REPUBLIC OF INDONESIA

MINISTRY OF PUBLIC WORKS

DIRECTORATE GENERAL OF WATER RESOURCES DEVELOPMENT

MASTER PLAN FOR THE CENTRAL SOUTH SULAWESI WATER RESOURCES DEVELOPMENT PROJECT

SUPPORTING REPORT
(VOLUME 7)
PART NINE GEOLOGY

MARCH 1980

JAPAN INTERNATIONAL COOPERATION AGENCY

TOKYO-JAPAN

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CHAPTER I PREFACE

A geological investigation was carried out to establish the Master Plan Study for the Central South Sulawesi Water Resources Development Project from February 27 to March 31, 1979 at the first assignment and from May 14 to June 27, 1979 at the second assignment.

The investigation contains collection of available data, geological reconnaissance on the proposed major structure sites and drilling work at the Mong damsite. The drilling work was carried out by D.P.M.A. under the Geologist's instruction.
In addition, swedish soundings and cone penetration tests were made at the alluvial plain around lakes and along middle to lower reach of the river for planning excavation works and for siting of structures in cooperation with River Engineer.

CHAPTER II DATA AVAILABLE

Maps with a scale of 1/25,000 with 10 meter contour interval are available in the whole project area. A geological reconnaissance was made principally based on these maps.

Besides, topographic maps and profiles were made at the major structure sites by JICA team. These are also used for the geological study.

General geology of the project area is described in a famous text book "The geology of Indonesia" written by R.W. VAN BEMMELEN in 1949. A geological map of 1/1,000,000 with a text covering the South Sulawesi issued by The Geological Survey of Indonesia contributes to understand the geology of the project area. A geological map of 1/250,000 issued by The Geological Survey of Indonesia is available only in the northern part of the project area.

It is informed that geological investigation was made on the intake structure sites of Bila and Sanrego which were previously planned by the Government of Indonesia, however, only a report "Penyelidikan Geologi Teknik dan Mekanika Tanah, Rencana Bendung Bila di Prop. Sulawesi Selatan" written in Indonesian prepared in 1976 is available now-a-day.

CHAPTER III GENERAL GEOLOGY OF STUDIED AREA

3.1 GEOMORPHOLOGY

The studied area is located in the southern arm of the Sulawesi which elongates in north - south direction (see Fig. 9.1).

The southern arm of the Sulawesi is geomorphologically divided into two parts by a depression running NW-SE direction from the debouchment of the Sadang river, north of the town of ParePare, to that of the Cenranae river, where the Lakes Tempe and Sidenreng are located.

The northern part from the depression is generally mountainous region formed mainly of hard sedimentary rocks and metamorphic rocks. Undulating hill-masses, composed of young molasse deposits of the alternation of mudstone, sandstone and conglomerate, develops along the skirt of the mountains. The project area of Boya, Bila and Gilirang are located in the flat plain from the southern end of the said northern part to the depression.

The Tempe depression is a flat plain of terrace and alluvial flood plain. The terrace is normally flat plain placed a few meter higher than the alluvial flood plain, however, the boundary between a terrace and the alluvial flood plain is in places unclear. The alluvial flood plain develops along the river and around the lakes in the studied area. It is commonly formed of natural levees and back marshes along the middle reach of a river course and of marsh only around the lakes. The project areas of Cenranae and a part of Walanae are present in this depression.

The southern part of the southern arm can be divided into five zones from west to east as

- West coast
- Western divide mountains
- Walanae depression (along the Walanae river)
- Bone mountains
- East coast

The West and East coasts are coastal flat plain. The western flank of the western divide mountains is composed of the complex of various rocks including huge masses of limestone, however, the eastern flank of it is generally formed of andesite and tuff breccia. The Bone mountains consist mainly of andesite, tuff breccia and limestone, however, they are plunging northward under the young Neogene formation at the east of the Lake Tempe.

The Walanae depression is formed of hilly areas and flat plains underlain by tuff breccia, alternation of weakly cemented mudstone, sandstone, coral limestone etc., and terrace and alluvial deposits. The Walanae depression is capped at the upper reach of the Walanae river by the volcanic massif of the Lompobatang. The project areas of Lawa, Langkemme, Sanrego and a part of Walanae are located in this depression.

3.2 GEOLOGY (FIG. 9.2)

On Pre-Tertiary age, little is known on the geologic history in this region because of poor outcrop of old rocks. It is presumed that sedimentary deposits occurred in Cretaceous on the basement complex of schist, gneiss and ultra basic rocks and that the deposits were metamorphosed by the subsequent orogenic activities.

In the Lower Tertiary (Paleocene, Eocene and Oligocene), the southern arm of the Sulawesi was a sedimentary basin where marine and continental deposits occurred.

From late Lower Tertiary to Middle Miocene, the southern arm of the Sulawesi was warping up and the Lower Tertiary deposits were folded and faulted due to the uplift. Intense volcanic activities started to form a huge volume of andesite and its tuff breccia, while sedimentary deposits including limestone were formed in sea region. Some intrusive rock masses occurred in this period.

From late Miocene to Pliocene, the Walanae depression was enlarged and marine sedimentary deposits of mudstone, sandstone coral limestone with fassils occurred in the depression. At the foot of the mountainous region an alternative of mudstone, sandstone conglomerate with no fossil was deposited as molasse sediments.

During Pleistocene terraces were formed due to sea water level fluctuation in the Walanae depression and at the southern end of the northern part where the project areas develop. Coral limestone was formed in places, specially in the Walanae depression since Pliocene. The lowest terrace formed in this period is found along the middle reach of major rivers and their tributaries composed of uncemented basal gravel beds and overlying massive soft silt.

In alluvium, deposits are being formed in and around river courses, gravel and sand in the upper reach of rivers, silt and clay in flood plain along the middle to the lower reach. The depression between the debouchment of the Sadang river to that of the Cenranae river was covered with sea in early alluvium. Soft clay deposits are known around Lakes Tempe and Sidenreng to a depth of a few meter below sea level. The alluvial soft clay deposits will be discussed in Chapter 9.5.

CHAPTER IV GROUNDWATER

In most of local villages groundwater is a source of domestic use of water. Groundwater is extracted commonly from a phreatic aquifer by a shallow dug well. The phreatic aquifer is generally present in alluvial and terrace deposits, and weathered zone of various rocks. The permeability of phreatic aquifer is commonly low.

It is presumed that a thick mass of limestone has caves and open fissures in its natural properties forming an excellent squifer. Springs are in many places seen under a cliffs of huge limestone masses providing water from its open fissures and caves with almost constant discharge rate throughout a year.

It is also realized in the limestone area that a gully probably above groundwater level shows no water flow in dry season or a little discharge after rain, while such a gully below ground water level (spring level) has a almost constant flow even in dry season. This suggests that a mass of limestone may have a high permeability to permit rainfall to percolate into ground and that water stored in the mass of limestone flows through fissures and caves to springs and streams.

However, such interesting flow mechanism may little affect discharge of major rivers because of minor distribution of limestone in comparison with the whole catchment area.

Another possible aquifer is a part of weakly cemented sandstone and conglomerate of Plio-Pleistocene deposits.

Some self flowing tubewells are present in the town of Pangkajene, tapping artesian aquifers below 25 meters in depth. It is supposed from the view point of geological structure that the aquifer may occur in uncemented or weakly cemented sandstone intercalating in Plio-Pleistocene sedimentary beds underlying terrace in Pangkajene. Potential of artesian water in this region is expected to be good as the ground water basin seems enormous.

CHAPTER V ALLUVIAL DEPOSITS

The wide alluvial flood plain develops along the middle to the lower reach of the Walanae river, its tributaries and around the lakes of Tempe and Sidenreng. The alluvial flood plain shows commonly natural levees and back marshes, specially on the middle reach of the Walanae river. In general, the natural levee formed of silt and fine sand is used for dry field and villages, and the bask marsh is cultivated for paddy field, respectively. However, the natural levee appears poorly in the alluvial plain around the lakes.

The alluvial flood plain is underlain by soft clayey deposits, which are investigated by means of Swedish soundings and cone penetration test in order to understand the soil properties for the plan of the river training works such as river bed excavation, embankment and construction of a regulating barrage, and for the plan of the irrigation pump station as shown in Table 9.1 and in Figure 9.3.

The obtained result of swedish soundings and cone penetration test is attached in the Data Sheets of Soundings. The result is converted into the standard penetration value (N. value) as shown in the Table 9.2 and unconfined compressive strength (qu, t/m^2) by applying the following formulae for Swedish sounding.

$$N = \frac{1}{12} \text{ Nsw} \qquad \text{(for sand)}$$

$$N = \frac{1}{9} \text{ Nsw} \qquad \text{(for clay or cohesive soil)}$$

$$qu = 0.045 \text{ Wsw} + 0.075 \text{ Nsw}$$

and for cone penetration test

$$qu = 2.\ qc$$

respectively, where Nsw is the number of times of half turn per meter by Swedish sounding and Wsw is the applied load (kg).

The alluvial flood plain along the Cenranae river is underlain by very soft silt having the standard penetration values ranging from 0 to 3 to depths of 8 or 9 meters below ground surface, that is, 4.5 - 6 meters below sea water level. Below the very soft silt, lithology is not known, however, the bed is still soft showing N values from 6 to 13.

Around the town of Sengkang a very soft layer below 4 in the standard penetration value occurs from ground surface to the depths 9 - 13 meters. The rocky hill masses are present near the Sengkang bridge, however, it is sure that such hill masses was intensely dissected before the deposit of the very soft layer. The very soft layer is commonly formed of clay and silt but partly of loose fine sand in places. Below the very soft layer the standard penetration value rises 7 to 9 but the bed does not be deemed as hard base rock.

Around the town of Sengkang, the ground excavation work for the river training and for the conduit canal to a pump station will be made easily because of presence of the very soft layer, however, a drilling investigation is additionally required for the design of a barrage and a pump station in order to find out a more firm foundation in deeper subsurface.

Such very soft layer continues to the alluvial plain along the Walanae river, but the layer become harder toward the upstream.

Around the Lake Tempe very soft silt, partly very loose sand, are present below ground surface to depths of 6 to 9 meters, underlain by unknown soft bed with standard penetration values 6 - 11. Unconfined compressive strength of the very soft layer immediately below ground surface is estimated to be 3 ton per square meters in the eastern shore and 4.5 ton per square meter in the western shore, respectively.

The alternation of very loose sand, very soft clay and silt occurs under the alluvial plain around the Lake Sidenreng. The thickness of the alternation ranges from 1 meter to 5 meters. The underlying bed indicates the standard penetration values from 7 to 14. Lithology of it is still unknown, but probably weathered zone of the Plio-Pleistocene base rock or dense alluvial deposits, however, high standard penetration value may suggest the presence of such base rock in shallow part in places.

In the northern area of the Lakes, particularly along the Bila river, alluvial deposits filled the dissected wide valleys between terraces. Very soft clay and silt is found to a depth of 12 meters overlying soft bed. Unconfined compressive strength immediately below ground surface is estimated to range from 1 ton per square meter to 4.5 tons per square meter.

The river bed alluvial deposits become coarser towards upstream.

CHAPTER VI GEOLOGICAL SURVEY ON MONG DAMSITE

6.1 GENERAL GEOLOGY AT THE SITE

There exists the proposed Mong Damsite in a canyon immediately down stream of the confluence of the Mario River to the Walanae river. The reservoir area is encircled and underlain by cemented Tertiary formations. Limestone occurs in the reservoir, however, no limestone mass extends from the reservoir to outside except the left abutment of a narrow ridge.

The left abutment of the damsite rises on a steep alope for about 70 meters and is topped by a flat ridge. The slope is underlain by the alternation of coral limestone, siltstone, sandstone and calcareous sandstone covered with top soil and scree. Calcareous sandstone is weakly cemented and changeable gradually into likely chalk and into limestone. The limestone occurring upstream along the left bank cliff appears cemented but has open fissures in places. Besides, the limestone on the ridge shows a typical coral limestone with intensive open fissures and caves containing various fossils. Siltstone and sandstone are massive and poorly cemented.

Gravel of andesite is present in the river channel and fine sand and silt rest at the right side of the channel. The underlying base rock is not known, however, the presence of the alternation of calcareous sandstone, limestone and sandstone etc. as observed at outcrops near the site will be presumed below the river deposits.

The right bank is formed by gentle slope of a narrow ridge dissected by gullies. The right bank is mostly composed of poorly cemented brownish sandstone intercalated with thin beds of limestone with N 40°E - EW in strike and 5° - 7°N in dip. Besides, the alternation of cemented siltstone and sandstone occurs immediately upstream of the right bank where strike and dip of the beds are N 25°E and 28°S respectively. Similiar alternation of the cemented mudstone and sandstone appears at the left bank of the Mario River around 400 meters upstream of the confluence.

The perennial streams occur in the most of gullies at the right bank, while no perennial flow is seen at the left bank except one that is present below about 60 meters in elevation around 500 meters upstream of the confluence along the Mario River. Such perennial stream is affected by groundwater. The groundwater table in the ridge of the left bank is presumed to be at around 60 meters in elevation around 500 meters far from the left abutment and to decline to the river water level toward the damsite, while the ground water level at the right bank hill is suggested to be higher than 70 meters in elevation and to descend in concordance with the slope toward the river. This suggests that no leakage is expected from the reservoir impounding up to 60 meters in elevation except abutment hill side around the damsite.

6.2 DRILLING INVESTIGATION

6.2.1 Drilling No.1

The drilling No.1 is sited at EL 33.56 on the right bank along the profile line A. The hole was drilled to a depth of 50 meters below ground surface. Lithology of the drilled section is formed of the alternation of siltstone, sandstone, calcareous sandstone and limestone.

Cementation of the recovered core materials is in various conditions from uncemented to well cemented: "Poorly Cemented" means the condition of sticky to fragment core materials which can be easily crushed to sand or silt particles by compression with fingers. "Weakly Cemented" indicates a condition of a sticky or fragments of core materials which can be easily broken into smaller pieces of fragments or particles by compression with a pair of pliers but not with fingers. "Cemented" means a condition of sticky of fragments of core materials which is easily broken to finger fragments by a strike with a hammer. "Well Cemented" shows a hard lithified core materials.

The upper part of the section is weathered to a depth of 7.5 meters where uncemented core materials were recovered. Sand and silt, poorly cemented in a part, are brownish and calcareous chalk, which seems to be weathered products of a limestone, in grey colour.

A rather fresh rock occurs below 7.5 meters. The alternation of filtstone and sandstone is dark grey in colour, poorly to weakly cemented and contains fossils in places. Sandstone is formed by a fine particles of sand weakly cemented containing silt materials.

Limestone, calcareous sandstone and chalk are not definitely distinguished. Fresh typical calcareous sandstone is commonly formed by calcareous materials and has mostly fine pores as indicated with core materials recovered from 15.00 meters to 21.90 meters in depth. In case the materials are fine or have become fine by weathering, calcareous sandstone seems a mass of chalk as shown in core obtained between 1.21 meters and 6.00 meters in depth. Limestone described here is commonly cemented. Two sections of limestone, 8.00 - 11.38 meters and 23.76 - 26.30 meters in depth, are likely calcareous sandstone but more cemented. Limestone occuring specially from 39.65 to 49.60 meters in depth is well cemented, however, it seems to have many pores and to be intensely cracked. Siltstone, below 49.60 meters, is massive cemented containing fragments of coral and mollusca.

6.2.2 Drilling No.2

The drilling No.2 is located at EL 50.46 on the middle slope of the left bank along the profile line A. The hole was drilled to a depth of 50 meters below ground surface. Lithology of the drilled section is as similar as that of the Drilling No.1.

Top soil and weathered zone continue from ground surface to a depth of 10.31 meters, however, in the subsequent section to a depth of 15.00 meters the rock is still soft and is interbedded with uncemented sand containing fossil fragments.

Fresh rock appears below 15.00 meters. Fresh siltstone and sandstone are weakly cemented, however, they have often hair cracks and joints as indicated by the presence of platy core pieces.

Calcareous sandstone is cemented and seems massive. Cracks and joints are supposed to be minor in it, even though it is rather porous. The lower part changes gradually into limestone.

6.2.3 Drilling No.3

The drilling No.3 is located at EL.78.93 meters near the top of the left bank along the profile line A. The hole was drilled to a depth of 50 meters below ground surface. The drilled section is as similar as that of the drilling No.1 and 2 in lithological view point.

Top soil and uncemented weathered zone continue to a depth of 22 meters from the surface. Upper part of the weathered zone, having a thickness of 14.4 meters from the surface, is composed of the alternation of siltstone, calcareous sandstone and coral limestone. The coral limestone occurring in the section from 3.6 to 5.5 meters and 12.0 - 14.4 meters in depth, is as same as the outcropping limestone at the top of the left bank and seems likely as the deposits of coral limestone gravels in the recovered core. Lower part of the weathered zone, from 14.4 to 22 meters, is composed of none-fossiliferous siltstone and sandstone.

The fresh rock below 22 meters from the surface is also divided into two sections of the upper part and lower part by the lithology. The upper part is composed of yellowish brown coloured well cemented sandstone and calcareous sandstone from 22 to 31.5 meters in depth. However, the lower part, from 31.5 to 50 meters, consists of black coloured alternation of siltstone and sandstone. They are weakly cemented and contain many fragments of the plant.

6.3 PERMEABILITY OF FOUNDATION

In case, test pressure is below 10 kg/cm^2, Lugeon value can be approximately calculated as follows;

$$\text{Lugeon value} = \frac{10Q}{P.L}$$

Q: Injected water volume ℓ/min.
P: Total pressure applied kg/cm^2
L: Length of tested section m

The water pressure test on the Mong damsite was carried out by a pump with the capacity of 60 ℓ/min, in order to clarify the characteristics of the foundation. The foundation rock is classified into 4 types based on the obtained Lugeon value in the permeability of the rock as;

- Type - A: over 60 Lugeon
- Type - B: between 20 Lugeon and 30 Lugeon
- Type - C: less than 10 Lugeon
- Type - D: easily deformed at around 6 kg/cm^2 in water pressure test and, then, Lugeon value increase to more than 60.

The Type - A is observed at the weathered zone occurring near ground surface.

The Type - B is found at the transitional zone from the Type A to Type C.

The Type - C indicate the properties of the fresh rock in the deep zone, except the section from 35 meters to 45 meters at the drilling hole No.1, which is presumed to be cracky and porous limestone.

The Type - D occurs in the sections from 8 to 10 meters at the drilling hole No.1 and from 30 to 35 meters at the drilling hole No.2. These sections are composed of very porous, weakly cemented limestone and cemented but cracky sandstone.

6.4 GEOLOGICAL CONDITIONS OF THE MONG DAMSITE

It is known by the result of the drilling investigation the base rock of the proposed Mong damsite is composed of the alternation of siltstone, sandstone and limestone, having the thickness from a few meters to ten meters in each layer. The layers are gently inclined from the left bank to the right bank.

The base rock is lithologically divided into three types of layers, namely, Ln, Sn and Mn.

Ln layer is chiefly composed of massive limestone and coral limestone. Sn layer has sandstone and calcareous sandstone. And Mn layer is formed of siltstone.

The geological profile of the proposed Mong damsite is shown in Fig. 8.4.

L1 layer

L1 layer extends at the top of the left bank being composed of permeable coral limestone and calcareous sandstone, with over 20 meters in thickness. At the drilling hole No.3, the weathered zone of L1 layer occurs to a depth at 8.65 m and has the A - type permeability with over 60 Lugeon value. The ground water does not appear.

Coral limestone does not crop out near 70 meters in elevation at the right bank, but calcareous sandstone crops out in the same place.

L1 layer would not be expected for the dam foundation on account of high permeability.

M1 layer

M1 layer does not crop out because of the thick overburden at the slope of both bank, however, it is observed on the recovered core at the drilling hole No.3 from 9.65 to 20.25 meters in depth which is composed of weathered uncemented siltstone interstratifying a thin limestone layer.

S1 layer

S1 layer is composed of sandstone and calcareous sandstone out cropping at the slopes of the both banks and observed on the recovered core of the drilling hole No.1, 2, and 3. That layer observed at the ground surface and the recovered core of the drilling hole No.1 and 2 is permeable uncemented weathering one, however, on the recovered core of the drilling No.3 from 20.5 to 35.85 meters in depth, it is cemented fresh rocks and has permeability of B or C type.

M2 layer

M2 layer crops out along the Walanae river, and observed at the all drilling hole. This layer is composed of siltstone interstratified with thin limestone beds at the drilling hole of No.1. The fresh part of the layer is black in colour and is weakly cemented with the permeability of the type C. However, the weathered zone is dark grey and is uncemented with the permeability of A or B type.

S2 layer

S2 layer can be observed on the reserved core of the all drilling hole. The layer consists of cemented sandstone and calcareous sandstone. However, since this layer has type - D in permeability due to cracky property, S2 layer will be required for special caution to the foundation treatment.

M3 layer

M3 layer is composed of siltstone and sandstone interstratified with thin limestone. It is remarkable in lateral change in facies or interfinger connection. At the drilling hole No.1, major portion is siltstone, but on the drilling hole No.2 sandstone is prevailing.

M3 layer is well cemented with the permeability of C-type.

L2 layer

L2 layer is distributed about 30 meters below the river bed with about 10 meters in thickness. It consists of well cemented limestone. This layer shows partly the permeability of type - C and partly type - A, because of, porous or cracky properties.

L2 layer will be required for most careful foundation treatment.

M4 layer

M4 layer is found only 0.4 meters at the bottom of the drilling hole No.1 from 49.6 to 50 meters in depth. The layer is composed of dark grey coloured massive cemented silstone containing plenty fragments of coral and molusca.

The thick of M4 layer can not be known, however, that layer will be based on the foundation treatment below the river bed.

6.5 POSSIBILITY OF DAM CONSTRUCTION

A fill type dam will be selected at the proposed Mong dam site by the geological condition in this moment. However, the following geological condition should be taken into account;

(a) The Dam height is limited by the occurrence of L1 layer at the top of the narrow ridge of the left bank. Because it is feared that the leakage may occur through L1 layer and accordingly piping might be caused in L1 layer downward of dam site provided that reservoir water level rises up to L1 layer. The crest of the proposed dam should be designed below the bottom of L1 layer. Based on the result of the drilling hole at No.3 the elevation of the dam crest is limited to 69 meters at the left bank, and crest elevation at right bank may be little lower than the left bank.

(b) The treatment of L2 layer with 30 meters in depth underlying below the river bed, is probably most serious problem for the dam foundation. That layer consists of well cemented limestone with about 10 meters in thickness and permeability shows partly over 60 in Lugeon value, and partly less than 10 in Lugeon value. It is presumed that L2 layer is compounded of porous or cracky limestone and compact limestone.

The foundation treatment of L2 layer should be made on the basis of sufficient study of grouting pattern, grouting pressure and grouting materials. In addition, foundation treatment of siltstone and sandstone adjacent to L2 layer will be also required.

(c) The treatment of the foundation for M1 to M4 and S1 to S2 layers, is also of importance for the construction of the dam. The weathered zone of the foundation which is uncemented or poorly cemented with high permeability, should be removed by cut off work for the impervious core of a dam. The thickness of cut off work will be around 10 - 15 meters below the river bed and around 15 - 20 meters at the both abutment.

The foundation treatment should be carried out by means of curtain grouting and consolidation grouting. Curtain grouting will be principally done by normal cement milk grout. Further, as the foundation has characteristics with space of particles and hair crack, chemical grouting will be also required. These curtain grouting must be made to M4 layer under L2 layer at the river bed.

(d) Even if the foundation treatment of the dam had been carried out completely, the ground water leaks out through the outside of the curtain grouting area at the both banks. When the volume of leakage water increases, the rim curtain grouting will be needed for the both banks of a dam axis. The relief wells will be installed around the structure in the downstream of the dam.

(e) The foundation treatment of the appurtenant structures such as spill way, diversion tunnel, power station etc., should be carried out as same as the damsite.

6.6 EMBANKMENT MATERIALS

Impervious material for central core in the fill type dam will be obtained from the weathered zone of the base rock and the talus deposits on the right bank slope.

Talus and river deposits can be used as pervious material of random fill in the zone embankment.

In case rock-fill type dam, the rock mateial will be obtain from the limestone hill at about 5 kilometers upstream of the damsite.

CHAPTER VII GEOLOGICAL SURVEY ON WALIMPONG DAMSITE

7.1 GENERAL GEOLOGY AT THE SITE

Walimpong damsite is selected as the alternative site of the Mong damsite, at about 1.5 kilometers upstream of the proposed Mong damsite.

The Walanae river at the alternative site flows in the hill masses. The both banks of the river form the gentle slope and the flat plain covered with terrace and talus deposits.

The height of top of the left hill is about 100 meters in elevation. The slope of the left hill is gentle. The flat terrace of the talus deposit extends from the end of the gentle slope to the Walanae river. The ground water seeps on the talus deposit near the boundary of the skirt of hill. Mudstone crops out at river side located immediately in the downward of the proposed dam site, where strike and dip is N 30°E and 13°S.

The slope of the left hill has no outcrop of rock due to thick overburden. It is, however, presumed that the skirt of the hill is underlain by the alternation of the mudstone and sandstone and the top of the hill is composed of coral limestone, this is presumed by the following reasons;

(a) the occurrence of mudstone at the river side.

(b) ground water seepage on the talus deposit.

(c) Occurrence of sandstone and coral limestone breccias in the talus deposits, tumbling from the hill.

