	–	1.0	4,630	–	7-Q-46
							6650	1.77	0.27	3.7	2.536	3.78	1.4	5,200	–	
7-Q-47	R21	211'6"-212'6"	Moderately fresh agglomerate	2"	2.32	11,500	7320	1.57	0.16	4.3	2.645	4.97	1.1	4,250	–	7-Q-47
							5380	(2.14)			2.607	5.24	–	–	–	
7-Q-48	R21	285'8"-286'6"	Moderately fresh agglomerate	2"	2.34	12,500	7330	1.71	0.24	4.5	2.571	1.74	–	–	1,160	7-Q-48
							5670	(2.20)			–	–	1.3	5,820	–	
							4580	(2.83)								
7-Q-49	R21	290'2"-290'10"	Moderately fresh agglomerate	1⅜"	2.32	13,300	7720	(1.36)			2.575	6.79	1.3	7,730	–	7-Q-49
							3740	(3.56)			–	–	0.9	4,275	–	
7-Q-50	R21	330'6"-331'0"	Moderately fresh agglomerate	1⅜"	2.40	11,700	7720	1.52	0.12	4.6	–	–	1.4	7,220	–	7-Q-50
							(3520)				2.655	4.85	1.6	9,178	–	
7-Q-51	R21	341'6"-342'0"	Moderately fresh agglomerate	2"	2.31	10,700	9910	(1.08)			2.566	4.93	1.0	[illegible],034	–	7-Q-51
							8450	(1.27)			–	–	–	–	(564)	
							7350	1.46	0.06	3.9						
7-Q-52	R21	441'2"-441'8"	Moderately fresh agglomerate	2"	2.37	9,840	7040	(1.40)			2.586	4.87	1.0	4,840	–	7-Q-52
							6060	1.62	0.19	3.0	–	–		–	(355)	
7-Q-53	R21	503'8"-504'0"	Moderately fresh agglomerate	1⅜"	2.42	10,000	–	–			2.699	4.80	1.3	5,921	–	7-Q-53
					(2.55)						2.652	6.09	–	–	532	
											2.685	2.26	–	–	1,130	
7-Q-54	R21	512'2"-512'10"	Moderately fresh agglomerate	1⅜"	2.59	13,000	–	–			–	–	1.2	5,550	–	7-Q-54
											2.763	1.73	1.7 to			
													1.9	14,670	–	
7-Q-55	R21	555'6"-556'1"	Moderately fresh agglomerate	1⅜"	2.55	14,500	(14680)				–	–	1.6	6,680	–	7-Q-55
							9970	1.45	0.05	7.3	–	–	3.0±0.2	26,300	–	
7-Q-56	R21	607'6"-607'11"	Moderately fresh agglomerate	1⅜"	2.28	10,980					–	–	0.7	4,220	–	7-Q-5[illegible]
											–	–	–	5,880	–	
7-Q-57	–	Test Sample (i)	?	2"	2.39	10,300	9970	(1.05)			2.475	2.59	2.0	>7,880	–	7-Q-57
							6420	1.60	0.18	3.2						
							5510	1.87	0.30	2.6	2.609	1.85	–	–	1,395	
		(ii)	?	2"	2.36	15,800	9950	1.59	0.18	7.9	2.572	3.62	1.4	>6,935	–	
							(4110)				2.582	3.72	–	–	598	
											2.579	3.84	–	–	344	
7-Q-58		Test Sample	?	2"	2.39	10,000	5640	1.77	0.27	2.7	2.575	3.07	1.7 ± 0.2	>6,980	–	7-Q-58
							4120	(2.43)			2.593	4.38	–	–	510	

Results shown in brackets are of doubtful significance.

TABLE 2

RESULTS OF STATIC TESTS ON SELECTED SPECIMENS OF DRILL CORE

Sample No.	Hole	Depth	Rock Type	Ultimate Compressive Stress p.s.i.	Young's Modulus p.s.i. x10^{-6}	Tensile Stress (Brazilian) p.s.i.
7-Q-73 (i) (ii)	R19	455'0"-455'6½"	Moderately fresh agglomerate	10,340 -	1.3 -	- 904
7-Q-72 (ii)	R19	455'6½"-455'8½"	Moderately fresh agglomerate	-	-	-
7-Q-71	R19	491'5"-491'9"	Moderately fresh conglomerate	-	-	-
7-Q-70 *	R19	491'11"-492'4"	Moderately fresh conglomerate	-	-	198
7-Q-69	R19	525'2"-525'6"	Moderately fresh conglomerate	2,140	0.3	-
7-Q-68	R19	527'5"-527'9"	Moderately fresh conglomerate	-	-	-
7-Q-75	R21	601'0"-601'2"	Moderately fresh tuff	-	-	-
7-Q-74	R21	601'2"-601'6"	Moderately fresh tuff	9,230	0.9	-
7-Q-76 (i) (ii)	R22	577'7"-578'5"	Moderately fresh tuff or fine agglomerate	5,060 5,090	0.9 0.8	- -
7-Q-77 (i) (ii)**	R22	540'7"-541'4"	Moderately fresh agglomerate	6,770 -	1.3 -	- 827
7-Q-78 (i) (ii)	R22	520'0½"-520'10"	Moderately fresh agglomerate	4,200 -	0.5 -	- 320
7-Q-79	R22	493'5"-498'10"	Moderately fresh agglomerate	-	-	-
7-Q-80 (i)*** (ii)	R22	327'4"-328'0"	Moderately fresh tuff	600 -	- -	- 458

* This sample was badly fractured and not suitable for compression testing. Quality of material is indicated by the tensile strength.

** Tensile specimen fractured across diametric plane initially at 470 p.s.i. stress.

*** Failed along fracture plane intersecting specimen at approximately 40° to longitudinal axis.

TABLE 3

DURABILITY TEST RESULTS

No. of Cycles		1		5		20		47	
Sample.	Ret.	3/16"	3/4"	3/16"	3/4"	3/16"	3/4"	3/16"	3/4"
7-Q-43		.99	.95	.98	.92	.95	.87	.93	(.93)?
7-Q-44		1.0	1.0	.99	1.0	.98	.94	.97	.90
7-Q-45/46		.99	.98	.99	.97	.98	.95	.97	.93
7-Q-48/49/50		.99	.95	.99	.95	.98	.90	.96	.89
7-Q-54/55/56		.99	.92	.99	.91	.96	.79	.93	.74

No. of Cycles	1		2		10		31	
Sample No.	3/16"	3/4"	3/16"	3/4"	3/16"	3/4"	3/16"	3/4"
7-Q-68,71,72,75 & 79	.93	.91	-	-	.76	.67	.68	.57
7-Q-76,77,78 & 80	-	-	.95	.91	.89	.80	.81	.74

The grading of the original materials was as follows.

passing	1.1/2"	3/4"	3/8"	1/4"	3/16"	No.7	No.14	No.25
%	100	28	11.4	8.4	6.8	4.7	3.3	2.4

APPENDIX 4

PETROLOGICAL DESCRIPTIONS

Six specimens of tuff and agglomerate were examined.

Specimens 1 and 2. Specimens of tuff collected near Trig station R 13 on the left bank of the Laloki River.

1. Granularity - Phanerocrystalline with unsorted rock fragments and individual crystal grains. Particle size ranges between 4 mm and 0.05 mm.

2. Crystallinity - hemihyaline - vitric groundmass in which are set crystal grains and rock fragments.

3. Composition - a. Rock fragments : Red andesitic basalt with augite phenocrysts; grey andesitic basalt with augite phenocrysts.

   b. Crystal grains: Lath-shaped andesitic plagioclase and augite, generally euhedral to sub-hedral. Also magnetite and phlogopite.

   c. Volcanic glass: Probably palagonite-greyish-brown and isotropic.

4. Fabric-Overall texture is that of a volcanic breccia. Rock fragments exhibit flow textures where lath-shaped crystals of plagioclase are aligned (pilotaxitic); also some plagioclase laths are arranged concentrically about augite phenocrysts.

5. Conclusion - The specimens are of lithic, vitric, crystalline tuff.

Specimens 3, 4, 5 and 6.

Random specimens of coarse-grained cohstituents of agglomerate.

The specimens are phenocrystalline to aphanitic. Most of the material is fine-grained porphyritic rock with augite and some olivine phenocrysts. The groundmass is hemicrystalline and consists of lath-shaped plagioclase and a minor amount of volcanic glass and magnetite.