The Walanae channel is filled with fine textured material such as silt and sand but not by gravel.

The top of the right of the hill is higher than the top of the left hill, about 130 meters in elevation, and forms steep cliff by the coral limestone at the top. The slope of the right hill is steep consisting of sandstone. Calcareous sandstone is not clear. The terrace deposit and the river deposit extends over the flood plain with the width of about 100 meters from the end of the steep slope to the right side of the Walanae. No outcrop of the base rock is found along the Walanae river side at the proposed axis.

The geological condition of the proposed Walimpong dam site is shown in Fig. 9.5.

7.2 DRILLING INVESTIGATION

During geological study of the Mong damsite, the Team requested the government to make another test drilling investigation at the Walimpong site for comparative study of subsurface geological conditions. Three boring points were located on the survey line, parallel at 50 metre downstream of the proposed dam axis. Each 50 m depth is selected on the both bank slopes and on the riverbed.

7.2.1 Drilling No.1

The drilling point was set at an elevation of 68.4 m on the left bank slope.

Soft and plastic clay of chocolate colour is covering on the surface with thickness of 4.3 m. It seems to be heavily weathered products of underlying claystone. An alternation of claystone and siltstone develops below the depth of 4.3 m. Standard penetration test value, obtained at every 3 m in the section 10 - 20 m depth, are more than 50. Between depth of 24.0 m and 40 m, unit layer of the alternation is rather thin, 0.2 - 0.5 m, fresh and grey to dark grey colour, weakly and medium consolidated, being pulverized between fingers. Four layers of thin limestone of less than one metre thickness is intercalated at the section between 17.0 - 30.0 m depth. Fossils of shell and bigger foraminifera and organic material are contained in every portion of the alternation.

Permanent groundwater table in the bore hole is 13.0 m below surface.

7.2.2 Drilling No.2

Hole No.2 is drilled at an elevation 35.29 m on the flat terrace at right bank side of riverbed.

River deposits occupies 10 m thickness from the surface, sandy clay in upper 5 metres and sand and pebble in lower 5 metres. An alternation of claystone and siltstone is underlying below depth of 10 m. Standard penetration tests at every 3 m in the section between 12 m and 21 m depth, show N-value of 30 - 45, representing weak or medium consolidation. Alternation below 22.5 m is thinly-laminated, the alternation is grey or dark grey in color and contains fossil of shell and big foraminifera and organic materials.

7.2.3 Drilling No.3

Boring No.3 is located at an elevation of 87.03 m on the right bank slope. Superficial 5 metre thick is limestone fragments of medium and bigger size and apparently to be a talus. But it may be weathered fragments derived from an exposed limestone body nearby. It is recorded in the geological columner section as a part of limestone. There is a less solidified sandy layer having penetration test value, N = 10 - 50, in the section between 5.0 m and 10.7 m depth. It is presumably a heavily weathered zone of underlying sandstone.

An alternation of sandstone and claystone comes below the depth of 10.7 m. Sandstone layers are intercalated at sections 10.7 m - 19.0 m and 30.9 m - 47.4 m. The upper sandstone is a little weathered and grey-chocolate coloured, being fragmental and moderately cemented. The lower sandstone is fresh and black coloured, well cemented, accompanying several thin layers of coarse-grained sandstone. Claystone layer intercalated between sandstone layer is fresh and black, medium and weakly consolidated. The alternation contains many fossils of shell and bigger foraminifera and organic materials.

7.3 PERMEABILITY OF FOUNDATION

Permeability tests under high water pressure were often failed at rather shallow portion of the bore holes. Permeability coefficient K at constant water head in the hole were measured instead.

Permeability coefficient K is calculated as follows;

$$K = \frac{Q}{2\pi LH} \log \frac{L}{r} \text{ cm/sec.}$$

Q:	poured water	cm^3/sec.
L:	measured length of bore hole	cm
H:	total water head	cm
r:	radius of bore hole	cm

In case of bore hole diameter of 56 mm, 1 Lugeon is approximately correspondent to 1×10^{-5} cm/sec.

General permeability in the foundation rock is summerised as follows;

(a) Permeability coefficients obtained by constant-waterhead method are mostly very big; $1 - 4 \times 10^{-3}$, especially at the depth 13.0 - 30.0 m in B. No.1. The alternation contains thin intercalation of limestone and cannot be porous or cracky. It is measured at the section below ground water level of -13.0 m. Big permeability value obtained in such a water-tight texture may suggests some erroneous measurements. Pressed contact of rubber packer would deform and break the wall of bore hole and induced pressure water would leak out through outside path of the packer, flowing out into the unsaturated layer above ground water level.

Thus the permeability at the depth of 13 - 30 m may be far smaller than those measured value and may presumably be similar to those in the depth of 30 m - 50 m, where rubber packer is set effectively. A bigger permeability was observed in the sandstone layer at the depth of 13 m - 18 m. It shows coarser texture of the sandstone compared with fine and compact texture of the claystone.

(b) Most parts of alternated formation show 20 - 30 Lugeon value at the high pressure permeability tests. In the process of high pressure permeability test, Lugeon value rises suddenly when increased pressure is applied. But no evidence was observed that the wall of bore hole is broken by the high pressure.

7.4 GEOLOGICAL CONDITIONS OF THE WALIMPONG DAMSITE

According to the geological survey by means of test drillings, foundation of the Walimpong damsite consist of Plio-Pleistocene formations; an alternation of claystone and siltstone (Mn) under the left bank slope and riverbed, and an alternation of claystone (Mn), sandstone (Sn) and coral limestone (Ln) under the right bank slope. These alternation formation is gently dipping from left bank to right bank.

L1 layer

L1 is a coral limestone exposed on the top of the right bank slope and its base elevation is supposed to be at an elevation of 82 m, as proved by the test boring No.3. This layer is same as that exposed on the top of the left bank slope in the Mong Damsite. It is too much permeable and unsuitable for dam foundation.

S1 layer

S1 is a sandstone exposed at the top of the steep slope on the right bank slope. It is also found at the depth of 5 - 9 m in the boring No.3. It is a little weathered and rather loose in consolidation. It is rather permeable, having rather high $K = 3 \times 10^{-4} - 1 \times 10^{-3}$ cm/sec., in the constant head permeability tests.

M1 layer

It is found at the depth of 19 - 31 m in the boring No.3. It does not crop out on the surface due to covering of surface soil. It is black coloured in fresh conditions, fossiliferous, and weakly to medium consolidated, having permeability of less than Lugeon 20.

S2 layer

S2 is exposed at the foot of the right bank slope and observed at the depth of 31 - 47 m in the boring No.3. Several thin layers of coarse-grained sandstone (less than 0.5 m thick) are intercalated. It is black coloured and fossiliferous. Its fresh faccies is well-consolidated. Permeability is 60 Lugeon in the uppermost 3 m range, but mostly less-than 10 Lugeon.

M2 layer

M2 is an alternation of claystone and siltstone which is developing under the left bank slope and under the riverbed, extending to the lower part under the right bank slope. Total thickness is more than 50 m. It is observed at test boring No.1 and No.2, and characteristic in fine lamination.

Under the left bank slope, several thin limestone of less than 1 m thickness are intercalated. It contains fossil of shell and foramifera and some organic materials. Its fresh faccies are weakly or moderately consolidated, having standard penetration value 30 - 50. It decays into soft clay when heavily weathered. Permeability tests in the M2 layer sometimes show bigger value but, as mentioned in the above articles, true permeability is presumed as 20 - 30 Lugeon.

7.5 POSSIBILITY OF DAM CONSTRUCTION

A fill-type dam can be built on the Walimpong site where an alternation of claystone and siltstone M2 occupies most part of the foundation, on conditions of special consideration in the design and construction procedures as follows;

(a) Dam crest should be set below elevation of 82 m to avoid contact with porous coral limestone at the top of the left bank slope.

(b) Heavily weathered cover of the foundation rock should be thoroughly excavated and removed prior embankment of dam body. Even fresh alternation of claystone and siltstone (M2) has soft intercalation of N = 30 - 50 in standard penetration value, representing lower consolidation. Careful treatment of consolidation grouting is necessary to increase bearing strength of foundation.

(c) A part of M2 layer has higher permeability. Supplementary chemical grouting will be necessary in the M2 layer to improve normal curtain grouting of cement milk.

7.6 EMBANKMENT MATERIALS

Fine grain material for impervious core can be obtained in the weathered products and talus deposits on the claystone-siltstone alternation on the left bank slope. Coarse grain material for random fill can be supplied from talus and river gravel deposits around the damsite. In case rockfill type dam, a limestone hill, 3.5 km upstream of the damsite can supply rock materials.

CHAPTER VIII COMPARISON OF GEOLOGICAL CONDITIONS IN THE MONG AND WALIMPONG DAMSITE

8.1 COMPARISON OF GEOLOGICAL CONDITIONS

Foundation rocks in the Mong and the Walimpong sites are both composed of Plio-Pleistocene alternation of claystone, siltstone, sandstone and limestone. The sequence and composition of stratification are characteristic in each site.

(a) In the Mong damsite, unit layer of silstone, sandstone and limestone are repeatedly bedded with similar thickness. In the Walimpong damsite, on the other hand, claystone and siltstone members occupy must part of the alternation. Sandstone member is intercalated as a minor member. There is no thick limestone.

(b) Consolidation of fresh rock in the foundation of the Mong damsite is rather better than that of the Walimpong damsite.

(c) General permeabilities in two damsites are almost evenly matched. But the Walimpong site is more preferable because there occurs no porous limestone layer.

(d) Coral limestone which are exposed at upper abutment slope in the both damsites would restrict the height of dam crest, because of their porosity. These limestone occur at an elevation 68 m in the Mong damsite and 82 m in the Walimpong damsite.

(e) Availability of construction materials around the two damsites is almost similar.

Summarizing above mentioned conditions, the Walimpong damsite has more favourable conditions than the Mong damsite, because the former is mostly occupied with claystone and siltstone and contains no sizable limestone which might cause groundwater leakage.

8.2 CONCLUSION

Preliminary rough comparison in this stage shows that geological conditions in the Walimpong damsite is more favourable for dam construction than those of the Mong damsite. Nevertheless, there are some problems to be solved in further detailed investigations.

(a) A number of test boring should be drilled around the proposed dam axis to investigate further extension of subsurface structure of foundation rocks.

(b) Especially, bearing strength and permeability of the alternating rock formation are most important for foundation treatment program. Detailed feature of these qualities in the foundation should be thoroughly studied by subsurface investigation.

(c) Bearing strength of foundation under the appurtenant structures, such as overflow gates and energy dissipator structures of spillway, should also be carefully studied to establish sufficient treatments.

(d) Detailed quality and quantity survey of embankment material should be carried out to set suitable borrow pit, quarry site and reasonable transportation.

CHAPTER IX GEOLOGICAL CONDITIONS OF INTAKES AND DAMSITES

The geological investigation were carried out on the intake and damsites of the proposed irrigation development projects by means of surface exploration. The general geology of the sites is described hereunder.

9.1 LANGKEMME INTAKE WEIR SITE (SEE FIG. 9.8)

Two alternative sites for an intake weir are conceived in view of topography on the Langkemme river; upstream site and downstream site. The upstream site is located 5.5 km upstream of the confluence of the Sero river. The alternative site is selected 200 m downstream from the upstream site.

The upstream site is in a canyon where an existing boulder dyke intake is present.

The left abutment rises on a very steep slope for more than 300 meters. Though the slope is mostly covered with soil, the base rock is assumed to be well cemented tuff breccia by some outcrops and tumbling rock blocks.

The right abutment rises on a cliff for about 10 meters, becomes a moderate slope and, then upward, ascends a very steep slope for more than 200 meters. On the cliff crops out well cemented tuff breccia which shows wide spacing vertical joint system. Tumbling down of rock blocks with a few meter dimension separated from joints may be foreseen even though it happens rarely.

The river bed is covered with andesite boulders and large tuff breccia blocks which tumbled down from the cliffs of both banks. The thickness of andesite boulders is expected to be 2-3 meters overlying the base rock of well cemented tuff breccia.

The site will be suitable for weir construction, however, protection work is to be taken in account of for the intake structure and conduit canal along the foot of steep slope against tumbling down of rock blocks.

As for the downstream site, the left abutment rises on a steep slope for about 10 meters and then on a gentle slope. The slope is also formed of well cemented massive tuff breccia. Top soil and scree overlie the base rock of the tuff breccia thinly on a steep slope, probably less than 1 meter, but rather thick on the gentle slope.

The river forms a deep pool at the site, so that deposits could not be observed. However, the well cemented massive tuff breccia is to occur at the bottom.

The right bank shows a steep slope formed of the well cemented tuff breccia. Top soil and scree seem thin on the slope. Minor talus deposits occur at the slope foot.

The tuff breccia is well consolidated though having a moderate spacing joint system. The downstream site is also suitable for construction of a high concrete made weir.

9.2 BILA INTAKE WEIR SITE (SEE FIG. 9.9)

The intake weir is sited 9 km upstream of the confluence of the Kalola river.

The left abutment of the site rises on a steep slope for about 25 meters on which an alternation of cemented mudstone and conglomerate probably of Pliocene deposits crops out in places. Top soil and weathered materials to be removed are presumed to be thin.

The river forms a pool, probably eroding the base rock of the said alternation. Boulders of hard rock of gneiss, schist, sandstone, andesite are deposited immediately downstream of the proposed site. Silt deposits are seen at the right side of the river channel.

The right abutment rises on a steep cliff of a terrace for about 8 meters and is topped by a flat plain of the terrace which is about 200 meters in width and formed of uncemented massive soft silt and of partly basal gravel. Further to the right occurs a gentle slope of a hill formed of the base rock of the alternation.

The fixed type concrete weir can be placed on the base rock at the present river channel. However, careful foundation treatment will be required in consideration of poor shearing strength of mudstone, specially weathered zone, and permeable conglomerate beds since such base rock does not seem so well cemented.

In addition, the embankment on the terrace is to have a sufficient cutoff to a firm base rock against leakage through uncemented silt of the terrace deposits.

9.3 SANREGO INTAKE WEIR SITE (SEE FIG. 9.10)

The intake weir site is selected on the Sanrego river 15 km upstream of the confluence of the Walanae river.

The left bank of the intake site shows a cliff for about 18 meter formed of the alternation of cemented mudstone and sandstone of Tertiary with N 40° - 60°E in strike and 8°W (upstream direction) in dip, and unconformably covered by well cemented massive tuff breccia. Tumbling blocks of tuff breccia are present at its foot.

The river bed is partly covered with cobble and boulder of andesite and limestone, and partly formed of outcropping sandstone. At the right side of the stream channel a pool are present, probably along weak zone of the base rock.

The right bank is formed of alluvial terrace around three meters higher than river bed. Further to the right around 70 meters from the river, a gentle slope occurs over that alluvial terrace. The terrace is composed of cobble to boulder of andesite and limestone probably overlying the alternation of mudstone and sandstone. The thickness is presumed to be about 5 meters or so. On the gentle slope weathered sandstone crops out in places below top soil.

The proposed site will be suitable for construction of fixed type concrete weir. However, careful treatment will be needed on weak zone along the unconformable contact between the alternation and tuff breccia. Cutoff work is required through the terrace to a depth to the firm foundation against leakage through terrace deposits and an assumed fault.

9.4 LAWO INTAKE WEIR SITE (SEE FIG. 9.11)

The intake weir is proposed to construct 0.6 km upstream of the road crossing near the Lawo water level gauging station.

The left abutment of the site rises on an alluvial terrace, on a steep slope for about five meters and then, on a gentle slope upward. The slope will consist of hard andesite rock covered with thin talus deposits. The thickness of such talus and weathered zone to be removed for eventual construction is probably 2 - 3 meters.

On the river bed firm andesite crops out in places. Andesite boulders covering partially the base rock of andesite will be less than 1 meter in thickness.

The right bank is formed of gentle slope of talus and gravel, and then, steep slope of an andesite rock mass. The thickness of overburden will be 2 - 5 meters.

The andesite base rock is massive and hard. The proposed site is quite adequate for construction of a fixed type concrete weir.

9.5 BOYA INTAKE WEIR SITE

In order to irrigate the project area of 10,000 ha, the rise of the water level to 30 m in elevation is required at the intake site. As the result of the investigation, no better alternative site can be found out near the existing Bulu Cenrana intake weir site. It is recommendable that the existing weir is raised up to the required level.

The present existing weir is completely placed on a outcropping firm rock and the site is the only place that can provide firm foundation to all the weir base, where the base rock of cemented sandstone and mudstone rises as a low ridge crossing the river.

At immediately up and downstream of the existing weir site, both banks consist of terrace formed of massive soft silt. On the river bed the cemented sandstone outcropping at the apron plunges immediately under river bed gravel toward downstream.

9.6 GILIRANG DAMSITE (SEE FIG. 9.12)

The damsite is proposed in a narrow gorge of the middle reach of the Gilirang river dissecting hill masses of Pliocene formation.

The reservoir area is underlain and enclosed by the alternation of cemented mudstone, sandstone and conglomerate. Therefore, the reservoir will be water tight. A minor scale land slide was caused on a gentle slope of a hillside in the reservoir area, however, no successive rapid fall could not be expected because of low dip of the sliding mass but gradual slide down may be presumed. Such a land slide will not cause considerable difficulties in preparing dam construction because of little scale.

The left abutment of the damsite rises on the moderately steep slope, then, become gentle slope upward. The slope is commonly covered with top soil and scree overlying the base rock of the alternation of cemented mudstone sandstone and conglomerate.

The gravel of andesite covers the river bed probably with 1 to 2 meters in thickness overlying the said alternation. Such base rock crops out at the left side of the river channel, with N 20°E in strike and 7°N in dip.

The right bank shows a steep cliff for about 35 meters and is topped by a flat ridge. The weathered conglomerate crops out on the cliff while minor talus deposits are seen at the foot of that cliff. The narrow round shaped ridge is covered with top soil, probably 2 to 3 meters in thickness.

The proposed site will permit to place a fill type dam with high water level, at maximum, of 50 meters above mean sea level. The base rock is to be more studied, specially on permeability of conglomerate. Excavation of the slope in eventual construction is to be carefully made against sliding.

9.7 PADENGANG DAMSITE (SEE FIG. 9.13)

A damsite is selected at the canyon in the Padangeng river, 1 km southwest of the village Tajuncu.

The left abutment rises on a steep cliff for about 35 meters where andesite and andesitic tuff breccia crop out in places. The cliff is topped by a flat plain. Top soil and scree seem thin through the left abutment.

The river bed is covered with andesitic gravel with thickness of around 1 meter overlying the andesitic base rock.

The right abutment is formed of a narrow ridge consisting of andesite. The overburden on ridge slope is thin, however, talus deposits occur at its foot with a thickness of around five meters or so.

The andesite and tuff breccia rock are well cemented and moderately jointed, however, such joint seems in general to be close contact and rock mass will have sufficient strength. The fresh base rock mass will provide a suitable foundation for a concrete gravity dam and for a filltype dam, after grout treatment.

9.8 CENRANAE PUMP STATION SITE

The Cenranae pump station is conceivable at the southern edge of Sengkang on the left bank of the Cenranae river.

The alluvial flood plain lies along the Cenranae river. The geological investigations by means of Swedish soundings and cone penetration tests were carried out along the river course. The results indicate that the Cenranae river bed is mainly composed of very soft silt with the standard penetration values of 0 to 3. This layer extends about 8 to 9 m in depth below the ground surface. No lithological condition of this layer is well known, however, N value of the base layer will range from 6 to 13. If the pump station is constructed near the river, the pile foundation with more than 10 m in depth will be required.

On the north of the confluence of the Cenranae and the Walanae rivers, the hill which is underlain by mudstone is located. By constructing the inlet channel near the hill, the pumping station will be founded on the bed rock.

9.9 BATU PUTE RIVER DAMSITE

The geological investigation was conducted to find the desirable damsites on the Batu Pute river, to irrigate the area of about 6,000 ha.

The topographically conceivable site for dam is located about 4 km west of the village of Tanabatue and immediately downstream of the confluence of a tributary. It is presumed on the geology around the site that a thick cemented welded tuff develops widely along the river bed underlying a well cemented tuff breccia which crops out at the hill tops.

The left abutment of the site rises on a waving surface of moderate steep slope of talus deposits containing many fresh blocks of welded tuff. Above the talus deposits at around 200 meters in elevation occurs a cliff of tuff breccia. At an outcrop below the talus deposits tuff breccia is intensely cracked. An open crack is seen at a part on the top of the talus deposits. This suggests that the talus deposits has been formed by a land side, probably in the cracked and weathered welded tuff and that the slope is placed in the condition of jeopardy. The height and width of such dangerous slope are around 50 meters and 150 meters, respectively.

Boulders of andesite and limestone rest on the river bed presumably with 5 meters covering tuff breccia. At the left side of the river channel, blocks of tuff breccia of the talus are present at the proposed site, while, a mass of welded tuff crops out under a gully immediately downstream of the site. Besides, at the right side, the welded tuff crops out along the river channel showing cubic joint system.

The right bank is formed of a steep slope of a ridge end for about 100 meters. The ridge consists of welded tuff and the overlying well cemented tuff breccia. The boundary between them is probably located at around 190 - 200 meters in elevation. Top soil and scree cover the slope, probably with 3 meters or less in thickness.

The fresh base rock of both welded tuff and tuff breccia will provide a firm foundation for a concrete gravity type or a rockfill type dam after grout treatment, so the right abutment and the river bed will be favorable for the dam construction. However, the left bank slope can not be considered a safe abutment because of fear of land slide. Such talus deposits and cracky zone of welded tuff, with enormous volume are to be removed and disposed for eventual construction of a dam. Fault zones are to be treated if they are present. It is doubtful that the dam which is required to have such great treatment is economically constructed at this stage.

As for an alternative site locating immediately downstream from the above mentioned site, it is also not recommendable for dam construction even though topographic and geologic condition of the alternative site may be suitable, because of fear of overtopping of waving water to be caused in case of rapid landslide.