The rock fragments are generally sub-idiomorphic to idiomorphic and some of them exhibit flow texture. In addition one specimen is vesicular.

The specimens examined, coarse components of agglomerate, are of basaltic andesite; some are vesicular.

PLATE 1

PORT MORESBY Nº2 UNDERGROUND HYDRO-ELECTRIC SCHEME

SURFACE GEOLOGICAL PLAN

Also showing location of Engineering Works

Bureau of Mineral Resources, Canberra, March 1963.

TO ACCOMPANY RECORD 1963/76

PLATE 2

PORT MORESBY No 2 UNDERGROUND HYDRO-ELECTRIC SCHEME

W - Weathered.
SW - Slightly weathered.
W.T. - Water table.
× - Fracture zone
Minor core loss (>90% core recovery)
Core loss

△	Agglomerate
-----	Tuff
∘	Conglomerate
⌃	Greywacke
‖‖‖	Clay

SECTION THROUGH POWER STATION AND TAILRACE TUNNEL

For location of Section see Plate 1

100 50 0 100 200 300 400 500
Scale in feet

Bureau of Mineral Resources, Geology & Geophysics, Canberra, March 1963

To accompany Record No 1963/76

PLATE 3

For location of Section see Plate 1

<table>
<tr><td rowspan="1">SURFACE</td><td>Geology including Structures</td><td colspan="2">Volcanic Conglomerate</td><td colspan="2">Few Outcrops</td><td>Tuff</td><td>Strongly jointed Agglomerate (Cliff)</td><td>Fracture zone. Flanked by shears.</td><td colspan="2">Agglomerate (Cliff)
Numerous joints, crush zones & fractures along Sogeri Road</td><td colspan="5">Agglomerate boulders & Soil. Probably some in place</td><td colspan="3">Well-jointed Agglomerate</td><td>Boulders of Agglomerate with numerous Outcrops and Soil</td><td colspan="4">Well-jointed Agglomerate</td><td colspan="3">Generally boulders of Agglomerate with Soil & some Outcropping Agglomerate.</td></tr>
<tr><td rowspan="7">TUNNEL LINE</td><td>Rock Type & Condition</td><td colspan="3">Volcanic Conglomerate, generally more or less weathered, fair strength.</td><td colspan="5">Conglomerate; some greywacke; weathered along fractures. Moderately strong.</td><td colspan="3">Conglomerate; extensively weathered; some clay. Overall fairly strong; some very weak zones</td><td colspan="5">Weathered to extremely weathered Conglomerate. Fairly weak to weak</td><td colspan="4">Conditions unknown. Probably all Agglomerate & Tuff, generally stained fractures and a few strongly weathered zones with clay</td><td>Generally fresh strong Agglomerate with tuff bands</td><td colspan="2">Generally fresh and strong Agglomerate & Tuff, with stained fractures and a few strongly weathered zones with clay</td><td colspan="2">Moderately fresh agglomerate with tuff bands; some clay and weathered rock along fractures. Generally strong</td></tr>
<tr><td>Rock Structure</td><td colspan="3">Core length 1″-12″. Numerous core losses probably indicate strongly weathered fractures. Large conglomerate boulders.</td><td colspan="5">Extensively fractured but no core loss. No faults or shears.</td><td colspan="3">Extensive core loss may indicate shears or faults. Core recovered very fractured; fractures irregular</td><td colspan="2">Extensive core loss. Probably close, steep jointing (& faulting?) as on Sogeri Road.</td><td colspan="3">Probably fewer joints and fractures than section to W. In places fragments lack cohesion. Tendency to overbreak to base of conglomerate</td><td colspan="4">Probably generally fractured but strong, with irregular joints. Probably some weak zones due to shears or faults</td><td>Few simple fractures, some weathered.</td><td colspan="2">Probably generally fractured but strong, with irregular joints. Probably some weak zones due to shears or faults.</td><td colspan="2">Fractures 2″-30″ apart, irregular. No core loss. A few strong joints or minor faults.</td></tr>
<tr><td>Groundwater Head</td><td colspan="10">0 — 100 feet</td><td colspan="2">100 - 250 feet. Possibly up to 400 feet</td><td colspan="3">250? - 410 feet</td><td colspan="4">410 — 550? feet</td><td colspan="6">410 — 480 feet</td></tr>
<tr><td>Groundwater Conditions</td><td colspan="6">Possibly free-draining along fractures, but low permeability. Less than 1 gall./min. discharge from R11. Weak spring action (mainly at soil-rock interface) at surface.</td><td colspan="7">Low permeability along fractures (Max. measured 0·22 gal/min./foot)</td><td colspan="3">Possibly slightly higher in very weathered conglomerate but < equivalent for AX hole of 0·2 gal/min/ft.</td><td colspan="7">Low permeability along fractures. Maximum water loss during pressure testing in R24 below 400 ft. depth 0·12 galls./min/foot at 90 p.s.i gauge pressure.</td><td colspan="2">Low permeability along fractures. (Max. measured 0·06 gal/min/ft.) Machine hall would need ceiling. Main fractures should be grouted</td></tr>
<tr><td>Steel & Concrete Support</td><td>100%</td><td colspan="2">30%</td><td colspan="5">NIL</td><td colspan="3">20%</td><td colspan="2">10%</td><td colspan="3">60%</td><td colspan="7">5%</td><td rowspan="3">Machine Hall</td><td>20%</td></tr>
<tr><td>Rock bolting for Support</td><td>NIL</td><td colspan="2">30%</td><td colspan="5">10%</td><td colspan="3">50%</td><td colspan="2">90%</td><td colspan="3">40%</td><td colspan="7">20%</td><td>80%</td></tr>
<tr><td>Gunite & Mesh (See Text)</td><td>NIL</td><td colspan="2">70%</td><td colspan="5">100%</td><td colspan="3">80%</td><td colspan="2">90%</td><td colspan="3">40%</td><td colspan="7">95%</td><td>NIL</td></tr>
</table>