Table 9.1 (1) Investigated Points of Sounding Test

No.	Name of River	Location				Method
		Map (1/25,000)	Latitude	Longitude	Name of Village	
1.	Cenranae	UJUNG	94.1	25.7	Tawaroe	SS-Test
2.	Cenranae	POMPANUA	83.9	32.2	Pompanua	SS-Test
3.	Cenranae	SENGKANG	71.8	38.4	Lapaccecci	SS-Test
4.	Cenranae	SENGKANG	71.8	38.6	Lijung Baru	SS-Test
5.	Cenranae	SENGKANG	70.6	40.3	Madukelleng	SS-Test
6.	Cenranae	SENGKANG	70.0	40.3	Tonvongeng	SS-Test
7.	Walanae	SOPPENG	67.2	33.2	Canru	SS-Test
8.	Walanae	SOPPENG	30.1	22.1	Watan Lompule	SS-Test
9.	Lake Tempe	TANCUNG	68.7	49.8	Tancung	SS-Test
10.	Lake Tempe	BATU BATU	22.7	42.3	Batu-Batu	SS-Test
11.	Bila	TANRUTEDONG	32.4	68.2	Tanru Tedong	SS-Test
12.	Bila	TANRUTEDONG	29.5	58.4	Tokkade	CP-Test
13.	Lake Sidenreng	D. TEMPE	24.2	53.6	Lautang	CP-Test
14.	Lake Sidenreng	PANGKAJENE	17.8	65.0	Empagae	SS-Test
15.	Lake Sidenreng	PANGKAJENE	14.4	58.2	Teteaji	SS-Test
16.	Lake Sidenreng	D. TEMPE	21.3	50.6	Wattae	SS-Test

Remarks: SS-Test: Swedish Sounding Test
CP-Test: Cone-penetration Test

Table 9.1 (2) Investigated Points of Sounding Test

No.	Name of River	Location				Method
		Map (1/25,000)	Latitude	Longitude	Name of Village	
17.	Cenranae	SENGKANG	72.6	38.0	Lempo	SS-Test
17.1		SENGKANG				CP-Test
17.2		SENGKANG				CP-Test
18.	Cenranae	SENGKANG	70.1	40.4	Madurolleng	SS-Test
18.1		SENGKANG				CP-Test
18.2		SENGKANG				CP-Test
19.	Lake Tempe	BATU-BATU	30.0	35.75	Salopokko	SS-Test
19.1		BATU-BATU				CP-Test
19.2		BATU-BATU				CP-Test
20.	Lake Tempe	BATU-BATU	30.4	35.5	Salopokko	SS-Test
20.1		BATU-BATU				CP-Test
20.2		BATU-BATU				CP-Test
21.	Lake Tempe	D. TEMPE	27.75	53.6	Tancung	SS-Test

Table 9.2 (1) N-value

Test Point No.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Kind of Test		SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	CP	CP	SS	SS	SS
Ground Elevation (m)		2	4.5	7	8	16	7	10	16.5	9	7.5	17	8	9	13	8.5	9
Depth (m)	0	0	1	0	3	2	0	1	11	1	1	2	1	1	1	1	1
	1	1	0	2	3	1	1	1		5	1	2	0	0	5	1	1
	2	1	3	2	3	1	1	2		0	0	1	0	1	7	14	0
	3	1	2	1	2	2	0	3		0	1	1	1				7
	4	0	2	2	2	2	0	3		2	0	1					8
	5	0	2	1	3	2	1	7		1	5	0					
	6	0	1	2	3	1	1			1	11	0					
	7	1	0	0	2	0	0			1		1					
	8	6	3	3	1	2	0			2		0					
	9		13	8	0	2	0			6		0					
	10				0	7	3					0					
	11				0		9					0					
	12				5							7					
	13				8							8					
	14											7					
	15											8					
	16											11					

Remarks: SS: by Swedish Sounding Test
CP: Cone-penetration Test

Table 9.2 (2) <u>N-value</u>

Test Point No.		17	17.1	17.2	18	18.1	18.2	19	19.1	19.2	20	20.1	20.2	21
Kind of Test		SS	CP	CP	SS	CP	CP	SS	CP	CP	SS	CP	CP	SS
Ground Elevation		7	7	7	7	7	7	7.5	7.5	7.5	7.5	7.5	7.5	7
Depth (m)	0	0	0	1	0	0	0	0	1	1	0	0	0	0
	1	2	0	0	0	1	1	2	1	0	0	1	0	0
	2	0	1	0	1		0	0	1	1	0	1	0	0
	3	0			0			0			2			0
	4	2			0			1			2			0
	5	2			0			1			2			3
	6	5			0			3			1			1
	7	4			0			5			0			5
	8	6			2			11			0			0
	9	6			4						0			10
	10	6			3						0			9
	11	4			4						2			9
	12	8			2						2			10
	13	10			3						5			
	14				3						8			
	15				9									
	16													
	17													

Table 9.3 Results of Water Pressure Test at Mong Damsite

Dr. No.	Depth	Type	Lugeon	Max. Pressure	Geology	
1.	8-10	D	Broken	4-6 kg/cm^2	Lmst	weakly-C. porous cracky
	10-15	A	90	0.2	Lmst, slst	weakly-C. porous cracky
	15-20	A	60	0.5	C-S.S.	weakly-C. porous
	20-25	B	30	3	C-S.S., slst, Lmst	poorly-C. sticky
	25-30	B	20	5	Lmst, slst, S.S.	weakly-C. sticky
	30-35	C	7	10	S.S., slst	weakly-C. sticky
	35-40	A	60	1	slst, Lmst	weakly-C. sticky fragment
	40-45	A	80	1.5	Lmst	well-C. fragment
	45-50	C	10	10	Lmst, slst	well-C. porous
2.	11-15	C	1	3	S.S., slst	un-weakly-C.
	16-20	B	30	1.2	slst	weakly-C. sticky-platy
	20-25	B	15	4	slst	weakly-C. sticky-platy
	25-30	B	30	2.6	S.S./	cemented fragment
	30-35	D	Broken	3-6	S.S. - slst	cemented sticky-fragment
	35-40	C	3	10	C-S.S.	cemented sticky porous
	40-45	C	5	8	slst-C-S.S.	weakly-C. sticky fragment
	45-50	C	7	9	C-S.S. Lmst	cemented sticky fragment
3.	5-10	A	100	0	C.S.S./	weathered poorly-C. porous
	10-15	A	80	0	slst, Lmst	weathered un-C. porous
	15-20	A	70	0	slst	weathered un-C.
	20-25	B	20	3.5	S.S.	un-well-C. sticky
	25-30	C	10	6	S.S., C-S.S.	well-C. sticky
	30-35	C	10	6	C-S.S., S.S.	well poorly-C
	35-40	Not - injected			slst	weakly-C. massive
	40-45	C	1	6	slst	cemented massive
	45-50	C	7	9	slst, S.S.	well-C. sticky

*1 Lmst - limestone, slst - siltstone
S.S. - sandstone, C-S.S. - calcareous sandstone

*2 (weakly)-C - (weakly) cemented

Table 9.4 (1) Results of Water Pressure Test at Walimpong Damsite

Dr. No.	Depth	Method	Lu or K		Max. Pressure	Geology
1.	0- 5	Cont-M	K	1×10^{-6}	0.3	Clay
	11-13	Lu-M	Lu	34	0.3	Claystone
	13-16	Cont-M	K	3.5×10^{-3}	1.3	Claystone
	16-19	Cont-M	K	2.5×10^{-3}	1.3	Claystone
	19-22	Cont-M	K	3.6×10^{-3}	1.3	Claystone
	22-25	Cont-M	K	5.0×10^{-3}	1.3	Claystone (partly limestone)
	25-28	Cont-M	K	8.8×10^{-4}	1.3	Claystone (partly limestone)
	28-31	Cont-M	K	1.0×10^{-3}	1.3	Claystone, siltstone
	31-34	Lu-M	Lu	1.0	4.5	Alternation of claystone and siltstone
	34-37	Cont-M	K	1.3×10^{-3}	1.3	Alternation of claystone and siltstone
	37-40	Lu-M	Lu	40	0.9	Alternation of claystone and siltstone
	40-43	Lu-M	Lu	39	0.9	Claystone
	43-46	Lu-M	Lu	24	2.0	Claystone
	47-50	Lu-M	Lu	<1	6.0	Siltstone
2.	10-12	Cont-M	K	1.2×10^{-5}	1.0	Claystone
	12-15	Cont-M	K	1.7×10^{-3}	1.0	Claystone
	15-18	Cont-M	K	8.1×10^{-4}	1.0	Claystone
	18-21	Cont-M	K	5.0×10^{-6}	1.0	Alternation
	22-24	Lu-M	Lu	<1	1.3	Alternation
	24-27	Lu-M	Lu	30	2.1	Alternation
	27-30	Lu-M	Lu	20	3.6	Alternation
	31-33	Lu-M	Lu	3	3.6	Alternation
	33-36	Lu-M	Lu	<1	5.1	Alternation
	36-39	Lu-M	Lu	30	5.2	Alternation
	39-42	Lu-M	Lu	15	5.2	Alternation
	42-45	Lu-M	Lu	15	2.1	Alternation
	45.5 -47.5	Lu-M	Lu	1	9.6	Alternation
	49-50	Lu-M	Lu	3	6.6	Alternation

Table 9.4 (2) Results of Water Pressure Test at Walimpong Damsite

Dr. No.	Depth	Method	Lu or K		Max. Pressure	Geology
3.	0- 3	Cont-M	K	8.8×10^{-6}	0.2	Talus
	3- 6	Cont-M	K	3.7×10^{-4}	0.4	Talus
	6- 9	Cont-M	K	4.6×10^{-6}	0.9	Sand
	9-12	Cont-M	K	2.5×10^{-3}	0.4	Sand and sandstone
	12-15	Lu-M	Lu	90 >	2.2	Sandstone
	15-18	Cont-M	K	1.0×10^{-3}	1.8	Sandstone
	18-21	Lu-M	Lu	15	5.6	Sands, claystone
	21-24	Lu-M	Lu	20	6.6	Claystone
	24-27	Lu-M	Lu	5	4.9	Claystone
	27-30	Lu-M	Lu	<1	6.0	Claystone
	30-33	Lu-M	Lu	60	2.0	Sandstone
	33-36	Lu-M	Lu	10	3.3	Sandstone
	36-39	Lu-M	Lu	10	4.7	Sandstone
	39-42	Lu-M	Lu	1	8.5	Sandstone
	42-45	Lu-M	Lu	5	7.8	Sandstone
	45-48	Lu-M	Lu	5	7.2	Sandstone
	48-50	Lu-M	Lu	15	8.0	Claystone

Cont-M: Constant head method
Lu-M : Lugeon method
K : Coefficient of permeability cm/sec
Lu : Lugeon value ℓ/min/m

RECORDS OF WATER PRESSURE TESTS

AT MONG DAMSITE

RECORD OF WATER PRESSURE TEST

PROJECT: Central South Sulawesi Water Resources Dep — LOCALITY: MONO DAMSITE, RIGHT BANK

BORE-HOLE No.: № 1 – 1 — GROUND WATER LEVEL: 9.00 below GL

DATE	DEPTH	SECTION LENGTH	HOLE RADIUS	SUPPLIED WATER PRESSURE: PRESSURE	SUPPLIED WATER PRESSURE: HEAD	STATIC HEAD IN HOLE	PRESSURE GAUGE HEIGHT	TOTAL HEAD $H_p+H_s+H_g$	WATER LEAKAGE		CALCULATING CONST. $\frac{2.3}{2\pi}\times\frac{1}{60}\times\frac{1}{L}\log\frac{L}{r}$	$\frac{Q}{H}$	COEFFICIENT OF PERMEABILITY	LUGEON UNIT
	m – m	L cm	r cm	P kg/cm²	Hp cm	Hs cm	Hg cm	H cm	Q' l/min	Q cm³/min	C min/cm·sec	cm²/min	K=Q/H×C cm/sec	Lu=Q'/L·H×10⁶
17/MAR	8 – 10	200	Zr = 5.6	2	2000	600	75	2675		2800	5.65 × 10⁻⁵		5.91 × 10⁻⁵	5.2
1979				4	4000	600	75	4675		18200			2.20 × 10⁻⁴	19
				6	6000	600	75	6675			break			
17/MAR	10 – 15	500	5.6	0.2	200	600	50	850		41600	2.74 × 10⁻⁵		1.34 × 10⁻³	98
18/MAR	15 – 20	500	5.6	0.5	500	930	90	1520		48000	2.74 × 10⁻⁵		8.65 × 10⁻⁴	63
20/MAR	20 – 25	500	5.6	2	2000	930	119	3049		54800	2.74 × 10⁻⁵		4.92 × 10⁻⁴	36
				3	3000	930	119	4049		65000			4.40 × 10⁻⁴	32
				2	2000	930	119	3049		40200			3.61 × 10⁻⁴	26
21/MAR	25 – 30	500	5.6	2	2000	850	100	2950		26300	2.74 × 10⁻⁵		2.44 × 10⁻⁴	18
				3	3000	850	100	3950		41300			2.86 × 10⁻⁴	21
				5	5000	850	100	5950		62700			2.89 × 10⁻⁴	21
				3	3000	850	100	3950		45000			3.12 × 10⁻⁴	23
				2	2000	850	100	2950		28000			2.60 × 10⁻⁴	19
22/MAR	30 – 35	500	5.6	3	3000	900	107	4007		1900	2.74 × 10⁻⁵		1.30 × 10⁻⁵	0.9
				6	6000	900	107	7007		2700			1.06 × 10⁻⁵	0.8
				10	10000	900	107	11007		38300			9.53 × 10⁻⁵	7
				6	6000	900	107	7007		6900			2.70 × 10⁻⁵	2
				3	3000	900	107	4007		3900			2.67 × 10⁻⁵	2
22/MAR	35 – 40	500	5.6	1	1000	900	153	2053		63400	2.74 × 10⁻⁵		8.46 × 10⁻⁴	62
24/MAY	40 – 45	500	5.6	1	1000	200	100	1300		52700	2.74 × 10⁻⁵		1.11 × 10⁻³	81
				1.5	1500	200	100	1800		75700			1.15 × 10⁻³	84
				1	1000	200	100	1300		53100			1.12 × 10⁻³	82
27/MAY	45 – 50	500	5.6	3	3000	100	75	3175		19000	2.74 × 10⁻⁵		1.64 × 10⁻⁴	12
				6	6000	100	75	6175		33000			1.46 × 10⁻⁴	11

RECORD OF WATER PRESSURE TEST

PROJECT: Central South Sulawesi Water Resources Dep
LOCALITY: MONG DAMSITE , RIGHTBANK
BORE-HOLE No.: № 1 − 2
GROUND WATER LEVEL:

DATE	DEPTH	SECTION LENGTH	HOLE RADIUS	SUPPLIED WATER PRESSURE		STATIC HEAD IN HOLE	PRESSURE GAUGE HEIGHT	TOTAL HEAD	WATER LEAKAGE		CALCULATING CONST.	$\frac{Q}{H}$	COEFFICIENT OF PERMEABILITY	LUGEON UNIT
				PRESSURE	HEAD			$H_p+H_s+H_g$			$\frac{2.3}{2\pi}\times\frac{1}{60}\times\frac{1}{L}\log\frac{L}{r}$			
	m− m	L cm	r cm	P kg/cm²	Hp cm	Hs cm	Hg cm	H cm	Q' ℓ/min	Q cm³/min	C min/cm·sec	cm²/min	K=Q/H×C cm/sec	Lu=Q'/L·H×10⁴
	45 − 50	500	5.6	10	10000	100	75	10175		44500	2.75×10^{-5}		1.20×10^{-4}	8.7
	(cont)			6	6000	100	75	6175		32500			1.44×10^{-4}	11
				3	3000	100	75	3175		22800			1.97×10^{-4}	14

RECORD OF WATER PRESSURE TEST

PROJECT Central South Sulawesi Water Resources Dep **LOCALITY** MONG DAMSITE . LEFT BANK

BORE-HOLE No. №. 2 − 1 **GROUND WATER LEVEL** 21.5 m below GL

DATE	DEPTH	SECTION LENGTH	HOLE RADIUS	SUPPLIED WATER PRESSURE: PRESSURE	SUPPLIED WATER PRESSURE: HEAD	STATIC HEAD IN HOLE	PRESSURE GAUGE HEIGHT	TOTAL HEAD $H_p+H_s+H_g$	WATER LEAKAGE		CALCULATING CONST. $\frac{2.3}{2\pi}\times\frac{1}{60}\times\frac{1}{L}\log\frac{L}{r}$	$\frac{Q}{H}$	COEFFICIENT OF PERMEABILITY	LUGEON UNIT
	m− m	L cm	r cm	P kg/cm²	Hp cm	Hs cm	Hg cm	H cm	Q' ℓ/min	Q cm³/min	C min/cm·sec	cm²/min	K=Q/H×C cm/sec	Lu=Q'/L·H×10⁶
14/MAR	11.60 − 15.00	340	zr= 7.6	1	1000	750	108	1858		900	3.5×10^{-5}		1.70×10^{-5}	1.4
1979				2	2000	750	108	2858		400			4.70×10^{-6}	0.4
				3	3000	750	108	3858		1000			9.07×10^{-6}	0.8
				2	2000	750	108	2858		650			7.96×10^{-6}	0.7
				1	1000	750	108	1858		300			5.65×10^{-6}	0.5
15/MAR	16.00 − 20.00	400	zr = 5.6	0.4	400	1200	135	1735		19400	3.28×10^{-5}		3.67×10^{-4}	28
				0.8	800	1200	135	2135		25400			3.90×10^{-4}	30
				1.2	1200	1200	135	2535		33000			4.27×10^{-4}	33
				0.8	800	1200	135	2135		27400			4.21×10^{-4}	32
				0.4	400	1200	135	1735		18400			3.48×10^{-4}	27
15/MAR	20.00 − 25.00	500	5.6	1	1000	1200	180	2380		1000	2.74×10^{-5}		1.15×10^{-5}	0.8
				2	2000	1200	180	3380		1200			9.73×10^{-6}	0.7
				3	3000	1200	180	4380		16200			1.01×10^{-4}	7
				2	2000	1200	180	3380		13400			1.09×10^{-4}	8
				1	1000	1200	180	2380		5200			5.99×10^{-5}	4
				3	3000	1200	180	4380		24900			1.56×10^{-4}	11
				4	4000	1200	180	5380		39400			2.01×10^{-4}	15
				3	3000	1200	180	4380		30000			1.88×10^{-4}	14
18/MAR	25.00 − 30.00	500	5.6	1	1000	1750	210	2960		14200	2.74×10^{-5}		1.31×10^{-4}	10
				2	2000	1750	210	3960		33500			2.32×10^{-4}	17
				2.6	2600	1750	210	4560		34700			2.09×10^{-4}	15
				2	2000	1750	210	3960		27500			1.90×10^{-4}	14
				1	1000	1750	210	2960		12600			1.17×10^{-4}	9
20/MAR	30.00 − 35.00	500	5.6	1	1000	2080	50	3130		660	2.74×10^{-5}		5.78×10^{-6}	0.4
				3	3000	2080	50	5130		2760			1.47×10^{-5}	1
				6	6000	2080	50	8130		8100 →	break			

RECORD OF WATER PRESSURE TEST

PROJECT: Central South Sulawesi Water Resources Dep

LOCALITY: MONG DAMSITE

BORE-HOLE No.: № 2 — 2

GROUND WATER LEVEL:

DATE	DEPTH	SECTION LENGTH	HOLE RADIUS	SUPPLIED WATER PRESSURE: PRESSURE	SUPPLIED WATER PRESSURE: HEAD	STATIC HEAD IN HOLE	PRESSURE GAUGE HEIGHT	TOTAL HEAD $H_p+H_s+H_g$	WATER LEAKAGE		CALCULATING CONST. $\frac{2.3}{2\pi}\times\frac{1}{60}\times\frac{1}{L}\log\frac{L}{r}$	$\frac{Q}{H}$	COEFFICIENT OF PERMEABILITY	LUGEON UNIT
	m— m	L cm	r cm	P kg/cm²	Hp cm	Hs cm	Hg cm	H cm	Q′ ℓ/min	Q cm³/min	C min/cm·sec	cm²/min	K=Q/H×C cm/sec	Lu=Q′/L·H×10⁶
21/MAR	35 — 40	500	5.6	3	3000	1900	145	5045		2900	2.74×10^{-5}		1.58×10^{-5}	1
				6	6000	1900	145	8045		4200			1.43×10^{-5}	1
				10	10000	1900	145	12045		19800			4.50×10^{-5}	3
				6	6000	1900	145	8045		13300			4.53×10^{-5}	3
				3	3000	1900	145	5045		6300			3.42×10^{-5}	2
22/MAR	40 — 45	500	5.6	3	3000	1920	95	5015		5400	2.74×10^{-5}		2.95×10^{-5}	2
				6	6000	1920	95	8015		24400			8.34×10^{-5}	6
				8	8000	1920	95	10015		26400			7.22×10^{-5}	5
				6	6000	1920	95	8015		19800			6.77×10^{-5}	5
				3	3000	1920	95	5015		11800			6.45×10^{-5}	5
23/MAR	45 — 50	500	5.6	3	3000	2150	160	5310		10200	2.74×10^{-5}		5.26×10^{-5}	4
				6	6000	2150	160	8310		24200			7.98×10^{-5}	6
				9	9000	2150	160	11310		37800			9.16×10^{-5}	7
				6	6000	2150	160	8310		20600			6.79×10^{-5}	5
				3	3000	2150	160	5310		10400			5.35×10^{-5}	4

RECORD OF WATER PRESSURE TEST

PROJECT Central South Sulawesi Water Resources Dep **LOCALITY** MONG DAMSITE

BORE-HOLE No. No. 3 − 1 **GROUND WATER LEVEL**

DATE	DEPTH	SECTION LENGTH	HOLE RADIUS	SUPPLIED WATER PRESSURE: PRESSURE	SUPPLIED WATER PRESSURE: HEAD	STATIC HEAD IN HOLE	PRESSURE GAUGE HEIGHT	TOTAL HEAD $H_p+H_s+H_g$	WATER LEAKAGE		CALCULATING CONST. $\frac{2.3}{2\pi}\times\frac{1}{60}\times\frac{1}{L}\log\frac{L}{r}$	$\frac{Q}{H}$	COEFFICIENT OF PERMEABILITY	LUGEON UNIT
	m − m	L cm	r cm	P kg/cm²	Hp cm	Hs cm	Hg cm	H cm	Q' ℓ/min	Q cm³/min	C min/cm·sec	cm²/min	K=Q/H×C cm/sec	Lu=Q'/L·H×10⁶
30/MAR	5.0 − 10.0	500	zr = 7.4	0	0	750	100	850		55000	2.6 × 10⁻⁵		1.68 × 10⁻³	129
1979														
30/MAR	10.0 − 15.0	500	7.4	0	0	1250	170	1420		55500	2.6 × 10⁻⁵		1.02 × 10⁻³	78
				0	0	1250	170	1420		65500			1.20 × 10⁻³	92
31/MAR	15.0 − 20.0	500	7.4	0	0	1430	50	1480		50400	2.6 × 10⁻⁵		8.85 × 10⁻⁴	68
				0	0	1430	50	1480		57500			1.01 × 10⁻³	78
1/APR	20.0 − 25.0	500	zr = 5.6	1	1000	2297	130	3427		13200	2.75 × 10⁻⁵		1.06 × 10⁻⁴	8
				2	2000	2297	130	4427		53000			3.28 × 10⁻⁴	24
				3.5	3500	2297	130	5927		55800			2.58 × 10⁻⁴	19
				2	2000	2297	130	4427		40600			2.51 × 10⁻⁴	18
				1	1000	2297	130	3427		5800			4.64 × 10⁻⁵	3
1/APR	25.0 − 30.0	500	5.6	2	2000	2297	150	4447		14900	2.75 × 10⁻⁵		9.18 × 10⁻⁵	7
				3	3000	2297	150	5447		27100			1.36 × 10⁻⁴	10
				6	6000	2297	150	8447		48400			1.57 × 10⁻⁴	11
				3	3000	2297	150	5447		37500			1.89 × 10⁻⁴	14
				2	2000	2297	150	4447		29000			1.79 × 10⁻⁴	13
2/APR	30.0 − 35.0	500	5.6	2	2000	3250	100	5350		1200	2.75 × 10⁻⁵		6.15 × 10⁻⁶	0.4
				3	3000	3250	100	6350		2050			8.84 × 10⁻⁶	0.6
				6	6000	3250	100	9350		44800			1.34 × 10⁻⁴	10
				3	3000	3250	100	6350		11500			4.96 × 10⁻⁵	4
				2	2000	3250	100	5350		9700			4.97 × 10⁻⁵	4
3/APR	35.0 − 40.0	500	5.6	−	−									
4/APR	40.0 − 45.0	500	5.6	1	1000	3400	200	4600		2630	2.75 × 10⁻⁵		1.57 × 10⁻⁵	1
				3	3000	3400	200	6600		2650			1.10 × 10⁻⁵	0.8
				4	4000	3400	200	7600		2810			1.01 × 10⁻⁵	0.8
				6	6000	3400	200	9600		4870			1.39 × 10⁻⁵	1

RECORD OF WATER PRESSURE TEST

PROJECT Central South Sulawesi Water Resources Dep　　**LOCALITY** MONG DAMSITE

BORE-HOLE No. No. 3 – 2　　**GROUND WATER LEVEL**

DATE	DEPTH	SECTION LENGTH	HOLE RADIUS	SUPPLIED WATER PRESSURE: PRESSURE	SUPPLIED WATER PRESSURE: HEAD	STATIC HEAD IN HOLE	PRESSURE GAUGE HEIGHT	TOTAL HEAD $H_p+H_s+H_g$	WATER LEAKAGE		CALCULATING CONST. $\frac{2.3}{2\pi}\times\frac{1}{60}\times\frac{1}{L}\log\frac{L}{r}$	$\frac{Q}{H}$	COEFFICIENT OF PERMEABILITY	LUGEON UNIT
	m – m	L cm	r cm	P kg/cm²	Hp cm	Hs cm	Hg cm	H cm	Q' ℓ/min	Q cm³/min	C min/cm·sec	cm²/min	K=Q/H×C cm/sec	$Lu=Q'/L\cdot H\times10^6$
				4	4000	3400	200	7600		3590			1.29×10^{-5}	0.9
				3	3000	3400	200	6600		6000			2.49×10^{-5}	2
				1	1000	3400	200	4600		5000			2.98×10^{-5}	2
5/APR	45.0 – 50.0	500	5.6	3	3000	3380	200	6580		1370	2.74×10^{-5}		5.70×10^{-6}	0.4
				6	6000	3380	200	9580		12370			3.54×10^{-5}	3
				9	9000	3380	200	12580		44100			9.61×10^{-5}	7
				6	6000	3380	200	9580		32500			9.30×10^{-5}	7
				3	3000	3380	200	6580		17400			7.25×10^{-5}	5

RECORDS OF WATER PRESSURE TESTS

AT WALIMPONG DAMSITE

RECORD OF WATER PRESSURE TEST

PROJECT SOUTH SULAWESI WATER RESOURCES DEV. **LOCALITY** Walimpong Dam Site Left Bank

BORE-HOLE No. No. 1 − 1 **GROUND WATER LEVEL**

DATE	DEPTH	SECTION LENGTH	HOLE RADIUS	SUPPLIED WATER PRESSURE: PRESSURE	SUPPLIED WATER PRESSURE: HEAD	STATIC HEAD IN HOLE	PRESSURE GAUGE HEIGHT	TOTAL HEAD $Hp+Hs+Hg$	WATER LEAKAGE		CALCULATING CONST. $\frac{2.3}{2\pi}\times\frac{1}{60}\times\frac{1}{L}\log\frac{L}{r}$	$\frac{Q}{H}$	COEFFICIENT OF PERMEABILITY	LUGEON UNIT
	m〜 m	L cm	2 r cm	P kg/cm²	Hp cm	Hs cm	Hg cm	H cm	Q' l/min	Q cm³/min	C min/cm·sec	cm²/min	K=Q/H×C cm/sec	Lu=Q'/L·H×10⁶
9. Aug	0.00 〜 5.00	500	7.6	0	0	250	28	278	0.018	18	2.58×10^{-5}	0.065	1.00×10^{-6}	
1979														
11. Aug	11.28 〜 13.00	172	7.6	0.1	100		886	986	5.8	5,800	5.87×10^{-5}	5.88	3.45×10^{-4}	34.2
1979				0.2	200		886	1,086	6.4	6,400		5.89	3.46×10^{-4}	34.3
				0.3	300		886	1,186	1.8	1,800		1.52	8.92×10^{-5}	8.8
				0.2	200		886	1,086	2.2	2,200		2.03	1.19×10^{-4}	11.8
				0.1	100		886	986	2.6	2,600		2.64	1.55×10^{-4}	15.3
12. Aug	13.00 〜 16.00	300	7.6	0	0	1,300	10	1,310	120	120,000	3.86×10^{-5}	91.60	3.54×10^{-3}	
12. Aug	16.00 〜 19.00	300	7.6	0	0	1,300	10	1,310	84	84,000	3.86×10^{-5}	64.12	2.48×10^{-3}	
13. Aug	19.00 〜 22.00	300	7.6	0	0	1,280	10	1,290	120	120,000	3.86×10^{-5}	93.02	3.59×10^{-3}	
14. Aug	22.00 〜 25.00	300	7.6	0	0	1,300	10	1,310	168	168,000	3.86×10^{-5}	128.24	4.96×10^{-3}	
15. Aug	25.00 〜 28.00	300	7.6	0	0	1,300	15	1,315	30	30,000	3.86×10^{-5}	22.81	8.80×10^{-4}	
18. Aug	28.00 〜 31.00	300	7.6	0	0	1,300	10	1,310	35	35,000	3.86×10^{-5}	26.72	1.03×10^{-3}	
19. Aug	31.00 〜 34.00	300	7.6	1.5	1,500		1,450	2,950	0.2	200	3.86×10^{-5}	0.07	2.70×10^{-6}	0.2
				3.0	3,000		1,450	4,450	0.2	200		0.04	1.54×10^{-6}	0.1
				4.5	4,500		1,450	5,950	1.7	1,700		0.29	1.12×10^{-5}	1.0
				3.0	3,000		1,450	4,450	2.0	2,000		0.45	1.74×10^{-5}	1.5
				1.5	1,500		1,450	2,950	0.8	800		0.27	1.04×10^{-5}	0.9
20. Aug	34.00 〜 37.00	300	7.6	0	0	1,300	10	1,310	4.5	4,500	3.86×10^{-5}	3.44	1.33×10^{-4}	

RECORD OF WATER PRESSURE TEST

PROJECT SOUTH SULAWESI WATER RESOUCES DEV. **LOCALITY** Walimpong Dam Site Left Bank

BORE-HOLE No. No. 1 − 2 **GROUND WATER LEVEL**

DATE	DEPTH	SECTION LENGTH	HOLE RADIUS	SUPPLIED WATER PRESSURE: PRESSURE	SUPPLIED WATER PRESSURE: HEAD	STATIC HEAD IN HOLE	PRESSURE GAUGE HEIGHT	TOTAL HEAD $H_p+H_s+H_g$	WATER LEAKAGE		CALCULATING CONST. $\frac{2.3}{2\pi}\times\frac{1}{60}\times\frac{1}{L}\log\frac{L}{r}$	$\frac{Q}{H}$	COEFFICIENT OF PERMEABILITY	LUGEON UNIT
	m ~ m	L cm	r cm	P kg/cm²	Hp cm	Hs cm	Hg cm	H cm	Q' ℓ/min	Q cm³/min	C min/cm·sec	cm²/min	K=Q/H×C cm/sec	Lu=Q'/L·H×10⁴
20. Aug	37.00 ~ 40.00	300	7.6	0.3	300		1,480	1,780	10.4	10,400	3.86×10^{-5}	5.84	2.25×10^{-4}	19.5
				0.6	600		1,480	2,080	16.0	16,000		7.69	2.97×10^{-4}	25.6
				0.9	900		1,480	2,380	28.4	28,400		11.93	4.60×10^{-4}	39.8
				0.6	600		1,480	2,080	28.4	28,400		13.65	5.27×10^{-4}	45.5
				0.3	300		1,480	1,780	5.2	5,200		2.92	1.13×10^{-4}	9.7
21. Aug	40.00 ~ 43.00	300	7.6	0.3	300		1,390	1,690	19.2	19,200	3.86×10^{-5}	11.36	4.38×10^{-4}	37.9
				0.6	600		1,390	1,990	22.0	22,000		11.06	4.27×10^{-4}	36.9
				0.9	900		1,390	2,190	25.4	25,400		11.60	4.48×10^{-4}	38.7
				0.6	600		1,390	1,990	22.0	22,000		11.06	4.27×10^{-4}	36.9
				0.3	300		1,390	1,690	17.3	17,300		10.24	3.95×10^{-4}	34.1
27. Aug	43.00 ~ 46.00	300	7.6	0.6	600		1,530	2,130	0.6	600	3.86×10^{-5}	0.28	1.08×10^{-5}	0.9
				1.2	1,200		1,530	2,730	2.0	2,000		0.73	2.82×10^{-5}	2.4
				2.0	2,000		1,530	3,530	25.8	25,800		7.31	2.82×10^{-4}	24.4
				1.2	1,200		1,530	2,730	4.0	4,000		1.47	5.67×10^{-5}	4.9
				0.6	600		1,530	2,130	6.0	6,000		2.82	1.09×10^{-4}	9.4
29. Aug	47.00 ~ 50.00	300	7.6	2.0	2,000		1,343	3,343	0.02	20	3.86×10^{-5}	0.006	2.32×10^{-7}	0.02
1979				4.0	4,000		1,343	5,343	0.02	20		0.004	1.54×10^{-7}	0.01
				6.0	6,000		1,343	7,343	0.02	20		0.003	1.16×10^{-7}	0.01
				4.0	4,000		1,343	5,343	0.02	20		0.004	1.54×10^{-7}	0.01
				2.0	2,000		1,343	3,343	0.02	20		0.006	2.32×10^{-7}	0.02

RECORD OF WATER PRESSURE TEST

PROJECT SOUTH SULAWESI WATER RESOURCES DEP. **LOCALITY** Walimpong Dam Sito Riner bed

BORE-HOLE No. 2 − 1 **GROUND WATER LEVEL**

DATE	DEPTH	SECTION LENGTH	HOLE RADIUS	SUPPLIED WATER PRESSURE: PRESSURE	SUPPLIED WATER PRESSURE: HEAD	STATIC HEAD IN HOLE	PRESSURE GAUGE HEIGHT	TOTAL HEAD $H_p+H_s+H_g$	WATER LEAKAGE		CALCULATING CONST. $\frac{2.3}{2\pi}\times\frac{1}{60}\times\frac{1}{L}\log\frac{L}{r}$	$\frac{Q}{H}$	COEFFICIENT OF PERMEABILITY	LUGEON UNIT
	m ~ m	L cm	r cm	P kg/cm²	Hp cm	Hs cm	Hg cm	H cm	Q' l/min	Q cm³/min	C min/cm·sec	cm²/min	K=Q/H×C cm/sec	Lu=Q'/L·H×10⁶
	10 ~ 12	200	7.6					576	0.13	130	5.25×10^{-5}	0.23	1.18×10^{-5}	
	12 ~ 15	300	7.6					960	41.2	41,200	3.86×10^{-5}	42.92	1.66×10^{-3}	
	15 ~ 18	300	5.6					960	18.83	18,830	4.13×10^{-5}	19.61	8.10×10^{-4}	
	18 ~ 21	300	5.6					960	0.119	119	4.13×10^{-5}	0.12	4.96×10^{-6}	
	22 ~ 24	200	5.6					864	0.01	10	5.65×10^{-5}	0.01	5.65×10^{-7}	—
								1,064	0.01	10		0.01	5.65×10^{-7}	—
								1264	0.01	10		0.01	5.65×10^{-7}	—
								1,064	0.01	10		0.01	5.65×10^{-7}	—
								864	0.02	20		0.02	1.13×10^{-6}	—
	24 ~ 27	300	5.6					1,112	7.1	7,100	4.13×10^{-5}	6.38	2.63×10^{-4}	21.3
								1,612	8.7	8,700		5.40	2.23×10^{-4}	18.0
								2,112	18.8	18,800		8.90	3.68×10^{-4}	29.7
								1,612	9.6	9,600		5.96	2.46×10^{-4}	19.9
								1,112	8.6	8,600		7.73	3.19×10^{-4}	25.8
	27 ~ 30	300	5.6					1,624	12.0	12,000	4.13×10^{-5}	7.39	3.05×10^{-4}	24.6
								2,624	13.2	13,200		5.03	2.08×10^{-4}	16.8
								3,624	19.2	19,200		5.30	2.19×10^{-4}	17.7
								2,624	14.6	14,600		5.56	2.30×10^{-4}	18.5
								1,624	8.1	2,700		1.66	6.86×10^{-5}	16.6
	31 ~ 33	200	5.6					1,642	0.4	400	5.65×10^{-5}	0.24	1.36×10^{-5}	1.2
								2,642	1.6	1,600		0.61	3.45×10^{-5}	3.0
								3,642	1.2	1,200		0.33	1.86×10^{-5}	1.6
								2,642	1.6	1,600		0.61	3.45×10^{-5}	3.0
								1,642	0.2	200		0.12	6.78×10^{-6}	0.6

RECORD OF WATER PRESSURE TEST

PROJECT

BORE-HOLE No. 2 − 2

LOCALITY Walimpong Domestie

GROUND WATER LEVEL

DATE	DEPTH	SECTION LENGTH	HOLE RADIUS	SUPPLIED WATER PRESSURE		STATIC HEAD IN HOLE	PRESSURE GAUGE HEIGHT	TOTAL HEAD Hp+Hs+Hg	WATER LEAKAGE		CALCULATING CONST. $\frac{2.3}{2\pi}\times\frac{1}{60}\times\frac{1}{L}\log\frac{L}{r}$	$\frac{Q}{H}$	COEFFICIENT OF PERMEABILITY	LUGEON UNIT
				PRESSURE	HEAD									
	m~ m	L cm	r cm	P kg/cm²	Hp cm	Hs cm	Hg cm	H cm	Q' l/min	Q cm³/min	C min/cm·sec	cm²/min	K=Q/H×C cm/sec	Lu=Q'/L·H×10⁶
	33 ~ 36	300	5.6					2,135	0.02	20	4.13×10⁻⁵	0.01	4.13×10⁻⁷	—
								3,635	0.02	20		0.01	4.13×10⁻⁷	—
								5,135	0.02	20		—	—	—
								3,635	0.02	20		0.01	4.13×10⁻⁷	—
								2,135	0.02	20		0.01	4.13×10⁻⁷	—
	36 ~ 39	300	5.6					2,172	0.02	20	4.13×10⁻⁵	0.01	4.13×10⁻⁷	—
								3,672	152.7	15,270		4.16	1.72×10⁻⁴	13.9
								5,172	44.7	44,700		8.64	3.57×10⁻⁴	28.8
								3,672	17.2	17,200		4.68	1.93×10⁻⁴	15.6
								2,172	0.02	20		0.01	4.13×10⁻⁷	—
	39 ~ 42	300	5.6					2,160	5.9	5,900	4.13×10⁻⁵	2.73	1.13×10⁻⁴	9.1
								3,660	10.3	10,300		2.81	1.16×10⁻⁴	9.4
								5,160	24.2	24,200		4.69	1.94×10⁻⁴	15.6
								3,660	17.2	17,200		4.70	1.94×10⁻⁴	15.7
								2,160	11.2	11,200		5.19	2.14×10⁻⁴	17.3
	42 ~ 45	300	5.6					1,106	5.8	5,800	4.13×10⁻⁵	5.24	2.16×10⁻⁴	17.5
								1,606	7.4	7,400		4.61	1.90×10⁻⁴	15.4
								2,106	9.6	9,600		4.56	1.88×10⁻⁴	15.2
								1,606	6.84	6,800		4.26	1.76×10⁻⁴	14.2
								1,106	7.10	7,100		6.42	2.65×10⁻⁴	21.4
	45.5 ~ 47.5	200	5.6					3,660	0.2	200	5.65×10⁻⁵	0.05	2.83×10⁻⁶	0.3
								6,660	1.1	1,100		0.17	9.61×10⁻⁶	0.8
								9,660	1.4	1,400		0.14	7.91×10⁻⁶	0.7
								6,660	1.4	1,400		0.21	1.19×10⁻⁵	1.1
								3,660	1.2	1,200		0.33	1.86×10⁻⁵	1.6

RECORD OF WATER PRESSURE TEST

PROJECT

BORE-HOLE No. 2 — 3

LOCALITY Walimpong Damsite

GROUND WATER LEVEL

DATE	DEPTH	SECTION LENGTH	HOLE RADIUS	SUPPLIED WATER PRESSURE: PRESSURE	SUPPLIED WATER PRESSURE: HEAD	STATIC HEAD IN HOLE	PRESSURE GAUGE HEIGHT	TOTAL HEAD $H_p + H_s + H_g$	WATER LEAKAGE		CALCULATING CONST. $\frac{2.3}{2\pi} \times \frac{1}{60} \times \frac{1}{L} \log \frac{L}{r}$	$\frac{Q}{H}$	COEFFICIENT OF PERMEABILITY	LUGEON UNIT
	m ~ m	L cm	2r cm	P kg/cm²	Hp cm	Hs cm	Hg cm	H cm	Q' ℓ/min	Q cm³/min	C min/cm·sec	cm²/min	$K = Q/H \times C$ cm/sec	$Lu = Q'/L \cdot H \times 10^4$
	49.0 ~ 50.0	100	5.6					2,600	1	1,000	9.47×10^{-5}	0.38	3.60×10^{-5}	3.8
								4,600	1	1,000		0.22	2.08×10^{-5}	2.2
								6,600	1.04	1,040		0.16	1.52×10^{-5}	1.6
								4,600	0.9	900		0.20	1.89×10^{-5}	2.0
								2,600	0.9	900		0.35	3.31×10^{-5}	3.5

RECORD OF WATER PRESSURE TEST

PROJECT SOUTH SULAWESI WATER RESOURCES DEP. **LOCALITY** Walimpong Dam Site Right Bank

BORE-HOLE No. № 3 − 1 **GROUND WATER LEVEL**

DATE	DEPTH m∼ m	SECTION LENGTH L cm	HOLE RADIUS r cm	SUPPLIED WATER PRESSURE: PRESSURE P kg/cm²	SUPPLIED WATER PRESSURE: HEAD Hp cm	STATIC HEAD IN HOLE Hs cm	PRESSURE GAUGE HEIGHT Hg cm	TOTAL HEAD Hp+Hs+Hg H cm	WATER LEAKAGE Q' ℓ/min	WATER LEAKAGE Q cm³/min	CALCULATING CONST. $\frac{2.3}{2\pi}\times\frac{1}{60}\times\frac{1}{L}\log\frac{L}{r}$ C min/cm·sec	$\frac{Q}{H}$ cm²/min	COEFFICIENT OF PERMEABILITY K=Q/H×C cm/sec	LUGEON UNIT Lu=Q'/L·H×10⁴
	0 ∼ 3	300	7.6					150	0.034	34	3.86×10^{-5}	0.227	8.76×10^{-6}	
	3 ∼ 6	300	7.6					410	3.94	3,940	3.86×10^{-5}	9.61	3.71×10^{-4}	
	6 ∼ 9	300	7.6					910	0.109	109	3.86×10^{-5}	0.120	4.63×10^{-6}	
	9 ∼ 12	300	7.6			400		400	26.22	26,220	3.86×10^{-5}	65.55	2.53×10^{-3}	
	12 ∼ 15	300	7.6					1,200	33.4	33,400	3.86×10^{-5}	27.83	1.07×10^{-3}	92.8
								1,700	38.3	38,300		22.53	8.70×10^{-4}	75.1
								2,200	46.4	46,400		21.09	8.14×10^{-4}	70.3
								1,700	44.4	44,400		26.12	1.01×10^{-3}	87.1
								1,200	30.2	30,200		25.17	9.72×10^{-4}	83.9
	15 ∼ 18	300	5.6					1,770	43.67	43,670	4.13×10^{-5}	24.67	1.02×10^{-3}	
	18 ∼ 21	300	5.6					3,200	0.06	60	4.13×10^{-5}	0.02	7.72×10^{-7}	
								4,400	12.2	12,200		2.77	1.07×10^{-4}	9.2
								5,600	25.2	25,200		4.50	1.74×10^{-4}	15.0
								4,400	15.4	15,400		3.50	1.35×10^{-4}	11.7
								3,200	6.6	6,600		2.06	7.95×10^{-5}	6.9
	21 ∼ 24	300	5.6					3,770	0.3	300	4.13×10^{-5}	0.08	3.09×10^{-6}	0.3
								5,170	24.5	24,500		4.74	1.83×10^{-4}	15.8
								6,570	40.6	40,600		6.18	2.39×10^{-4}	20.6
								5,170	22.1	22,100		4.27	1.65×10^{-4}	14.2
								3,770	2.3	2,300		0.61	2.35×10^{-5}	2.0

RECORD OF WATER PRESSURE TEST

PROJECT

BORE-HOLE No. 3 − 2

LOCALITY Walimpong Damsite

GROUND WATER LEVEL

DATE	DEPTH	SECTION LENGTH	HOLE RADIUS	SUPPLIED WATER PRESSURE: PRESSURE	SUPPLIED WATER PRESSURE: HEAD	STATIC HEAD IN HOLE	PRESSURE GAUGE HEIGHT	TOTAL HEAD $H_p+H_s+H_g$	WATER LEAKAGE		CALCULATING CONST. $\frac{2.3}{2\pi}\times\frac{1}{60}\times\frac{1}{L}\log\frac{L}{r}$	$\frac{Q}{H}$	COEFFICIENT OF PERMEABILITY	LUGEON UNIT
	m~ m	L cm	r cm	P kg/cm²	Hp cm	Hs cm	Hg cm	H cm	Q' l/min	Q cm³/min	C min/cm·sec	cm²/min	K=Q/H×C cm/sec	Lu=Q'/L·H×10⁶
	24 ~ 27	300	5.6					2,890	0.02	20	4.13×10^{-5}	0.01	3.86×10^{-7}	—
								3,890	0.2	200		0.05	1.93×10^{-6}	0.2
								4,890	7.7	7,700		1.57	6.06×10^{-5}	5.2
								3,890	5.36	5,360		1.38	5.33×10^{-5}	4.6
								2,890	1.6	1,600		0.55	2.12×10^{-5}	1.8
	27 ~ 30	300	5.6					3,270	0.16	160	4.13×10^{-5}	0.05	1.93×10^{-6}	0.2
								4,670	0.66	660		0.14	5.40×10^{-6}	0.6
								6,070	0.84	840		0.14	5.40×10^{-6}	0.5
								4,670	0.8	800		0.17	6.56×10^{-6}	0.1
								3,270	0.04	40		0.01	3.86×10^{-7}	—
	30 ~ 33	300	5.6					1,970	42.0	42,000	4.13×10^{-5}	21.32	8.81×10^{-4}	71.1
								2,020	45.1	45,100		22.33	9.22×10^{-4}	74.4
								2,070	36.6	36,600		17.68	7.30×10^{-4}	58.9
								2,020	24.0	24,000		11.88	4.91×10^{-4}	39.6
								1,970	25.6	25,600		12.99	3.86×10^{-4}	43.3
	33 ~ 36	300	5.6					2,480	1.7	1,700	4.13×10^{-5}	0.69	2.85×10^{-5}	2.3
								2,880	3.5	3,500		1.22	5.04×10^{-5}	4.1
								3,280	10.4	10,400		3.17	1.31×10^{-4}	10.6
								2,880	9.0	9,000		3.13	1.29×10^{-4}	10.4
								2,480	7.4	7,400		2.98	1.23×10^{-4}	9.9
	36 ~ 39	300	5.6											
								3,900	10.0	10,000	4.13×10^{-5}	2.56	1.06×10^{-4}	8.5
								4,300	12.0	12,000		2.79	1.15×10^{-4}	9.3
								4,700	13.0	13,000		2.77	1.14×10^{-4}	9.2
								4,300	10.0	10,000		2.33	9.62×10^{-5}	7.8
								3,900	8.6	8,600		2.21	9.13×10^{-5}	7.4

RECORD OF WATER PRESSURE TEST

PROJECT

LOCALITY Walimpong Damsite

BORE-HOLE No. 3 — 3 (Walimpong)

GROUND WATER LEVEL

DATE	DEPTH	SECTION LENGTH	HOLE RADIUS	SUPPLIED WATER PRESSURE		STATIC HEAD IN HOLE	PRESSURE GAUGE HEIGHT	TOTAL HEAD $H_p+H_s+H_g$	WATER LEAKAGE		CALCULATING CONST. $\frac{2.3}{2\pi}\times\frac{1}{60}\times\frac{1}{L}\log\frac{L}{r}$	$\frac{Q}{H}$	COEFFICIENT OF PERMEABILITY	LUGEON UNIT
				PRESSURE	HEAD									
	m ~ m	L cm	r cm	P kg/cm²	Hp cm	Hs cm	Hg cm	H cm	Q' ℓ/min	Q cm³/min	C min/cm·sec	cm²/min	K=Q/H×C cm/sec	Lu=Q'/L·H×10⁴
	39 ~ 42	300	5.6					4,700	1.2	1,200	4.13×10^{-5}	0.26	1.10×10^{-5}	0.9
								7,100	2.2	2,200		0.31	1.28×10^{-5}	1.0
								8,500	3.4	3,400		0.40	1.65×10^{-5}	1.3
								7,100	2.6	2,600		0.37	1.53×10^{-5}	1.2
								4,700	0.8	800		0.17	7.02×10^{-6}	0.6
	42 ~ 45	300	5.6					5,000	1.44	1,440	4.13×10^{-5}	0.29	1.20×10^{-5}	1.0
								6,400	4.1	4,100		0.64	2.64×10^{-5}	2.1
								7,800	10.4	10,400		1.33	5.37×10^{-5}	4.4
								6,400	6.4	6,400		1.00	4.13×10^{-5}	3.3
								5,000	3.8	3,800		0.76	3.14×10^{-5}	2.5
	45 ~ 48	300	5.6					4,800	1.7	1,700	4.13×10^{-5}	0.35	1.45×10^{-5}	1.2
								6,000	2.6	2,600		0.43	1.78×10^{-5}	1.4
								7,200	10.6	10,600		1.47	6.07×10^{-5}	4.9
								6,000	7.2	7,200		1.20	4.96×10^{-5}	4.0
								4,800	4.2	4,200		0.88	3.63×10^{-5}	2.9
	48 ~ 50	200	5.6					5,200	0.76	760	5.65×10^{-5}	0.15	8.48×10^{-6}	0.7
								6,800	0.8	800		0.12	6.78×10^{-6}	0.6
								8,000	22.2	22,200		2.78	1.57×10^{-4}	13.9
								6,800	13.2	13,200		1.94	1.10×10^{-4}	9.7
								5,200	2.1	2,100		0.40	2.26×10^{-5}	2.0

GEOLOGICAL RECORDS OF BORING

AT MONG DAMSITE

GEOLOGICAL RECORD OF BORING

HOLE No. 1 - 1

PROJECT	SOUTH SULAWESI WATER RESOURCES DEV.	LOCATION	Mong dam site right bank
ELEVATION OF GROUND SURFACE	33.56 m	DEPTH OF HOLE	50 m
INCLINATION OF HOLE	90°	DIAMETER OF HOLE	76~56 mm
MACHINE	UD-5	DATE OF DRILLING	
CORE RECOVERY	82 %	DRILLED BY	
LOGGED BY	N. MIYAMOTO		

DEPTH (m)	ELEVATION (m)	ROCK TYPE	CORE RECOVERY (m)	BIT DIAMETER	DESCRIPTION	WATER PRESSURE TEST LUGEON
0.50	33.06	Sandy silt	0.5	76 mm	Top soil., brown	
1.21	32.35	Fine sand	0.71		containingsilt, dark brown	
6.00	27.56	Weathered Calcareous Sandstone	4.38		Not consolidated likely as chalk, white grey 2.00~2.10 sticky core	
6.50	27.06	Siltstone	0.5		Sticky core, 5cm, poorly cemented dark grey	
7.50	26.06	Silt	0.5		uncemented, dark grey, 6.50~6.80 brownish	
8.00	25.56	Finesandstone	5.0		Poorly cemented, dark grey	
11.38	22.18	Limestone	3.38	56 mm	Sticky core 5~10cm, weakly cemented, porous, containing fossil fragments, grey	
15.00	18.56	Siltstone	2.94		Weakly cemented, sticky core, 5~15cm containing fossil fragments dark grey	
21.90	11.66	Calcareous Sandstone	6.92		15.00~15.62, porous, poorly cemented, 15.62~20.00 porous, weakly cemented, with sticky core and fragments, 20.40~21.90, porous, cemented with sticky core Commonly light grey	55
23.76	9.8	Siltstone	1.16		poorly cemented, 3~5cm sticky core, containing calcareous patches dark grey 22.85~23.26 calcareous	34
26.36	7.2	Limestone	1.36		Cemented, white grey 23.76~24.35, sticky core 3~15cm 24.35~26.36 fragments	
28.90	4.66	Siltstone	1.73		Weakly cemented, sticky core 5~10cm dark grey	21
					cont	

RQD / Core recovery

GEOLOGICAL RECORD OF BORING

HOLE No. 1 - 2

PROJECT	SOUTH SULAWESI WATER RESOURCES DEV	LOCATION	Mong damsite, right bank		
ELEVATION OF GROUND SURFACE	33.56 m	DEPTH OF HOLE	50 m	INCLINATION OF HOLE	90°
DIAMETER OF HOLE	66 mm	MACHINE	UD-5	DATE OF DRILLING	
CORE RECOVERY	82 %	DRILLED BY		LOGGED BY	N.MIYAMOTO