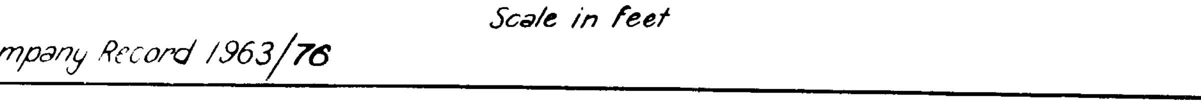
Bureau of Mineral Resources, Geology & Geophysics, Canberra, A.C.T. March 1963

PORT MORESBY Nº2 UNDERGROUND HYDRO-ELECTRIC SCHEME

SECTION THROUGH POWER STATION AND TAILRACE TUNNEL

Interpretation of Geology, Groundwater Conditions and Support Requirements

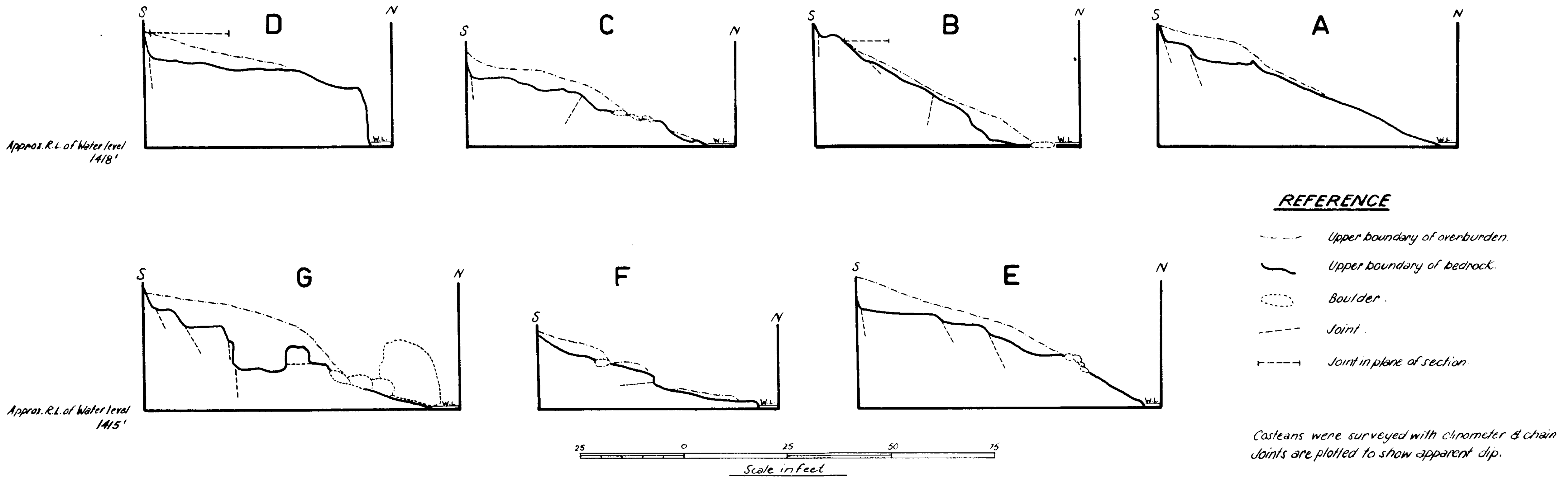
Also showing uncorrected water pressure test results