DATE	DEPTH (m)	ELEVATION (m)	ROCK TYPE	CORE RECOVERY (m)	BIT & DIAMETER	DESCRIPTION	WATER PRESSURE TEST LUGEON
	31.88	1.68	Sandstone	2.69		Fine, weakly cemented. Sticky core 5~10cm dark grey	
	39.65	-6.09	Siltstone	6.60		Weakly cemented, sticky core 2~20cm, containing fossils, dark grey	60; >60
	40.87	-7.31	Limestone	0.92		Cemented fragments cracky white grey	
	42.00	-8.44	Limestone	1.13		Well cemented, a litle brownish light grey fragments, cracky	
	44.70	-11.14	Limestone	1.29		Well cemented, white grey fragments, 42.88~42.61, rather sticky	>80
	49.60	-16.04	Limestone	4.10		Well cemented, fragments with pores, cracky light grey	10
	50.00	-16.44	Siltstone	0.40		massive, cemented fossiliferous dark grey	

RQD Core recovery

End

GEOLOGICAL RECORD OF BORING

HOLE No. 2 - 1

PROJECT	SOUTH SULAWESI WATER RESOURCES DEV	LOCATION	MONG DAMSITE , LEFTBANK		
ELEVATION OF GROUND SURFACE	50.46 m	DEPTH OF HOLE	50.0 m	INCLINATION OF HOLE	90°
DIAMETER OF HOLE	76 - 56 mm	MACHINE	UD - 5	DATE OF DRILLING	
CORE RECOVERY	81 %	DRILLED BY		LOGGED BY	N. MIYAMOTO

DATE	DEPTH (m)	ELEVATION (m)	ROCK TYPE	CORE RECOVERY (m)	BIT & DIAMETER	DESCRIPTION	WATER PRESSURE TEST LUGEON
	0.40	50.06	Top soil		76 mm	Dark brownish	
	6.00	44.46	Sand	5.43		Fine sand, containing calcareous chalk patches, brownish likely as weathered zone Poorly cemented in lower part	
	9.50	40.96	Sandstone	2.96		Poorly cemented fine sandstone, with sticky core 5~10cm, brownish 8.76~9.50, poorly cemented	
	10.31	40.16	Clay	0.5		Containing fossil, dark brownish, soft	
	10.48	39.98	Limestone	0.17		fragments 2~3cm	
	12.33	38.13	Sandyclay	0.97		Soft, sticky core 10~25cm, dark grey cracked when dry	
	12.63	37.83	Sand	0.3		Coarse with fossil, grey	
	13.00	37.46	Siltstone	0.37		Fragments, grey	
	13.30	37.16	Sand	0.3		Coarse with fossil, grey	
	25.35	25.11	Siltstone	11.47	56 mm	Weakly cemented, grey 13.30~13.66 fragments 13.66~17.60 sticky core 5~10cm 17.60~17.90 platy 18.00~19.50 sticky core 5~10cm 19.50~20.30 platy 20.30~24.00 sticky 24.00~24.30 platy 24.30~25.00 sticky 25.00~25.35 blocky	33.0 20.5
	28.00	22.46	Sandstone	1.81		Cemented, containing calcareous patch light grey	30.0
						cont	

RQD — Core recovery

GEOLOGICAL RECORD OF BORING

HOLE No. 2 − 2

PROJECT	SOUTH SULAWESI WATER RESOURCES DEV	LOCATION	MONG DAMSITE. LEFT BANK
ELEVATION OF GROUND SURFACE	50.46 m	DEPTH OF HOLE	50.0 m
INCLINATION OF HOLE	90°	DIAMETER OF HOLE	56 mm
MACHINE	UD − 5	DATE OF DRILLING	
CORE RECOVERY	81 %	DRILLED BY	
LOGGED BY	N. MIYAMOTO		

DATE	DEPTH (m)	ELEVATION (m)	ROCK TYPE	CORE RECOVERY (m)	BIT & DIAMETER	DESCRIPTION	WATER PRESSURE TEST LOGEON
	33.28	17.18	Sandstone	2.98		Cemented, blocky to fragments of 1~5cm core light grey 33.0~33.28 sticky core 10cm	Break at 6 l/m
	35.45	15.01	Siltstone	1.20		Weakly cemented, dark grey	
	40.18	10.29	Calcareous Sandstone	4.28		Cemented, sticky porous core 5~10cm having fossils, light grey	3.0
	41.62	8.84	Siltstone	0.98		Weakly cemented, with fossils sticky core~fragments dark grey	
	47.74	2.72	Calcareous Sandstone	4.04		Cemented, porous sticky 5~10cm, partly fragments, grey	5.2 / 5.5
	50.00	0.46	Limestone	1.86		Cemented white grey fragments, 49.4~50.0 sticky 3~15cm	
						end	

RQD — Core recovery

GEOLOGICAL RECORD OF BORING

HOLE No. 3 - 1

PROJECT	SOUTH SULAWESI WATER RESOURCES DEV			LOCATION	Mong dame site, left bank		
ELEVATION OF GROUND SURFACE	78.93 m	DEPTH OF HOLE	50.0 m	INCLINATION OF HOLE	90°		
DIAMETER OF HOLE	76~56 mm	MACHINE	UD - 5	DATE OF DRILLING			
CORE RECOVERY	84 %	DRILLED BY		LOGGED BY	A. KASUGA		

DEPTH (m)	ELEVATION (m)	ROCK TYPE	CORE RECOVERY (m)	BIT & DIAMETER	DESCRIPTION	WATER PRESSURE TEST LUGEON
1.35	77.58	Silt	1.35		Top soil, yellowish brown	
3.60	75.33	Weathered Calcareous Sandstone	1.35		yellowish brown weakly cemented partly sticky	
5.50	73.43	Limestone	1.90		Coral limestone likely as limeston gravelly bed yellow~yellowish brown	
9.65	69.28	Calcareous Sandstone	3.40		poorly cemented but porous partly thin silt layer included yellow ~ yellowish brown	>80
12.00	66.93	Silt	1.85		mostly unconsolidated yelow or brown	
14.40	64.53	Limestone	1.60	76%	coral limeston, cemented, porous lower part likely as limeston gravelly bed yellow~ yellowish grey	>80
20.50	58.43	Silt	4.65		unconsolideted partly thin sand layer included	>60
22.00	56.93	Sand	0.95		uncemented grain size fine pale brown	
28.50	50.43	Sandstone	5.15	56%	well cemented grain size medium or coarse bedding plan clear thick ness 1~3 cm pale~dark yellow	20, 10
		Calcareous Sandstone	3.0		well cemented fossiliferous pale yellow~dark brown	

RQD — Core recovery

GEOLOGICAL RECORD OF BORING

HOLE No. 3 − 2

PROJECT	SOUTH SULAWESI WATER RESOURCES DEV	LOCATION	Mong dame site, left bank
ELEVATION OF GROUND SURFACE	78.93 m	DEPTH OF HOLE	50.0 m
INCLINATION OF HOLE	90°	DIAMETER OF HOLE	76∼56 %
MACHINE	UD−5	DATE OF DRILLING	
CORE RECOVERY	84 %	DRILLED BY	
LOGGED BY	A.KASUGA		

DATE	DEPTH (m)	ELEVATION (m)	ROCK TYPE	CORE RECOVERY (m)	BIT DIAMETER	DESCRIPTION	WATER PRESSURE TEST LUGEON
	31.50	47.43	Calcareous Sandstone			− do −	
	35.85	43.08	Sandstone	3.25		bluish black 32.70∼34.60 uncemented 34.10∼34.60 micaceous 34.50∼34.80 fossiliferous, cemented 34.80∼35.00 very fine silty sand uncemented 35.00∼35.85 fine∼medium sand uncemented	10
	40.70	38.23	Siltstone	4.85	56 %	black weakly consolidated plant flagment contained	<1
	41.20	37.73	Sandstone	0.50		fossiliferous cemented	
	46.10	32.83	Siltstone	4.50		black fossiliferous consolidated 44.00∼44.10 cracky on dry condition	1
	50.00	28.93	Sandstone	3.80		black sticky core well cemented	7
						END	

RQD — Core recovery

GEOLOGICAL RECORDS OF BORING

AT WALIMPONG DAMSITE

GEOLOGICAL RECORD OF BORING

HOLE No. 1 - 1

PROJECT	SOUTH SULAWESI WATER RESOURCES DEV	LOCATION	Walimpong Dam Site Left Bank		
ELEVATION OF GROUND SURFACE	6 8.4 0 m	DEPTH OF HOLE	5 0 m	INCLINATION OF HOLE	90°
DIAMETER OF HOLE	7 6 mm	MACHINE		DATE OF DRILLING	
CORE RECOVERY	8 8.5 %	DRILLED BY		LOGGED BY A. KASUGA	

DATE	DEPTH (m)	ELEVATION (m)	ROCK TYPE	BIT DIAMETER	DESCRIPTION	WATER PRESSURE TEST (LUGEON VOLUE)
	4.30	64.10	Clay	76	Strong weathered claystone. Soft and Stinky Chocolate color	
	17.33	51.07	Claystone	To hole bottom; 13.00 m Final ground water level	4.6 m N - 68 Fresh Weakly cemented Grey ~ greyey black Focilliferous Mollusca fragment Foraminifer 9.6 m N - 52 13.20 m N - 51 16.20 m N - 50	Lugeon method Lu 3.4 Constant head method K 3.5×10^[illegible] cm/s Do K 2.5×10^[illegible] cm/s
	17.55	50.85	Limestone		Fresh Well - cemented Greyey black Focilliferous	
	22.60	45.80	Claystone		Fresh Greyey black Weakly ~ moderatly cemented Contaived fossil and foraminifer 19.10 m N 150	Do K 3.6×10^[illegible] cm/s
	23.90	44.50	Limestone		Fresh Well - cemented Greyey black Focilliferous	Do K 5.0×10^[illegible] cm/s
	26.95	41.45	Alternation of Siltstone and Claystone		Fresh Weakly ~ moderaly cemented Grey ~ Greyey black Contaived fossil and organic matter	Do K 8.8×10^[illegible] cm/s
	27.65	40.75	Limestone		Well - cemented Grey	
	28.62	39.78	Claystone		Fresh Black Weakly cemented	
	30.00	38.40	Siltstone		Fresh Grey ~ greyey black moderatly cemented	Do K 1.0×10^[illegible] cm/s

core recovery

RQD

GEOLOGICAL RECORD OF BORING

HOLE No. 1 − 2

PROJECT	SOUTH SULAWESI WATER RESOURCES DEV	LOCATION	Walimpong Dam Site Left Bank		
ELEVATION OF GROUND SURFACE	6 8.4 0 m	DEPTH OF HOLE	5 0 m	INCLINATION OF HOLE	9 0°
DIAMETER OF HOLE	7 6 mm	MACHINE		DATE OF DRILLING	
CORE RECOVERY	8 8.5 %	DRILLED BY		LOGGED BY	A. KASUGA

DATE	DEPTH (m)	ELEVATION (m)	ROCK TYPE	COLUMN SECTION	CORE RECOVERY %	BIT & DIAMETER	DESCRIPTION	WATER PRESSURE TEST LUGEON VALUE (20, 40, 60, 80)
	80.29	8 8.1 1	Limestone				Well − cemented, Grey	
	89.90	28.5 0	Alternation of Siltstone and Claystone				Each thickness of alternation of siltstone and claystone is 0.2 ~ 0.5 m Siltstone Weackly~moderatly cemented Greenish grey Contained fossil and organic matter. Claystone Poorly cemented Black	Lugeon method; Constant head method K = 1.38×10⁻⁴ cm/s; Lugeon method Lu = 40
	45.50	22.9 0	Claystone				Fresh Weakly cemented Greyey black Contained fossil	Lu = 89; Lu = 24
	50.00	18.4 0	Siltstone				Fresh Weakly cemented Greenish grey ~ dark grey Carboniferous 48.80 ~ 49.06 Gravel Size 1cm Igneous rock and chert	

core recovery
RQD

GEOLOGICAL RECORD OF BORING

HOLE No. 2 - 1

PROJECT	SOUTH SULAWESI WATER RESOURCES DEV	LOCATION	Walimpong Dam Site River Bed (Right)
ELEVATION OF GROUND SURFACE	85.29 m	DEPTH OF HOLE	50 m
INCLINATION OF HOLE	90°	DIAMETER OF HOLE	76 ~ 56 m
MACHINE		DATE OF DRILLING	
CORE RECOVERY		DRILLED BY	
LOGGED BY	A. KASUGA		

DATE	DEPTH (m)	ELEVATION (m)	ROCK TYPE	COLUMN SECTION	CORE RECOVERY %	BIT & DIAMETER	DESCRIPTION	WATER PRESSURE TEST / LUGEON VALUE (20, 40, 60, 80)
	5.00	80.29	Sandy Clay			4.50 m ▽	River Deposit Chocorate color Final ground water level	
	10.00	25.29	Sand and Gravel				River Deposit Gravel diameter Pebble	
	19.5	15.79	Claystone				12.2 m N - 81 Fresh Grey ~ greyey black Weakly ~ moderatly cemented Contained fossil and foraminifera 15.20 m N - 44 18.2 m N - 85	Constant head method K = 1.13 × 10^{-5} cm/sec — Do — K = 1.66 × 10^{-3} cm/sec — Do — K = 8.10 × 10^{-4} cm/sec — Do — K = 4.96 × 10^{-6} cm/sec
	21.0	14.29	Alternation of Claystone and Siltstone				Fresh Greyey black Weakly ~ moderatly cemented	
	22.5	12.79	Claystone				Fresh Grey ~ greyey black Weakly ~ moderatly cemented 21.20 m N - 81	Lugeon method Lu < 1
			Alternation of Claystone and Siltstone				Fresh Grey ~ greyey black Thin lamina clear Contain fossil and organic matter 24.20 m N 26	Lu 80 Lu 20

GEOLOGICAL RECORD OF BORING

HOLE No. 2 - 2

PROJECT	SOUTH SULAWESI WATER RESOUCES DEP	LOCATION	Walimpong Dam Site River Bed (Right)		
ELEVATION OF GROUND SURFACE	85.29 m	DEPTH OF HOLE	50 m	INCLINATION OF HOLE	90°
DIAMETER OF HOLE	76~56 m	MACHINE		DATE OF DRILLING	
CORE RECOVERY		DRILLED BY		LOGGED BY	A. KASUGA

DATE	DEPTH (m)	ELEVATION (m)	ROCK TYPE	COLUMN SECTION	CORE RECOVERY %	BIT DIAMETER	DESCRIPTION	WATER PRESSURE TEST LUGEON VOLUE
	50.0	−14.71	Alternation of Claystone and Siltstone				Fresh Grey ~ greyey black Thin lamina clear Contain fossil and organic matter	1.0 3 1 1.0 − 30 1.0 15 1.0 15 1.0 1 1.0 2

GEOLOGICAL RECORD OF BORING

HOLE No. 8 − 1

PROJECT	SOUTH SULAWESI WATER RESOURCES DEV	LOCATION	Walimpong Dam Site Right Bank
ELEVATION OF GROUND SURFACE	87.03 m	DEPTH OF HOLE	50 m
INCLINATION OF HOLE	90°	DIAMETER OF HOLE	76 ~ 56 mm
MACHINE		DATE OF DRILLING	
CORE RECOVERY		DRILLED BY	
LOGGED BY	A. KASUGA		

DATE	DEPTH (m)	ELEVATION (m)	ROCK TYPE	DESCRIPTION	WATER PRESSURE TEST (LUGEON VOLUE)
	5.00	82.08	Talus	Pable ~ Coble Limestone gravel Light chocorate color 3.2 m N 19	Constant head method K = 8.76 × 10^{-5} cm/s — Do — K = 8.7 × 10^{-4} cm/s
	10.70	76.88	Sand	6.2 m N = 10 Strong weathered Sandstone Light chocorate 9.2 m N 50	— Do — K = 4.63 × 10^{-4} cm/s — Do — K = 2.53 × 10^{-3} cm/s
	19.00	68.08	Sandstone	Weathered zone Weackly cemented Fragment core Grey ~ chocorate	Lugeon method Lu = 9.0 > Constant head method K = 1.02 × 10^{-3} cm/s
			Claystone	Fresh Blank Weakly ~ moderatly Cemented Contained fossil	Lugeon method Lu = 1.5 Lu = 2.0 Lu = 5

GEOLOGICAL RECORD OF BORING

HOLE No. 3 – 2

PROJECT	SOUTH SULAWESI WATER RESOURCES DEV	LOCATION	Walimpong Dam Site Right Bank
ELEVATION OF GROUND SURFACE	87.08 m	DEPTH OF HOLE	50 m
INCLINATION OF HOLE	90°	DIAMETER OF HOLE	76 ~ 56 m
MACHINE		DATE OF DRILLING	
CORE RECOVERY		DRILLED BY	
LOGGED BY	A. KASUGA		

DATE	DEPTH (m)	ELEVATION (m)	ROCK TYPE	BIT & DIAMETER	DESCRIPTION	WATER PRESSURE TEST LUGEON VALUE
	30.9	56.18	Claystone			
			Sandstone		Fresh Black Weakly to moderatly Cemented Contained fossil and foraminifera	Lu = 60
	33.9	53.18	Coarse Sandstone	m 34.50 ▽	Final ground water level	
	34.5	52.58				Lu = 10
			Sandstone		– Do – 30.9 ~ 38.9	Lu = 10
	38.5	48.58	Coarse Sandstone			
	38.7	48.38	Sandstone		– Do – 30.9 ~ 38.9	
	40.0	47.08	Coarse Sandstone			
			Sandstone		– Do – 30.9 ~ 38.9	Lu = 1
	43.0	44.08	Coarse Sandstone			
	43.4	43.68	Sandstone		– Do – 30.9 ~ 38.9	Lu = 5
						Lu = 5
	47.4	39.68	Claystone		Fresh Black Weakly to moderatly Cemented Contained fossil of mollusca	Lu = 5
	50.0	37.08				

Fig 9.1 GEOMORPHOLOGY

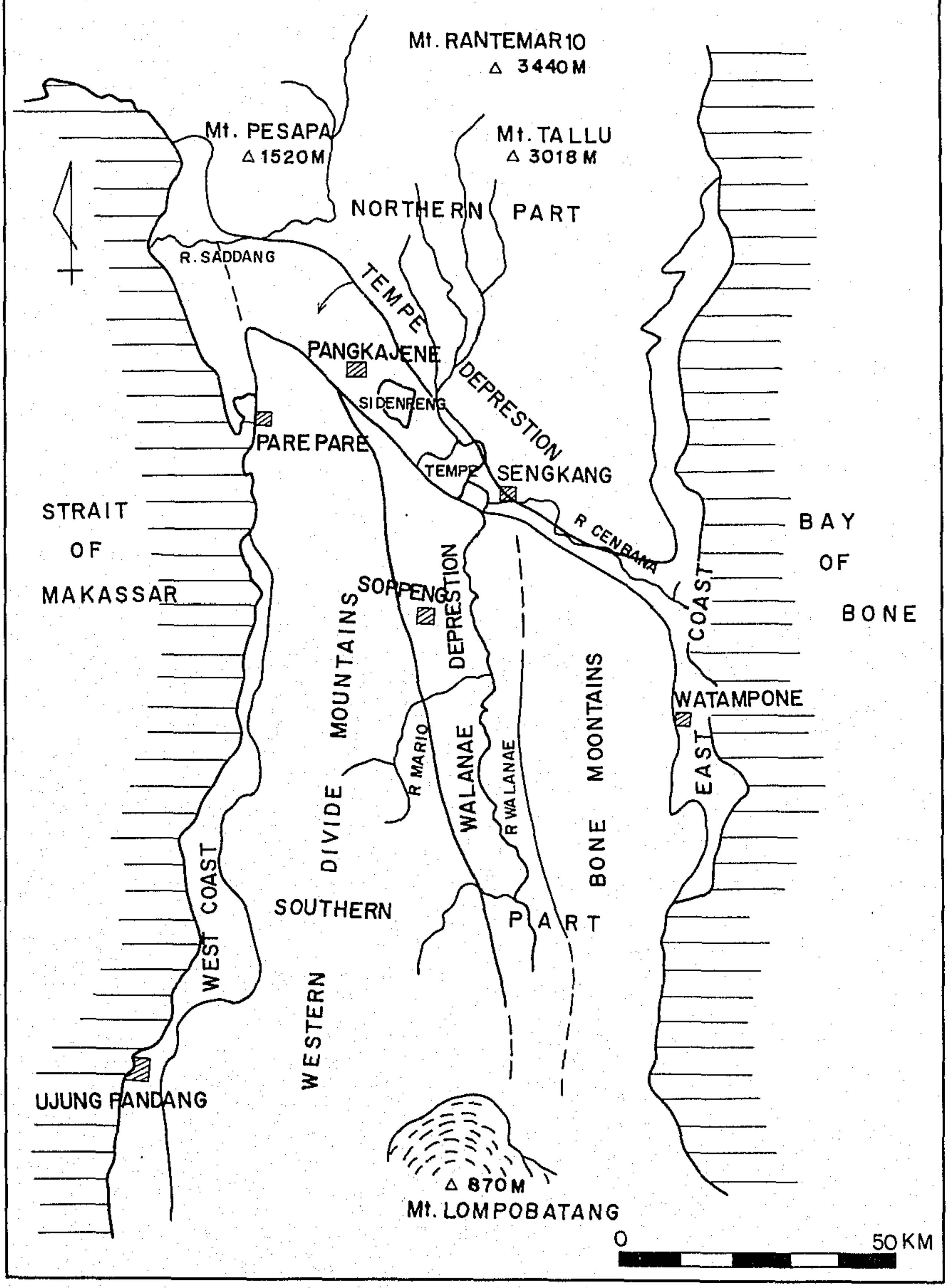


Fig. 9.2 Geological Map

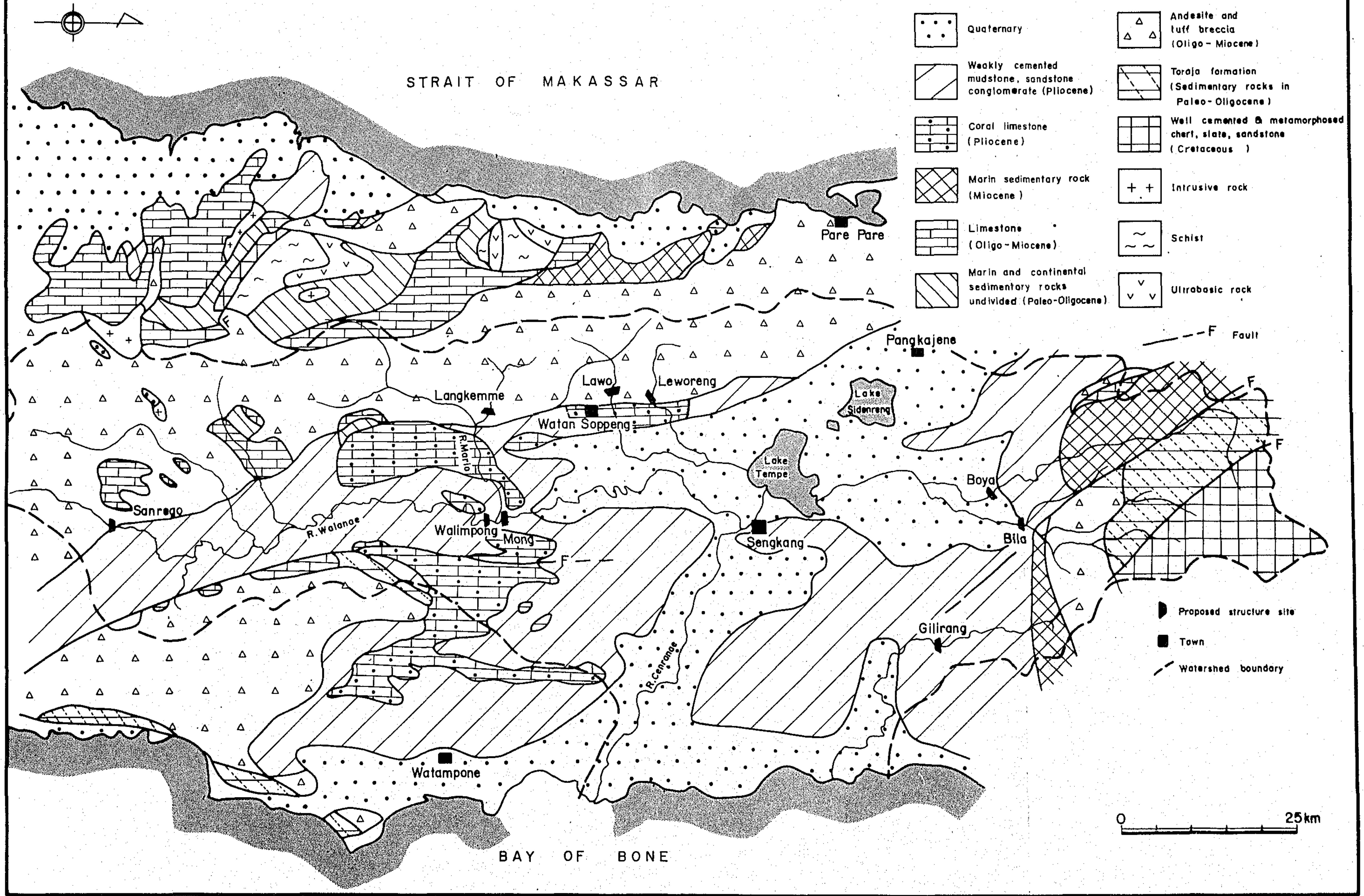


Fig. 9. 3 LOCATION OF SOUNDING TEST

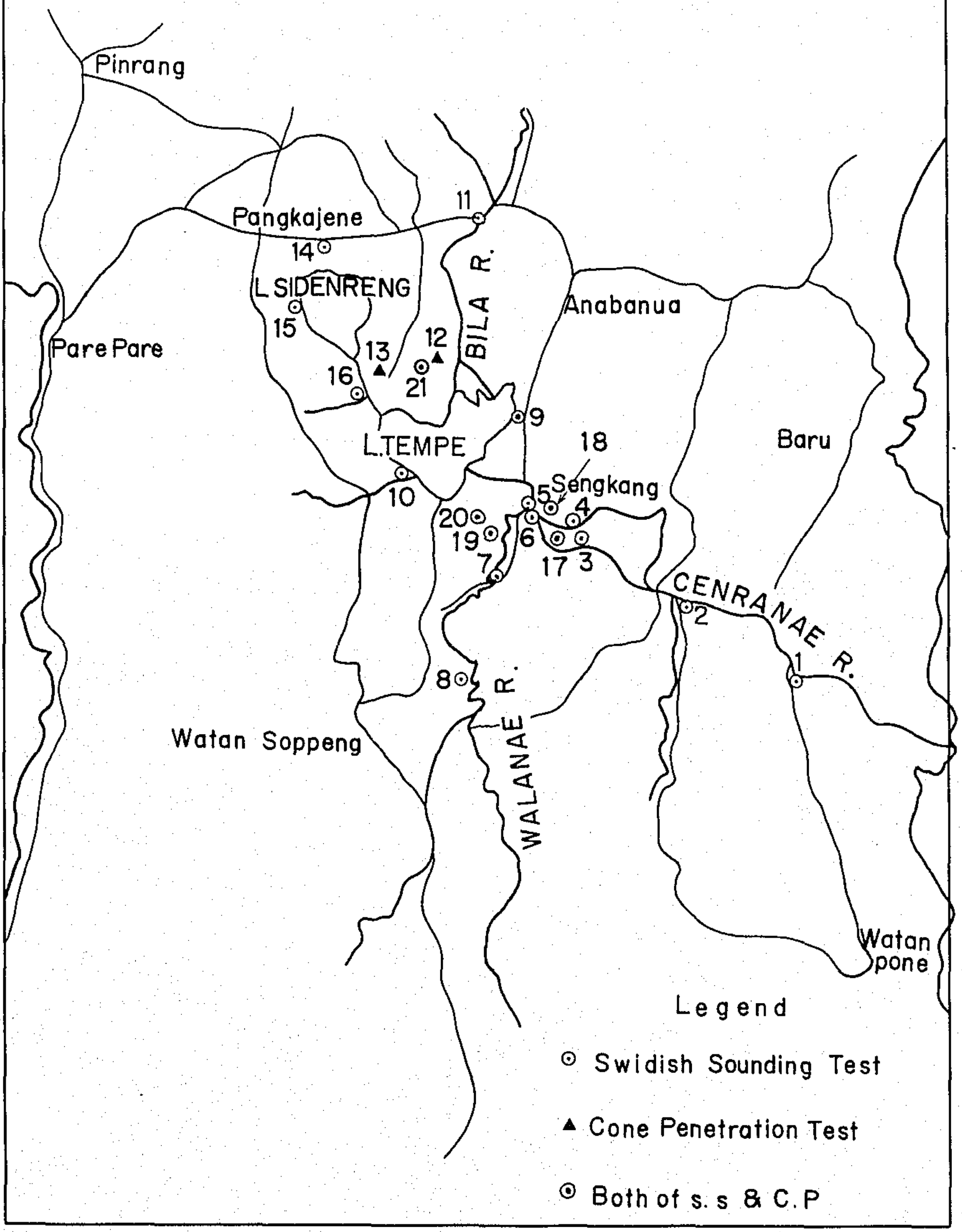


Fig 9.4 GEOLOGICAL MAP OF MONG DAM

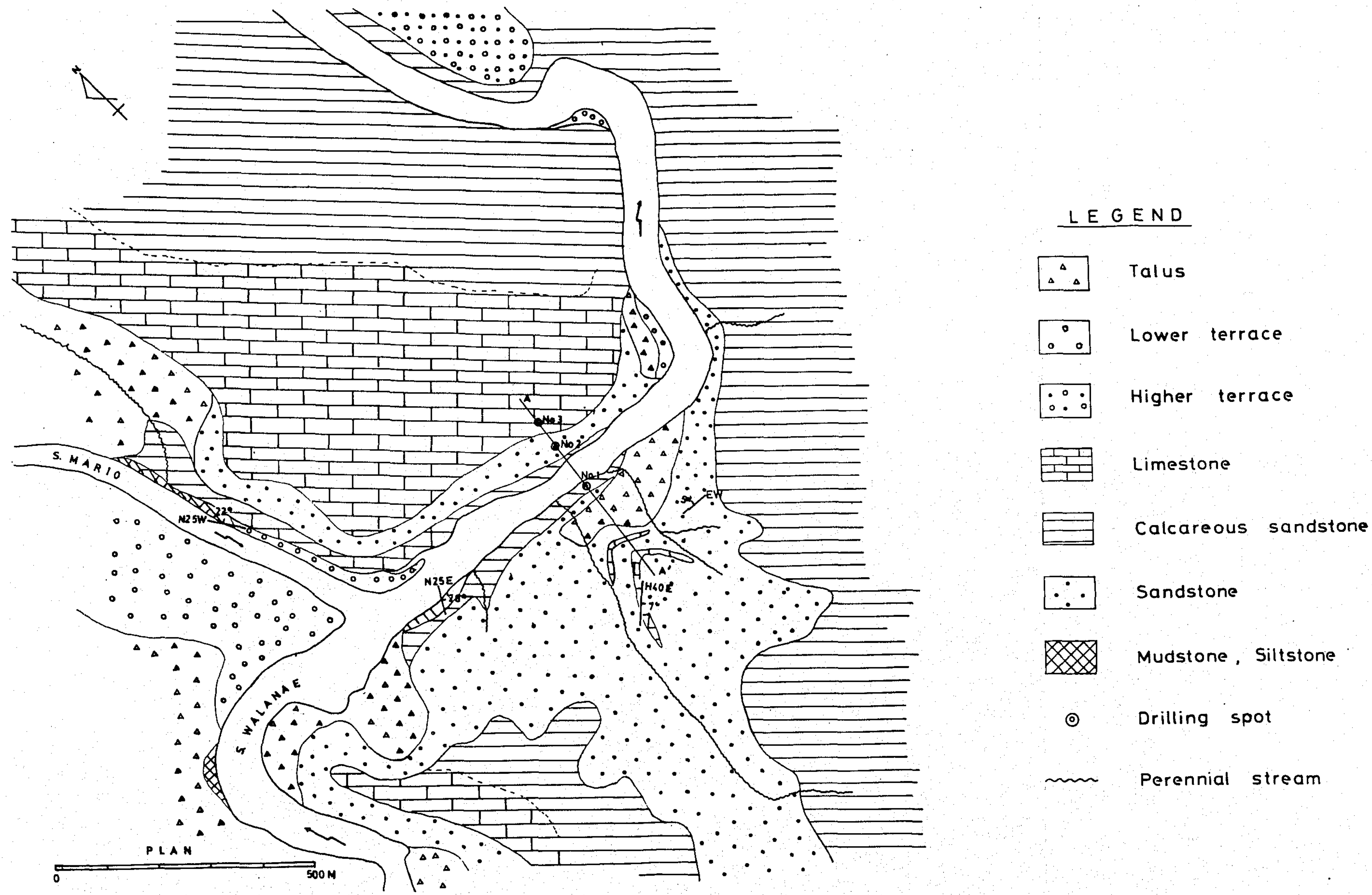


Fig. 9.5 GEOLOGICAL CROSS SECTION OF MONG DAM

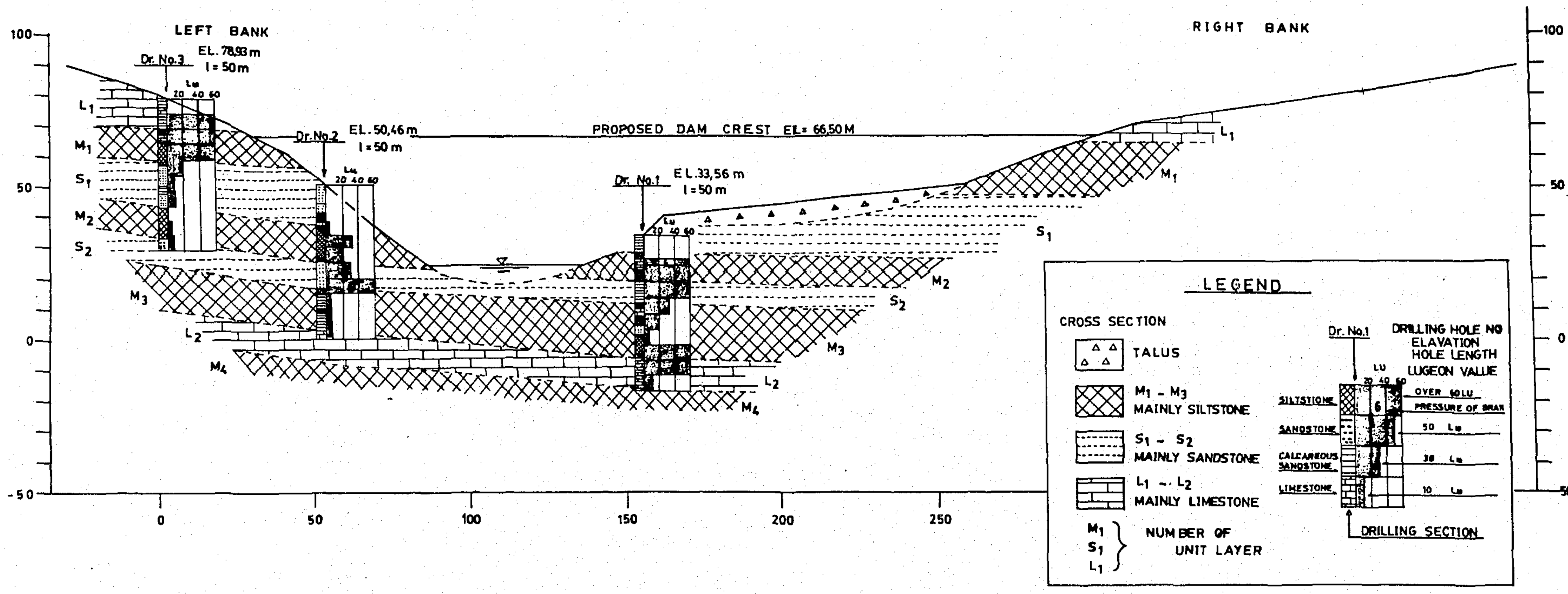


Fig 9.6 GEOLOGICAL MAP OF WALIMPONG DAM

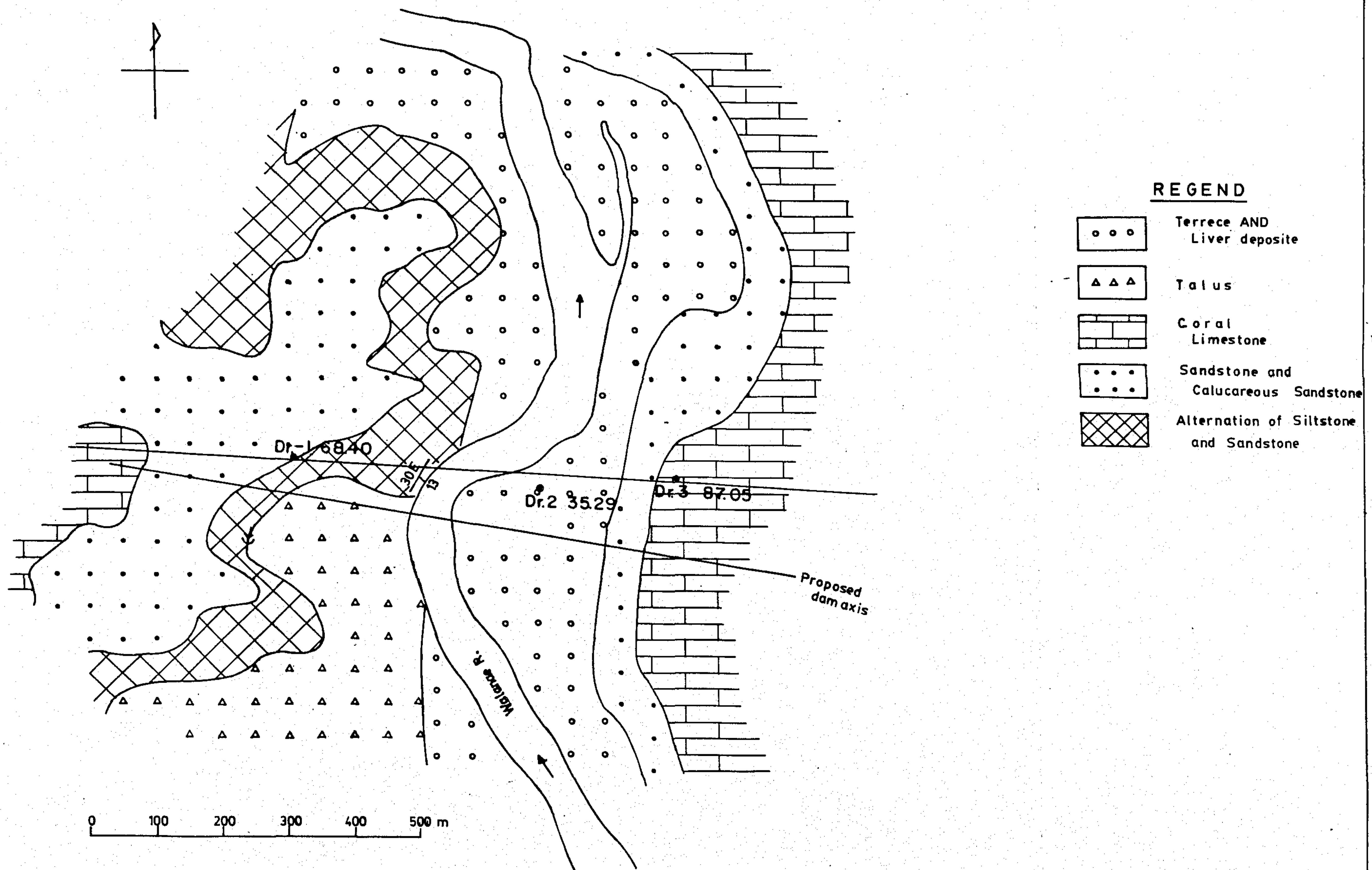


Fig. 9.7 GEOLOGICAL CROSS SECTION OF WALIMPONG DAM

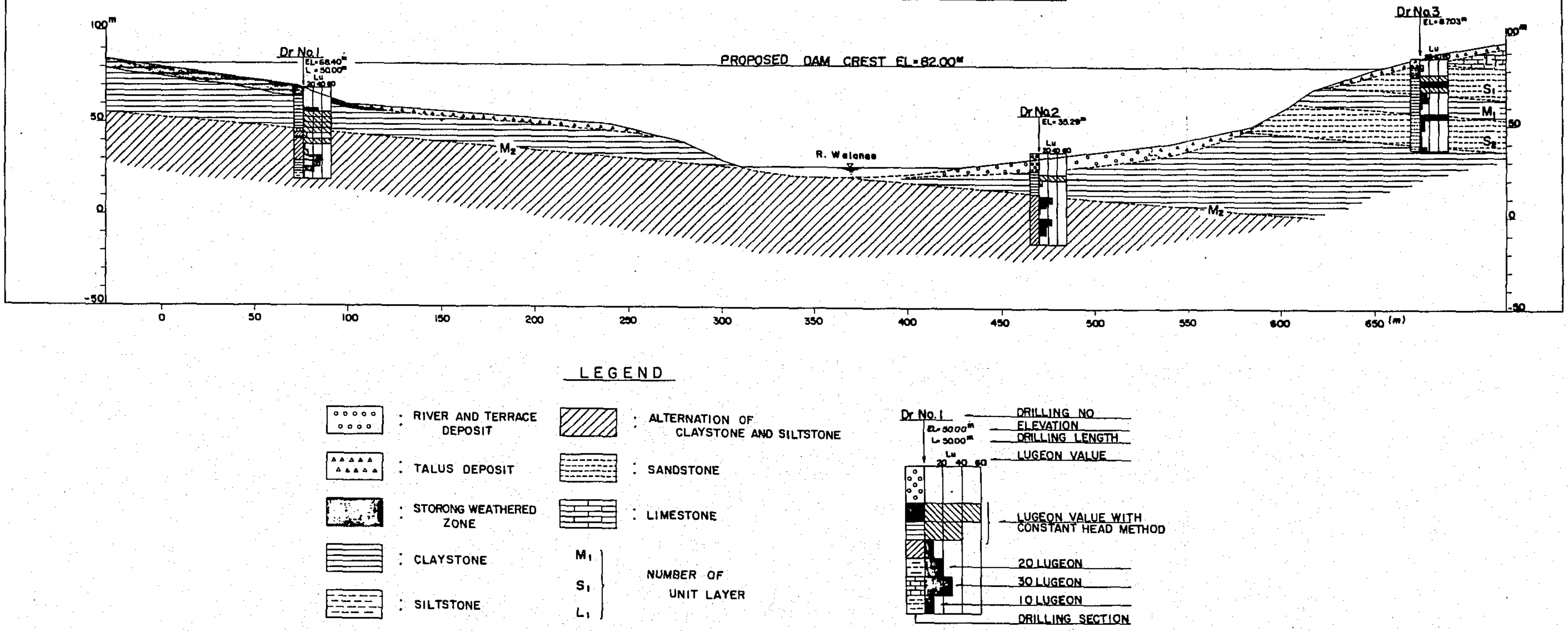


Fig 9.8 GEOLOGICAL PROFILE OF LANGKEMME INTAKE SITE

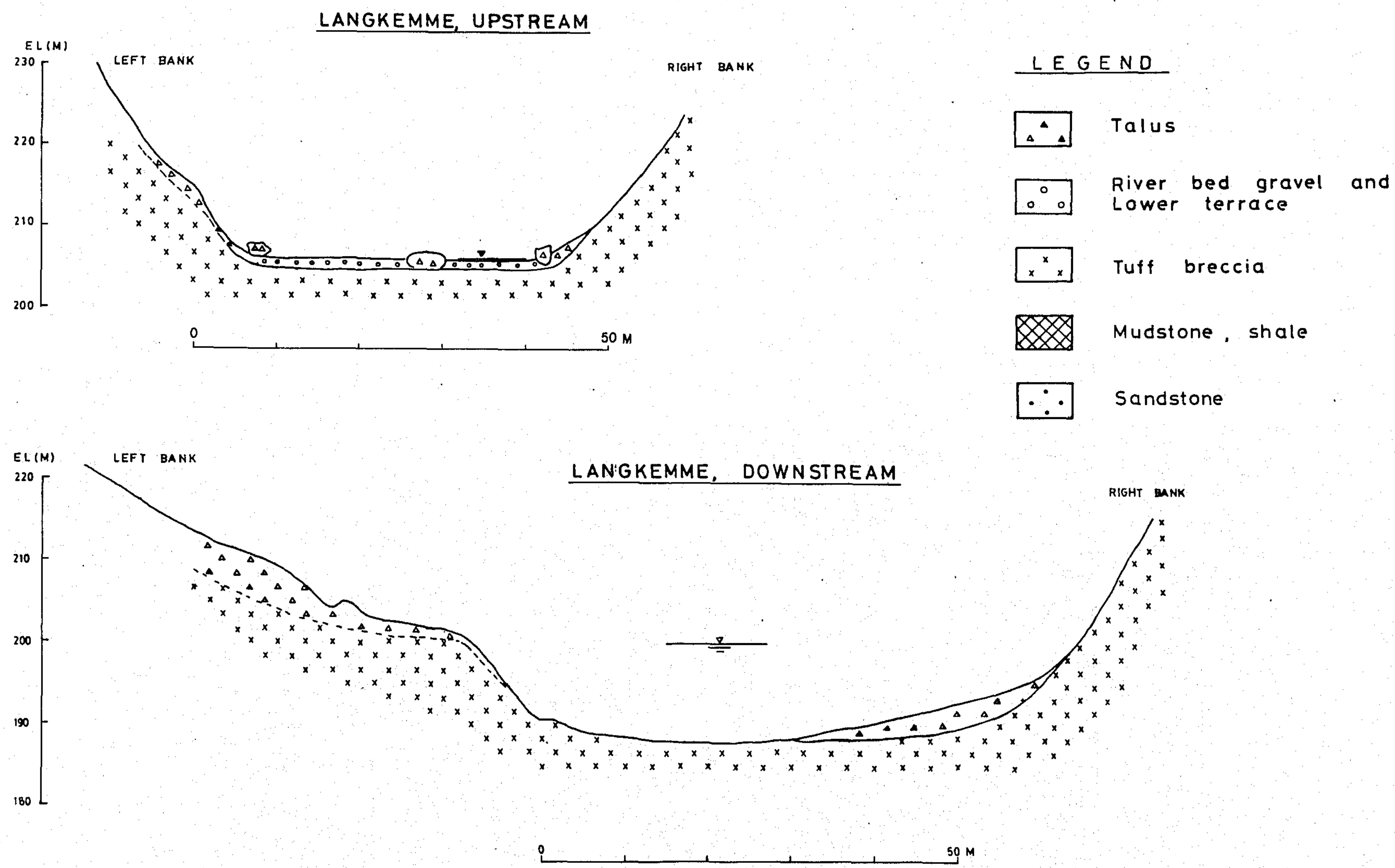


Fig 9.9 GEOLOGICAL PROFILE OF BILA INTAKE SITE

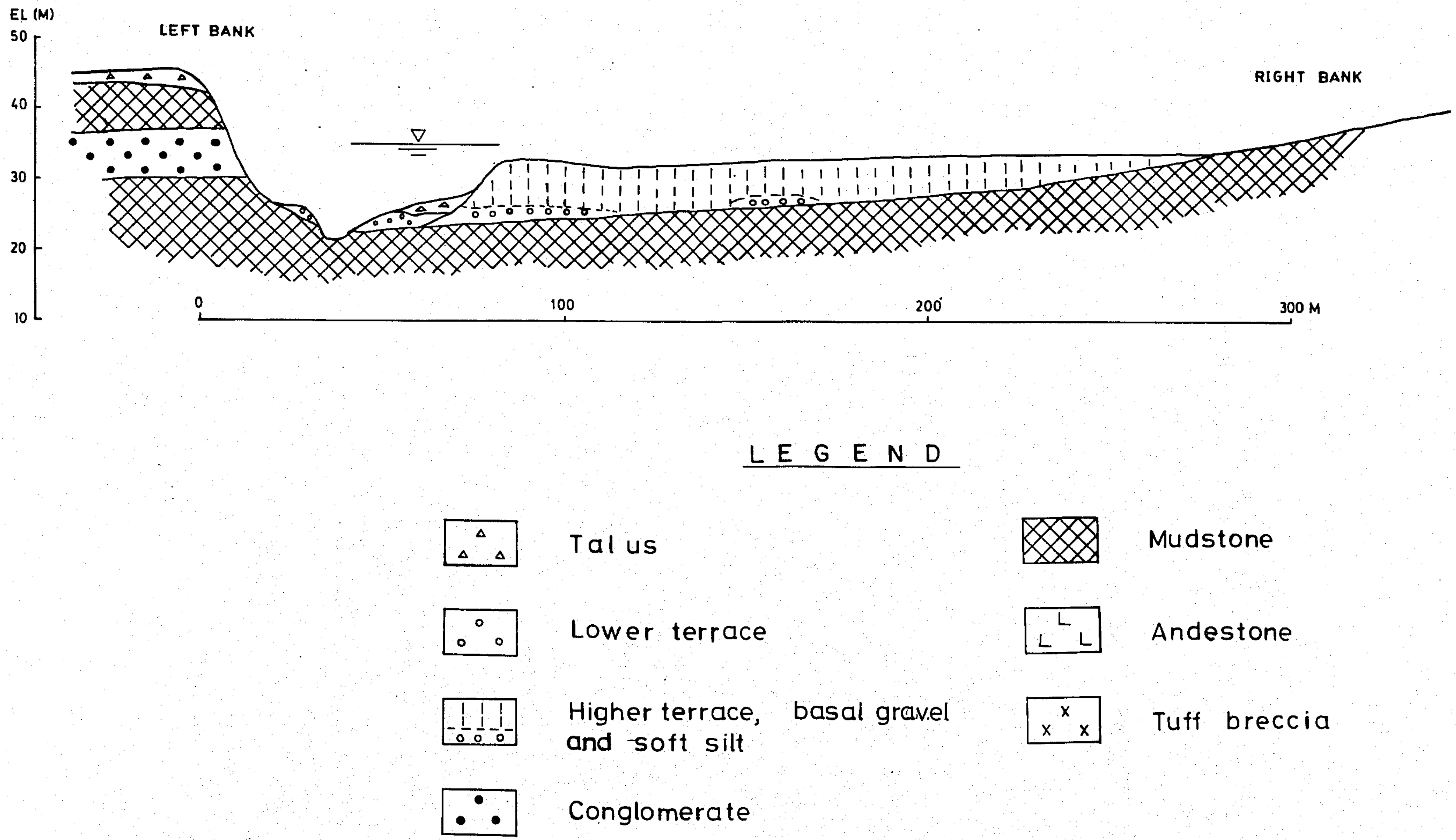


Fig 9.10 GEOLOGICAL PROFILE OF SANREGO INTAKE SITE

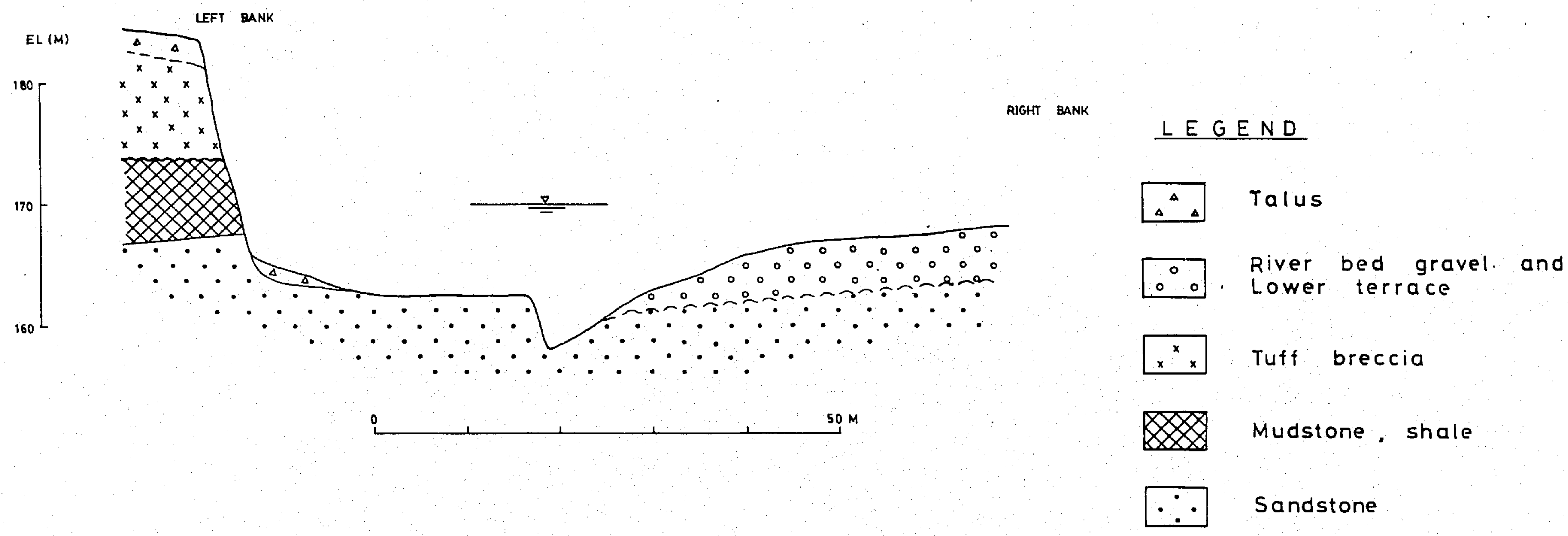
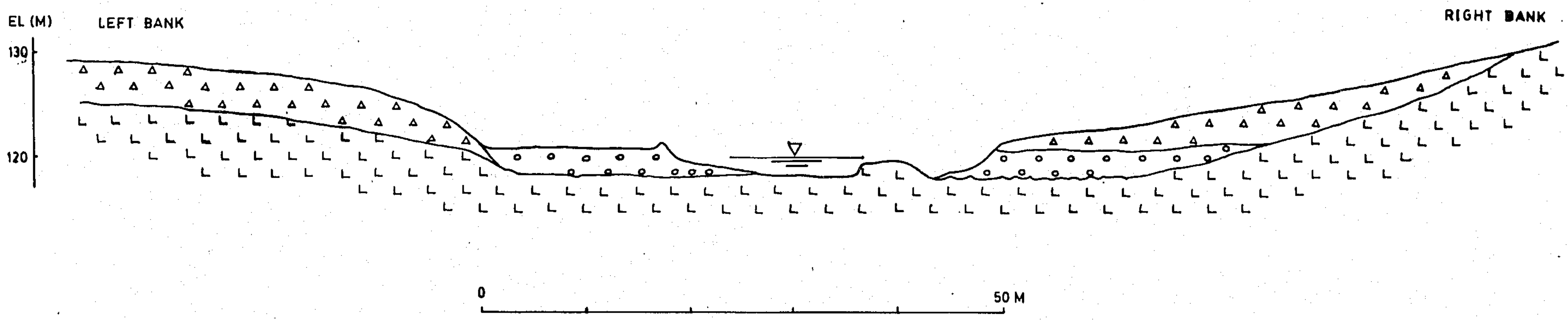


Fig 9.11 GEOLOGICAL PROFILE OF LAWO INTAKE SITE



LEGEND

- Tal us
- Lower terrace
- Higher terrace, basal gravel and soft silt
- Conglomerate
- Mudstone
- Andestone
- Tuff breccia

Fig 9.12 GEOLOGICAL PROFILE OF GILIRANG INTAKE SITE

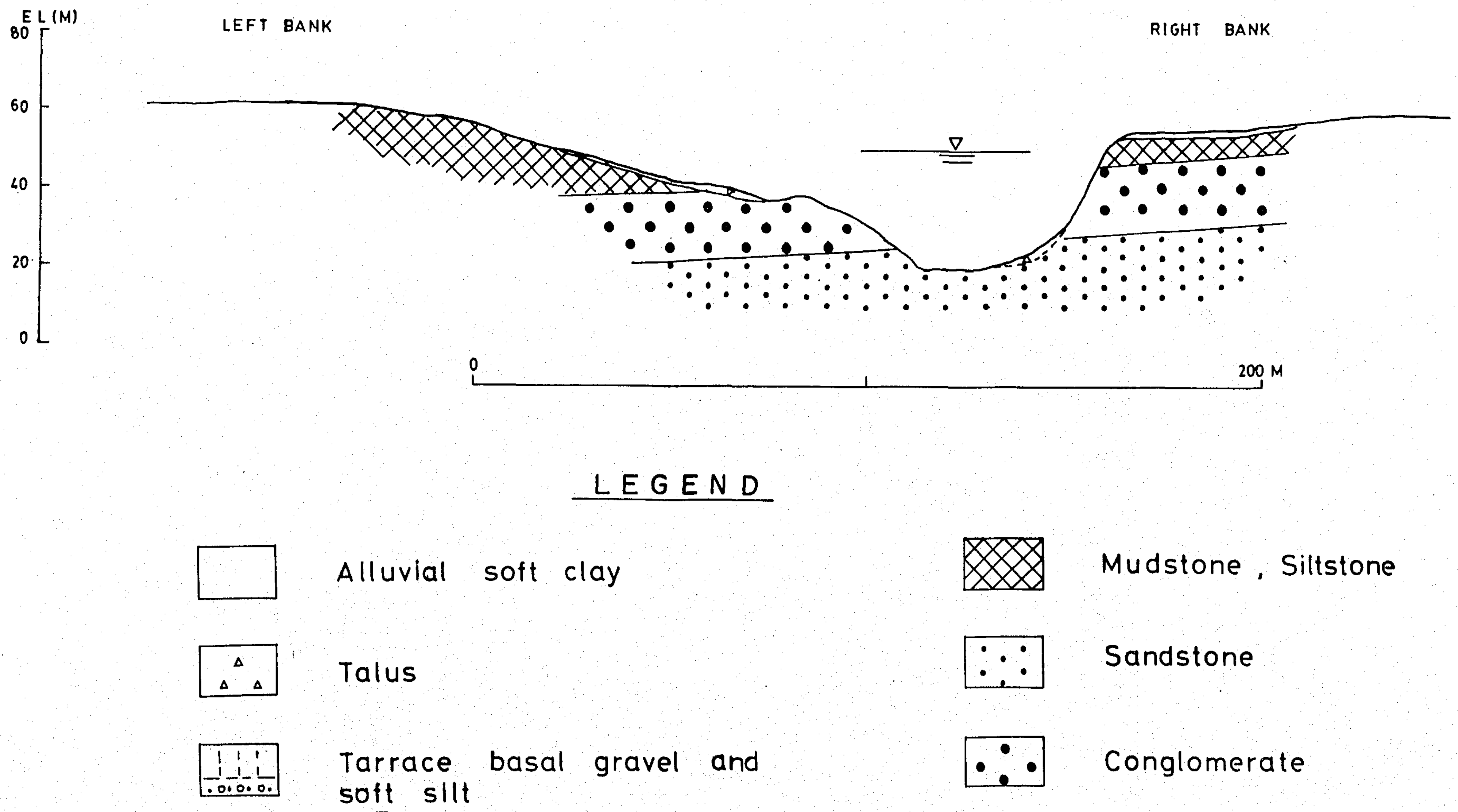
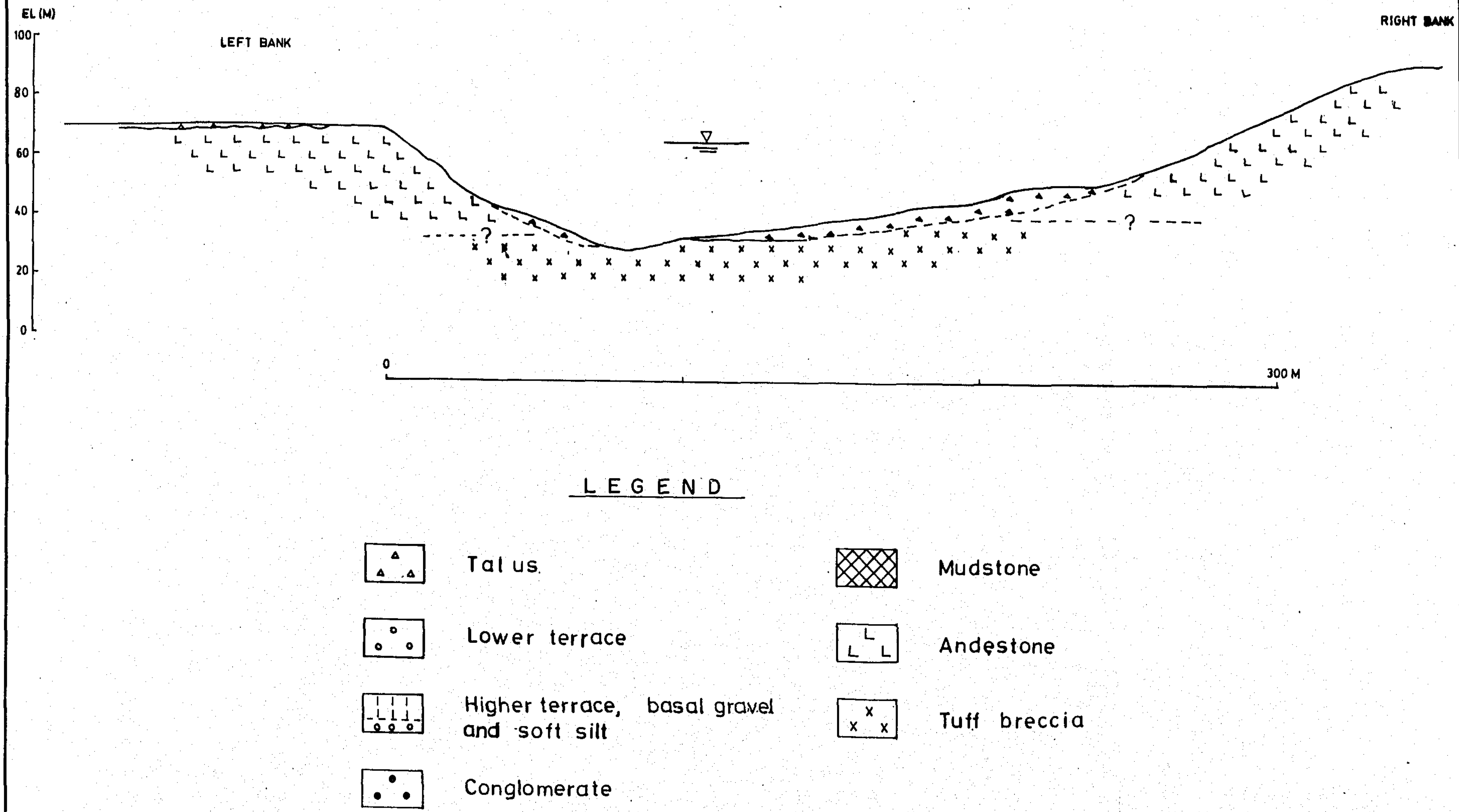


Fig 9.13 GEOLOGICAL PROFILE OF PADANGENG DAMSITE



A N N E X

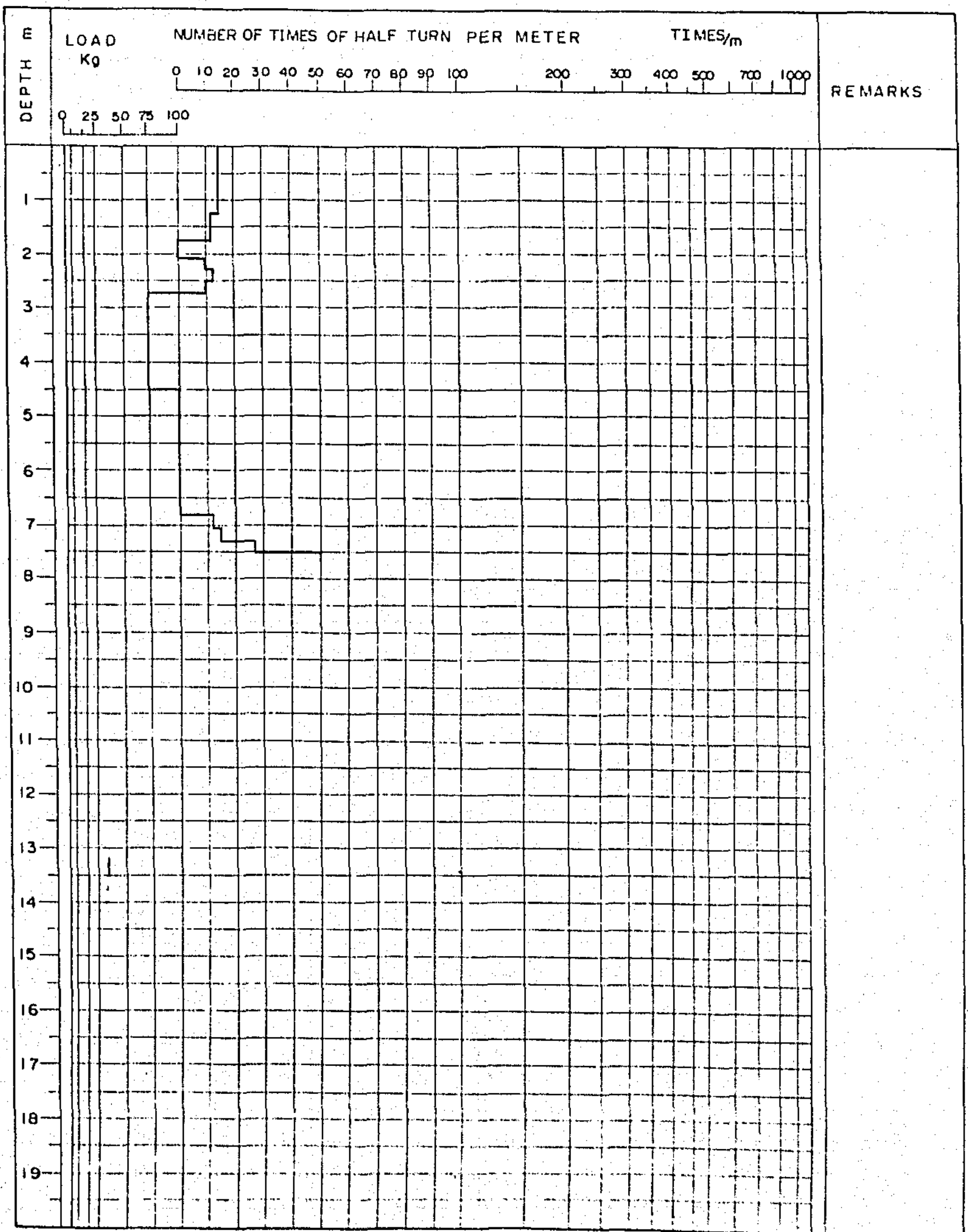
Records of Swedish Sounding Tests

SWEDISH SOUNDING TEST

LOCATION Cenranae 21km/Tanaroe   DATE 20 March 1979

STATION NO 1   ELEVATION 2.0 m   GROUND WATER LEVEL ____ m

TOTAL DEPTH 7.70 m   TESTED BY R. Nagata



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SWEDISH SOUNDING TEST

LOCATION OENRANAE 21km/TAWAROE DATE 20 MARET

STATION NO 1. ELEVATION 2.0 m GROUND WATER LEVEL m

TOTAL DEPTH 7.70 m TESTED BY

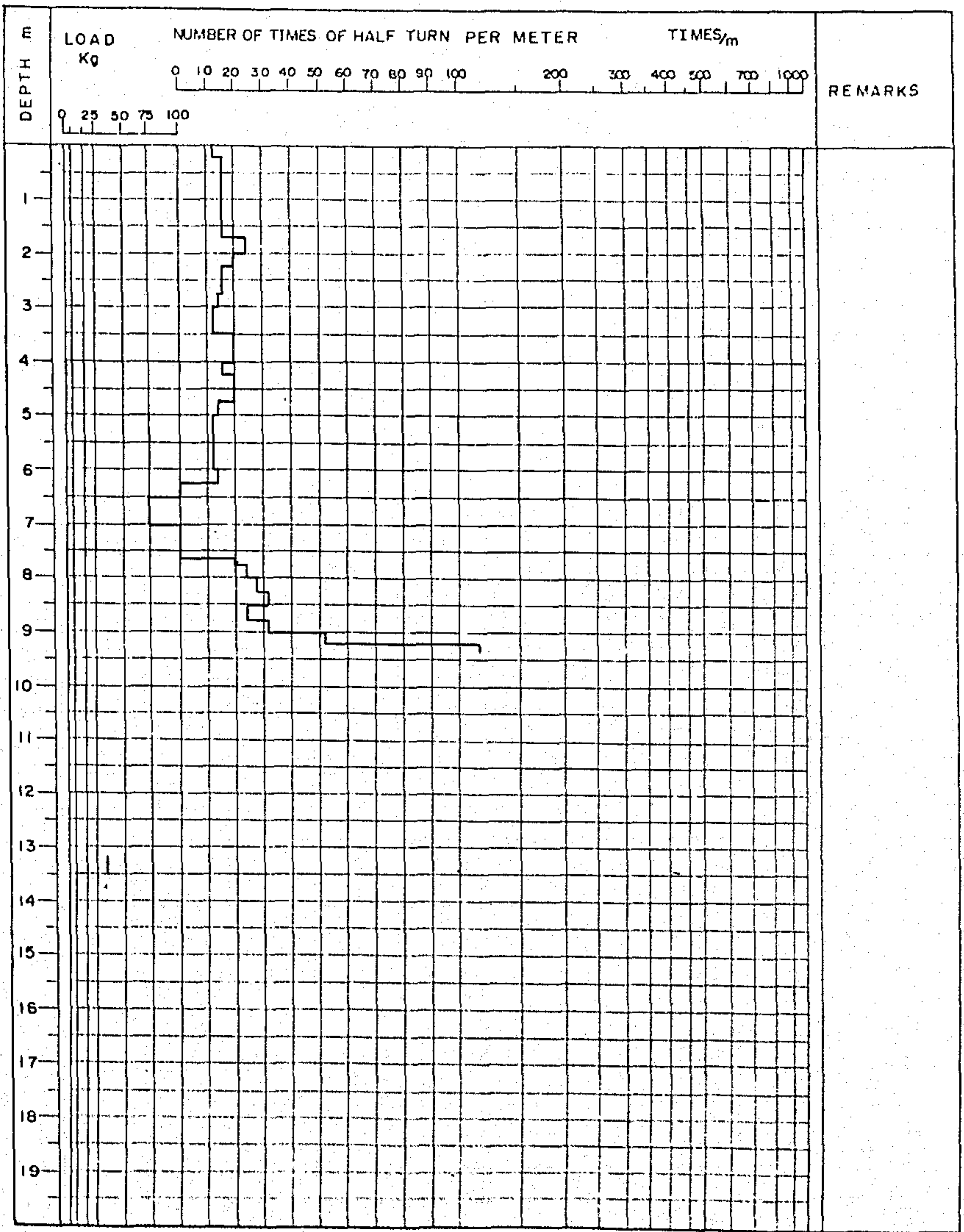
LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES/m	REMARKS N	LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES/m	REMARKS
100	4	25	0.25	16	2						
〃	4	〃	0.50	〃							
〃	4	〃	0.75	〃							
〃	4	〃	1.00	〃							
〃	4	〃	1.25	〃							
〃	3	〃	1.50	12	1						
〃	3	〃	1.75	12							
〃	—	30	2.05								
〃	2	20	2.25	10							
〃	3	25	2.50	12							
〃	2.5	25	2.75	10	1						
75	—	75	3.50								
〃	—	100	4.50								
100	—	〃	5.50								
〃	—	50	6.00								
〃	—	25	6.25								
〃	—	〃	6.50								
〃	—	〃	6.75								
〃	3	〃	7.00	12	1						
〃	3.5	〃	7.25	14							
〃	7	25	7.50	28	3						
〃	10	20	7.70	50	6						

SWEDISH SOUNDING TEST

LOCATION Cenranae 37km/pompanua DATE 20 Mareh 1979

STATION NO 2 ELEVATION 4.5 m GROUND WATER LEVEL m

TOTAL DEPTH 9.35 m TESTED BY R. Nagata



SWEDISH SOUNDING TEST

LOCATION OENRANAE 37 km/POMPANUA DATE 20 MARET 1979

STATION NO 2. ELEVATION 4.5 m GROUND WATER LEVEL m

TOTAL DEPTH 9.35 m TESTED BY R . Nagata

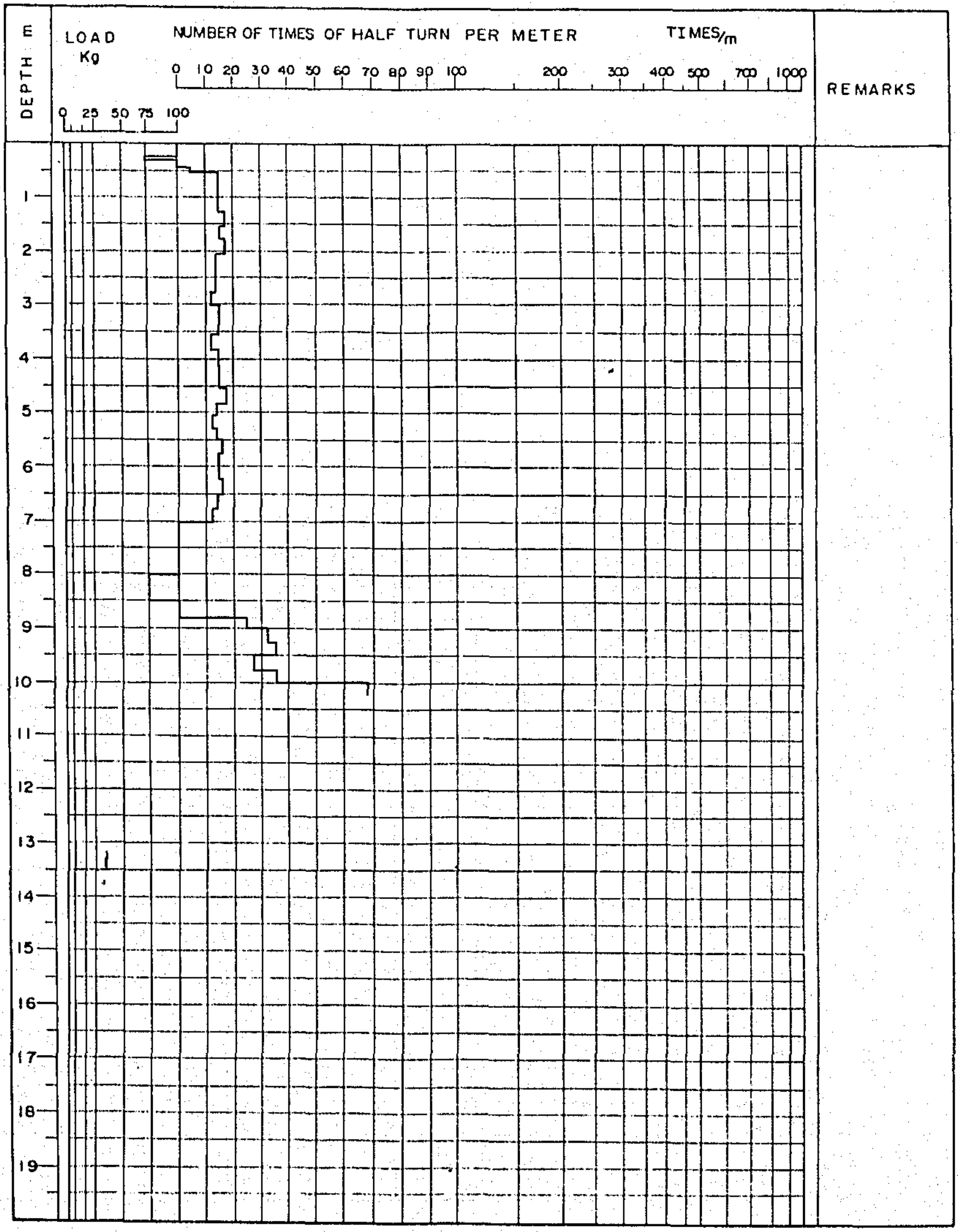
LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS N	LOAD kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS
100	3	25	0.25	12	1	100	8	25	8.50	32	3
〃	4	〃	0.50	16	2	〃	6	〃	8.75	24	
〃	4	〃	0.75	〃		〃	8	〃	9.00	32	
〃	4	〃	1.00	〃	0	〃	13	〃	9.25	52	6
〃	4	〃	1.25	〃		〃	12	10	9.35	120	13
〃	4	〃	1.50	〃							
〃	4	〃	1.75	〃							
〃	6	〃	2.00	24	3						
〃	5	〃	2.25	20	2						
〃	4	〃	2.50	16							
〃	4	〃	2.75	16							
〃	3.5	〃	3.00	14	2						
〃	3	〃	3.25	12							
〃	3	〃	3.50	12							
〃	5	〃	3.75	20							
〃	5	〃	4.00	20	2						
〃	4	〃	4.25	16							
〃	5	〃	4.50	20							
〃	5	〃	4.75	20	2						
〃	4	〃	5.00	14	1						
〃	3.5	〃	5.25	12							
〃	3	〃	5.50	〃							
〃	3	〃	5.75	〃							
〃	3	〃	6.00	〃	1						
〃	3.5	〃	6.25	14							
〃	—	〃	6.50								
75	—	50	7.00								
100	—	50	7.50								
〃	—	10	7.60								
〃	3	15	7.75	20							
〃	6	25	8.00	24							
〃	7	25	8.25	28							