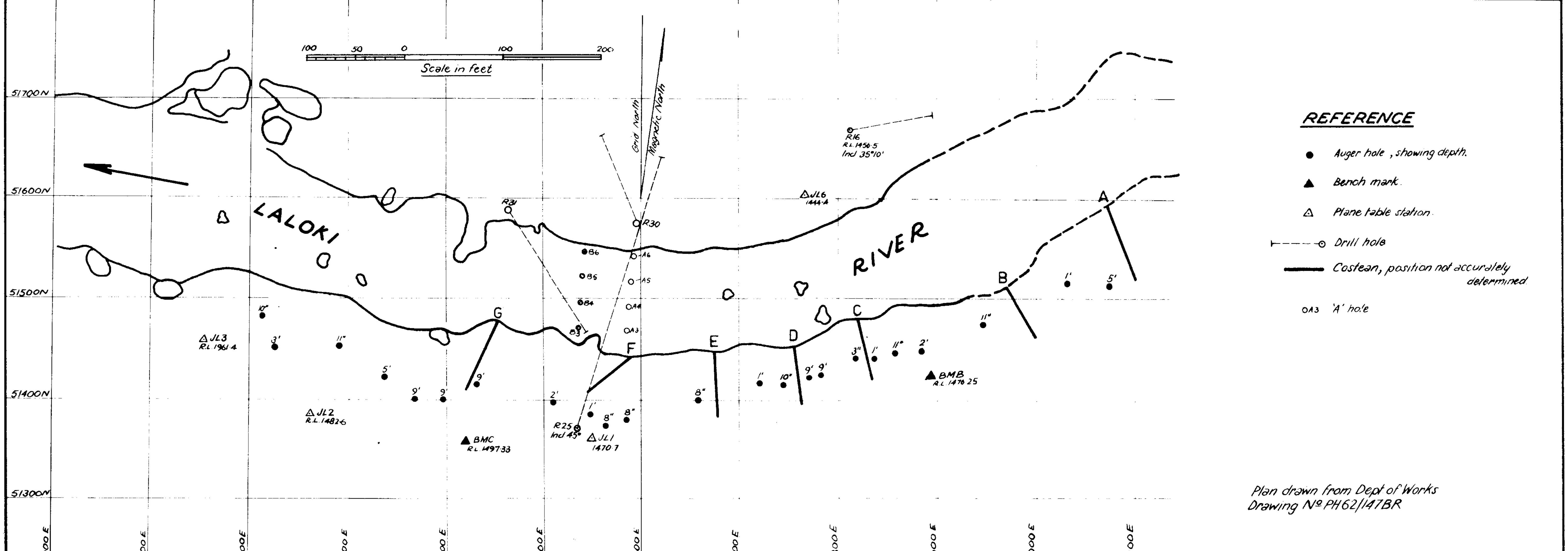
To accompany Record 1963/76

PORT MORESBY No 2 UNDERGROUND HYDRO-ELECTRIC SCHEME

COSTEANS, DRILL HOLES & AUGER HOLES TO TEST DIVERSION WEIR FOUNDATIONS



Costeans were surveyed with clinometer & chain.
Joints are plotted to show apparent dip.

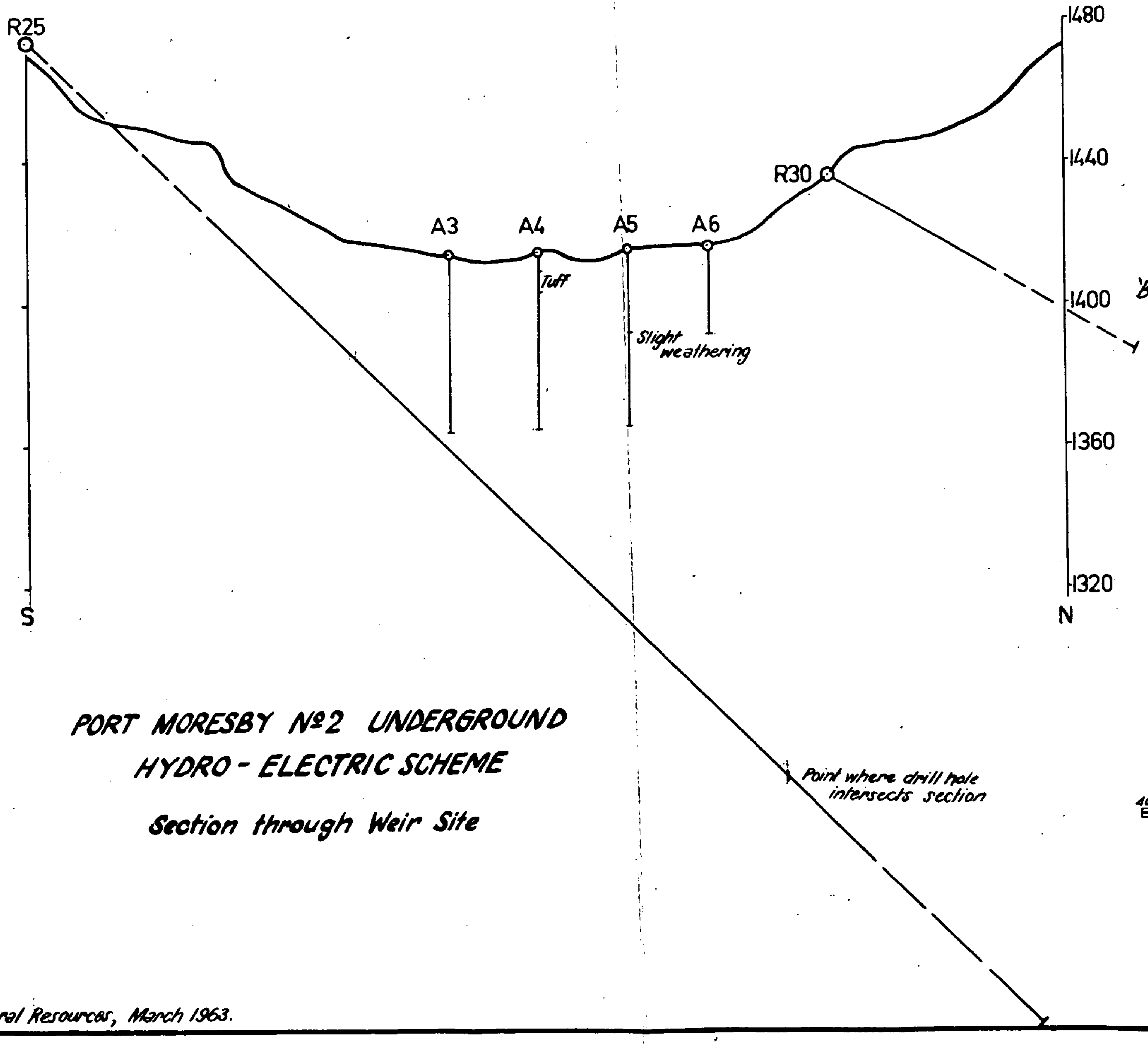


Plan drawn from Dept. of Works
Drawing No PH62/147BR

Bureau of Mineral Resources, Canberra, March 1963

To accompany Record No 1963/76

PLATE 5



B3- 4'-5' - Cavity, slight weathering below cavity.

B4- 2'3"-3'6" Cavity, broken below cavity.

B5- Broken, but fresh.

B6- 8'9"-10'3" - Tuff

'B' Holes 50 feet downstream of 'A' Holes.

For geological logs see Appendix 1

PORT MORESBY No2 UNDERGROUND HYDRO - ELECTRIC SCHEME

Section through Weir Site

au of Mineral Resources, March 1963.

To accompany Record 1963/76