SWEDISH SOUNDING TEST

LOCATION 0 − 62K (R) DATE 20 March 1979

STATION NO. 3 ELEVATION 7 m GROUND WATER LEVEL m

TOTAL DEPTH 10.25 m TESTED BY R . Nagata



SWEDISH SOUNDING TEST

LOCATION 0 − 62K (R) DATE 20 March 1979

STATION NO 3. ELEVATION about 7 m GROUND WATER LEVEL m

TOTAL DEPTH 10.25 m TESTED BY

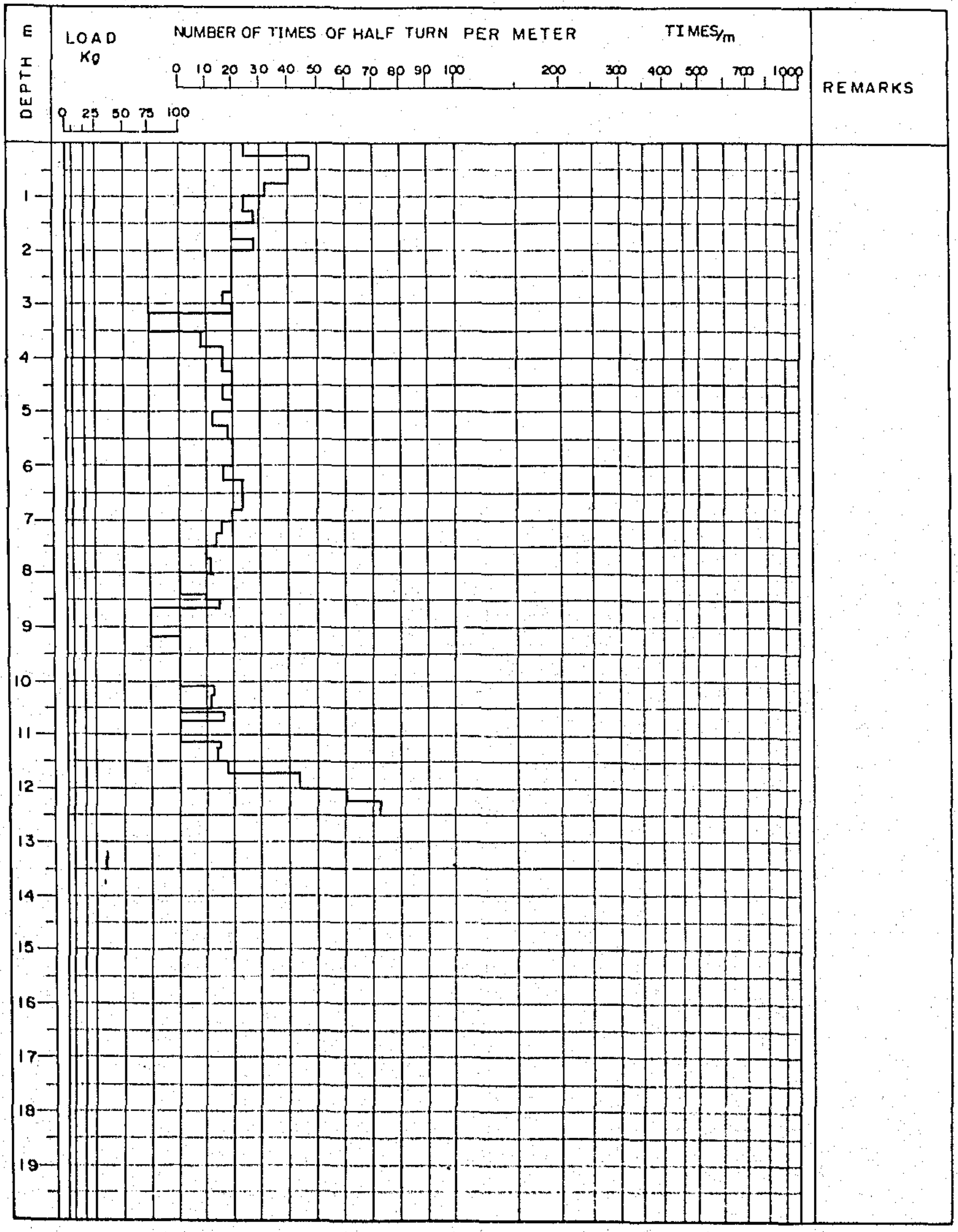
LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS N	LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS
100		20	0.20		0	75		25	8.25		
75		5	0.25			〃		25	8.50		
100		15	0.40			100		25	8.75		
〃	1	10	0.50	4		〃		5	8.80		
〃	4	25	0.75	16		〃	5	20	9.00	25	3
〃	4	〃	1.00	16	2	〃	8	25	9.25	32	
〃	4	〃	1.25	16		〃	9	25	9.50	36	
〃	4.5	〃	1.50	18		〃	7	25	9.75	28	
〃	4	〃	1.75	16		〃	9	25	10.00	36	4
〃	4.5	〃	2.00	18	2	〃	17	25	10.25	68	7.5
〃	3.5	〃	2.25	14							
〃	3.5	〃	2.50	14							
〃	3.5	〃	2.75	14							
〃	3	〃	3.00	12	1						
〃	4	〃	3.25	16							
〃	4	〃	3.50	16							
〃	3	〃	3.75	12							
〃	4	〃	4.00	16	2						
〃	4	〃	4.25	16							
〃	4	〃	4.50	16							
〃	4.5	〃	4.75	18							
〃	3.5	〃	5.00	14	1						
〃	3	〃	5.25	12							
〃	3.5	〃	5.50	14							
〃	4	〃	5.75	16							
〃	3.5	〃	6.00	14	2						
〃	3.5	〃	6.25	14							
〃	4	〃	6.50	16							
〃	3.5	〃	6.75	14							
〃	3	〃	7.00	12	1						
〃	—	50	7.50								
〃	—	10	7.60								
75	—	40	8.00		0						

SWEDISH SOUNDING TEST

LOCATION SENGKANG – 2 km (L) DATE 1 . March 1979

STATION NO 4 ELEVATION 7.8 m GROUND WATER LEVEL m

TOTAL DEPTH 12.5 m TESTED BY R . Nagata



SWEDISH SOUNDING TEST

LOCATION SENGKANG – 2km from Bridge (L) DATE 1 March 1979

STATION NO 4. ELEVATION 7.8 m GROUND WATER LEVEL m

TOTAL DEPTH 12.5 m TESTED BY R. Nagata

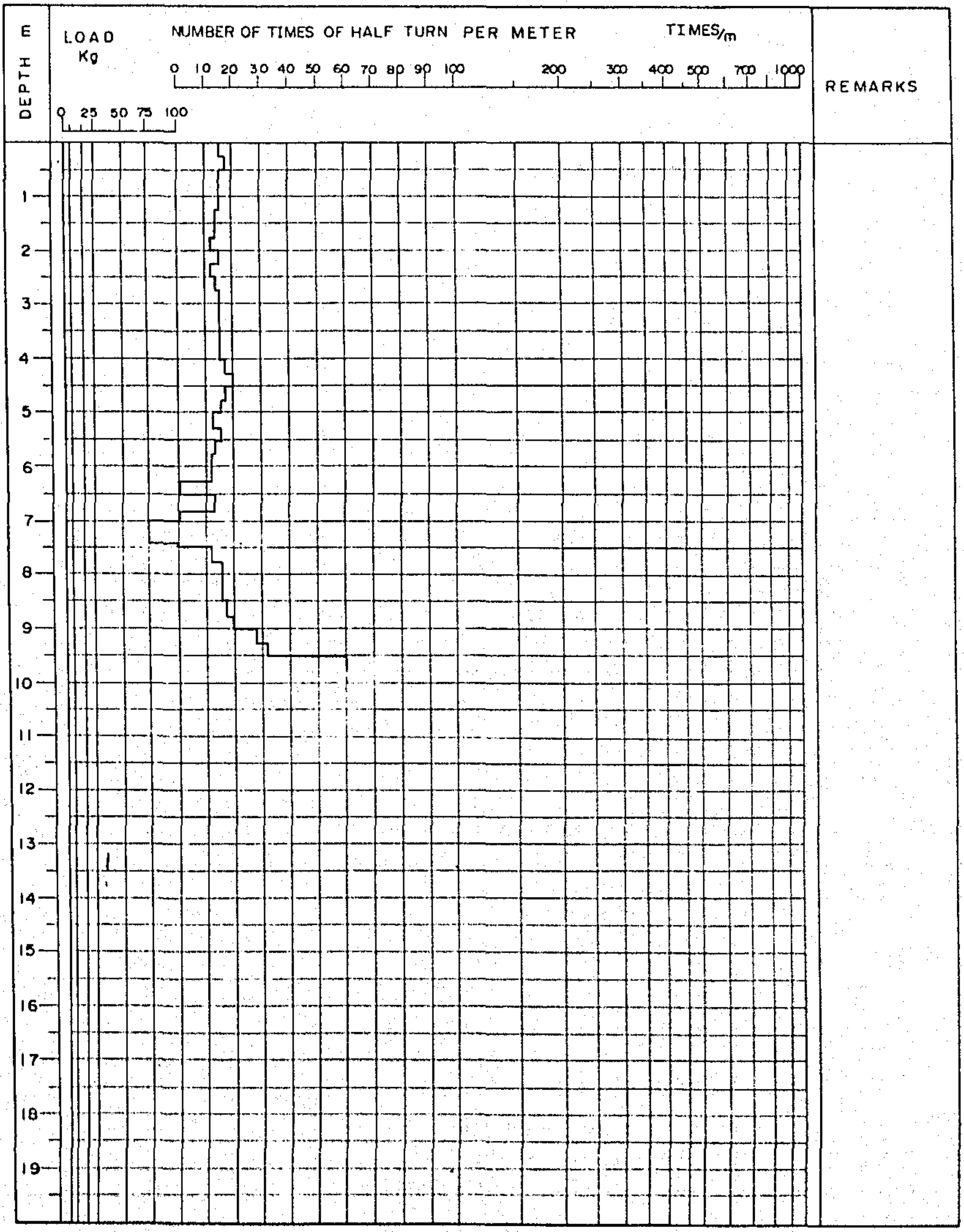
LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS	LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS
100	6	0.25	25	24	3	100	0.5	8.5	5	10	
〃	12	0.50	〃	48		〃	3	8.65	15	16	
〃	10	0.75	〃	40		75		9.20	56		0
〃	8	1.0	〃	32	3	100		9.5	29		
〃	6	1.25	〃	24		〃		10.1	60		
〃	7	1.5	〃	28		〃	2	10.25	15	13	
〃	5	1.75	〃	20		〃	3	10.50	25	12	
〃	7	2.0	〃	28	3	〃		10.60	10		
〃	5	2.25	〃	20		〃	2.5	10.75	15	16	
〃	5	2.5	〃	20		〃		11.15	40	'	
〃	5	2.75	〃	20		〃	1.5	11.25	15	15	
〃	4	3.0	〃	16	2	〃	3.5	11.50	25	14	
〃	3	3.15	15	20		〃	4.5	11.75	〃	18	
75		3.5	35			〃	11	12.00	〃	44	5
100	2	3.75	25	8		〃	15	12.25	〃	60	
〃	4	4.0	〃	16	2	〃	18	12.56	〃	72	8
〃	4	4.25	〃	16							
〃	5	4.5	〃	20							
〃	4	4.75	〃	16							
〃	5	5.0	〃	20	3						
〃	3	5.25	〃	12							
〃	4.5	5.5	〃	18							
〃	5	5.75	〃	20							
〃	5	6.0	〃	20	3						
〃	4	6.25	〃	16							
〃	6	6.5	〃	24							
〃	6	6.75	〃	24							
〃	5	7.0	〃	20	2						
〃	4	7.25	〃	16							
〃	3.5	7.5	〃	14							
〃	2.5	7.75	〃	10							
〃	3	8.0	〃	12	1						
〃		8.45	45								

SWEDISH SOUNDING TEST

LOCATION SENGKANG Hill site　　DATE 20 . March 1979

STATION NO. 5　　ELEVATION 1.6 m　　GROUND WATER LEVEL m

TOTAL DEPTH 9.75 m　　TESTED BY R . Nagata



SWEDISH SOUNDING TEST

LOCATION SENGKANG Hill sito DATE 20 March 1979

STATION NO 5 . ELEVATION about 16 m GROUND WATER LEVEL m

TOTAL DEPTH 9.75 m TESTED BY R . Nagata

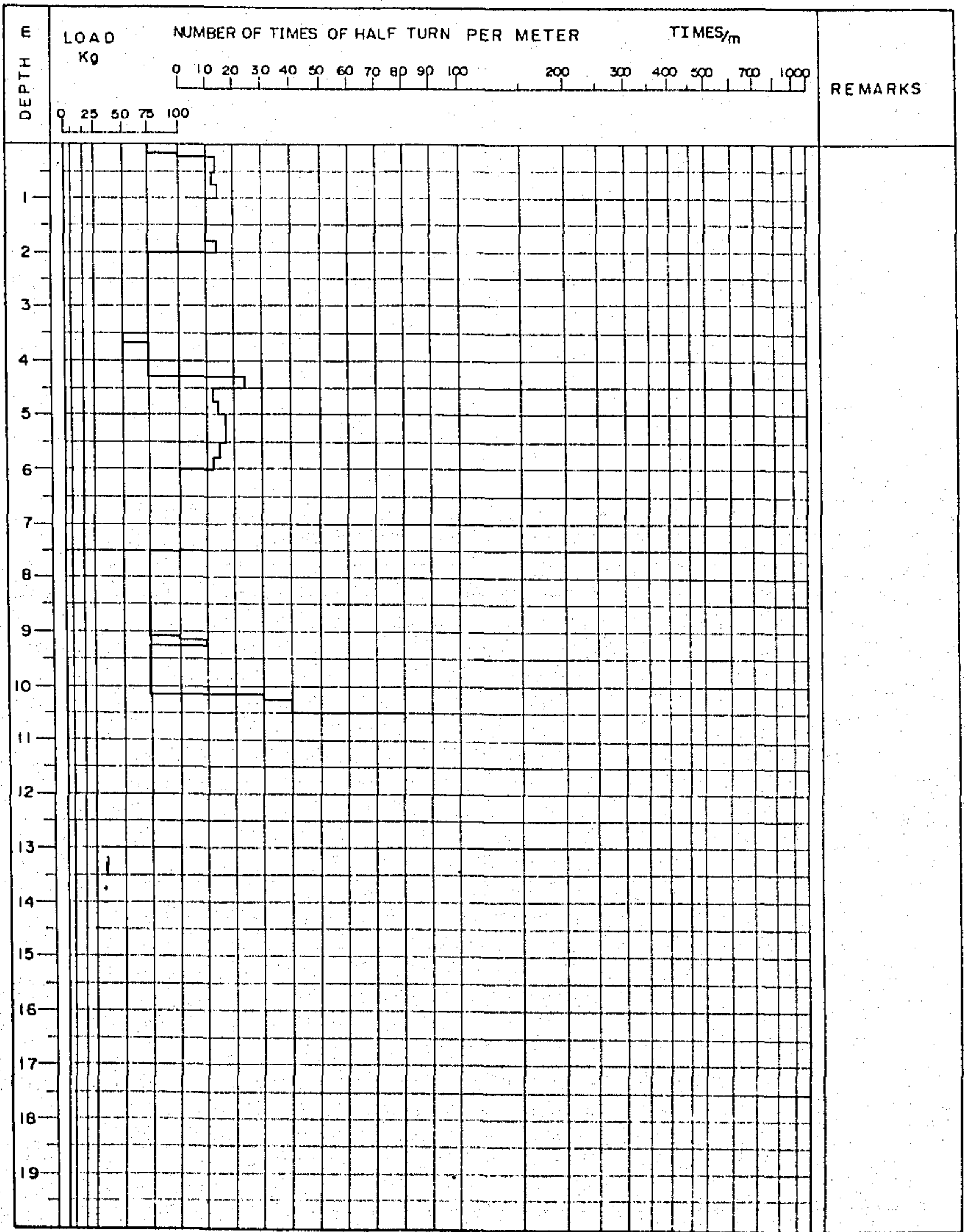
LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS N	LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS N
100	4	25	0.25	16	2	100	4	25	8.25	16	
〃	4.5	〃	0.50	18		〃	4	〃	8.50	16	
〃	4	〃	0.75	16		〃	4.5	〃	8.75	18	
〃	4	〃	1.00	16		〃	5	〃	9.00	20	2
〃	4	〃	1.25	16		〃	7	〃	9.25	28	
〃	3.5	〃	1.50	14	sand	〃	8	〃	9.50	32	
〃	3.5	〃	1.75	14		〃	12	〃	9.75	60	cant ROTATE
〃	3	〃	2.00	12	1						again
〃	4	〃	2.25	16							
〃	3	〃	2.50	12							
〃	3.5	〃	2.75	14							
〃	4	〃	3.00	16	2						
〃	4	〃	3.25	16							
〃	4	〃	3.50	16							
〃	4	〃	3.75	16							
〃	4	〃	4.00	16	2						
〃	4.5	〃	4.25	18							
〃	5	〃	4.50	20							
〃	4.5	〃	4.75	18							
〃	4	〃	5.00	16	2						
〃	3	〃	5.25	12							
〃	4	〃	5.50	16							
〃	3.5	〃	5.75	14							
〃	3	〃	6.00	12	1						
〃	3	〃	6.25	12							
〃	—	〃	6.50	—							
〃	3.5	〃	6.75	14							
〃	—	〃	7.00	—	0						
75	—	〃	7.25	—							
〃	—	20	7.45	—							
100	—	5	7.50	—							
〃	3	25	7.75	12							
〃	4	〃	8.00	16	2						

SWEDISH SOUNDING TEST

LOCATION SENGKANG +1.0m from Bridge — DATE 27. Feb 1979

STATION NO 6 — ELEVATION . 7 m — GROUND WATER LEVEL m

TOTAL DEPTH 10.7 m — TESTED BY R. Nagata



SWEDISH SOUNDING TEST

LOCATION SENGKANG +1.0m from Bridge DATE 27 Feb 1979

STATION NO 6 . ELEVATION 7 m GROUND WATER LEVEL m

TOTAL DEPTH 10.7 m TESTED BY R Nagata

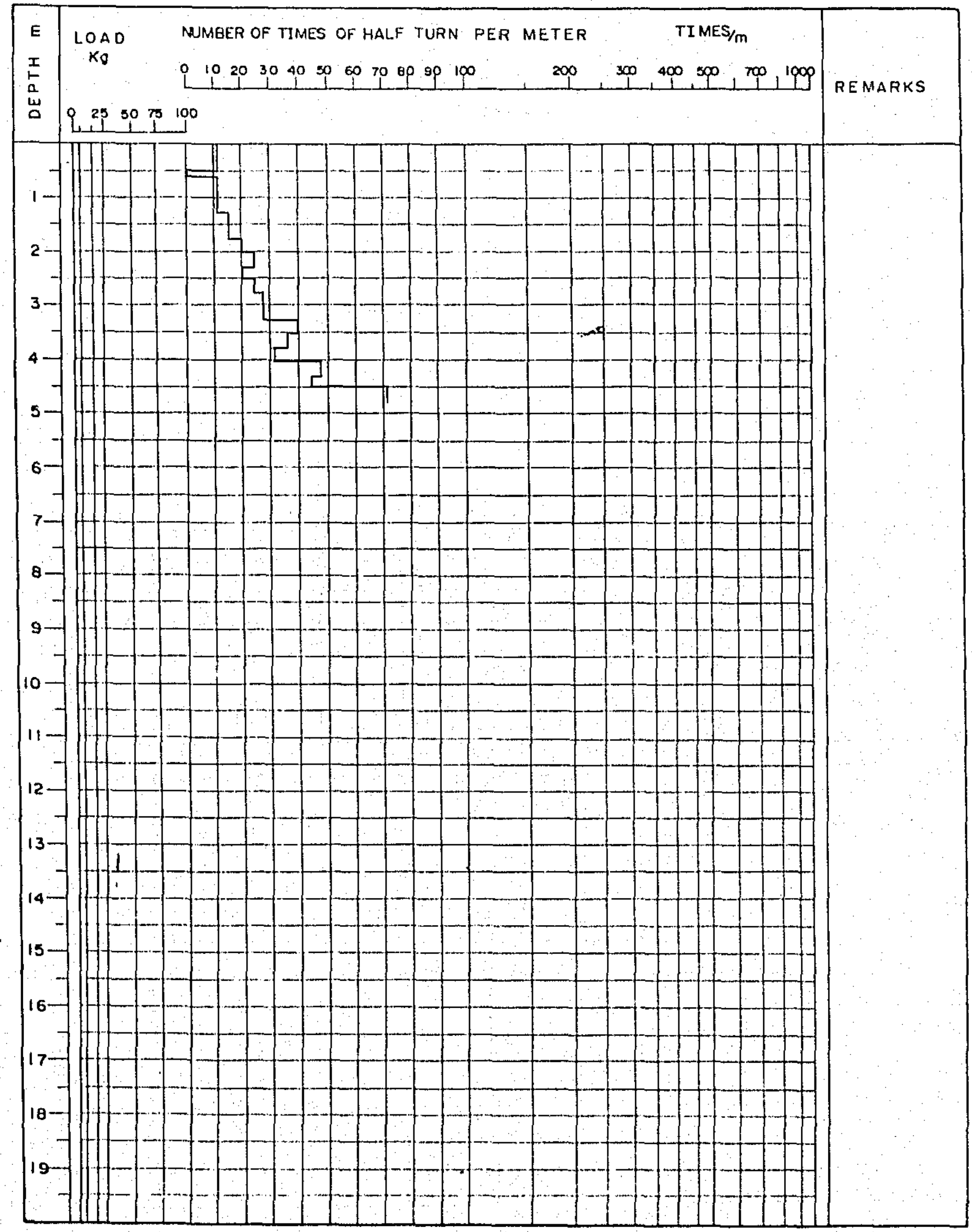
LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetration Length cm	TIMES / m	REMARKS N	LOAD kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS
75		0.15	15		0						
100		0.20	5								
〃	4	0.50	30	13	1						
〃	3	0.75	25	12							
〃	3.5	1.00	〃	14							
〃		1.50	50								
〃		1.75	25								
〃	3	2.00	25	12	1						
75		3.5	150								
50		3.65	15		0						
75		4.25	60								
100	6	4.50	25	24							
〃	3	4.75	〃	12							
〃	3.5	5.00	〃	14	1						
〃	4	5.25	〃	16							
〃	4	5.50	〃	16							
〃	3.5	5.75	〃	14							
〃	3	6.00	〃	12	1						
〃		7.50	150								
75		9.10	160		0						
100		9.15	5								
〃	1	9.25	10	10							
75		10.15	90								
100	3	10.25	10	30	3						
〃	10	10.50	25	40							
〃	16	10.70	20	80							

SWEDISH SOUNDING TEST

LOCATION OANRU DATE 20. March 1979

STATION NO. 7 ELEVATION 1000 m GROUND WATER LEVEL m

TOTAL DEPTH 4.75 m TESTED BY R. Nagata



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SWEDISH SOUNDING TEST

LOCATION OANRU DATE 20 March 1979

STATION NO 7. ELEVATION 10.00 m GROUND WATER LEVEL m

TOTAL DEPTH 4.75 m TESTED BY R. Nagata

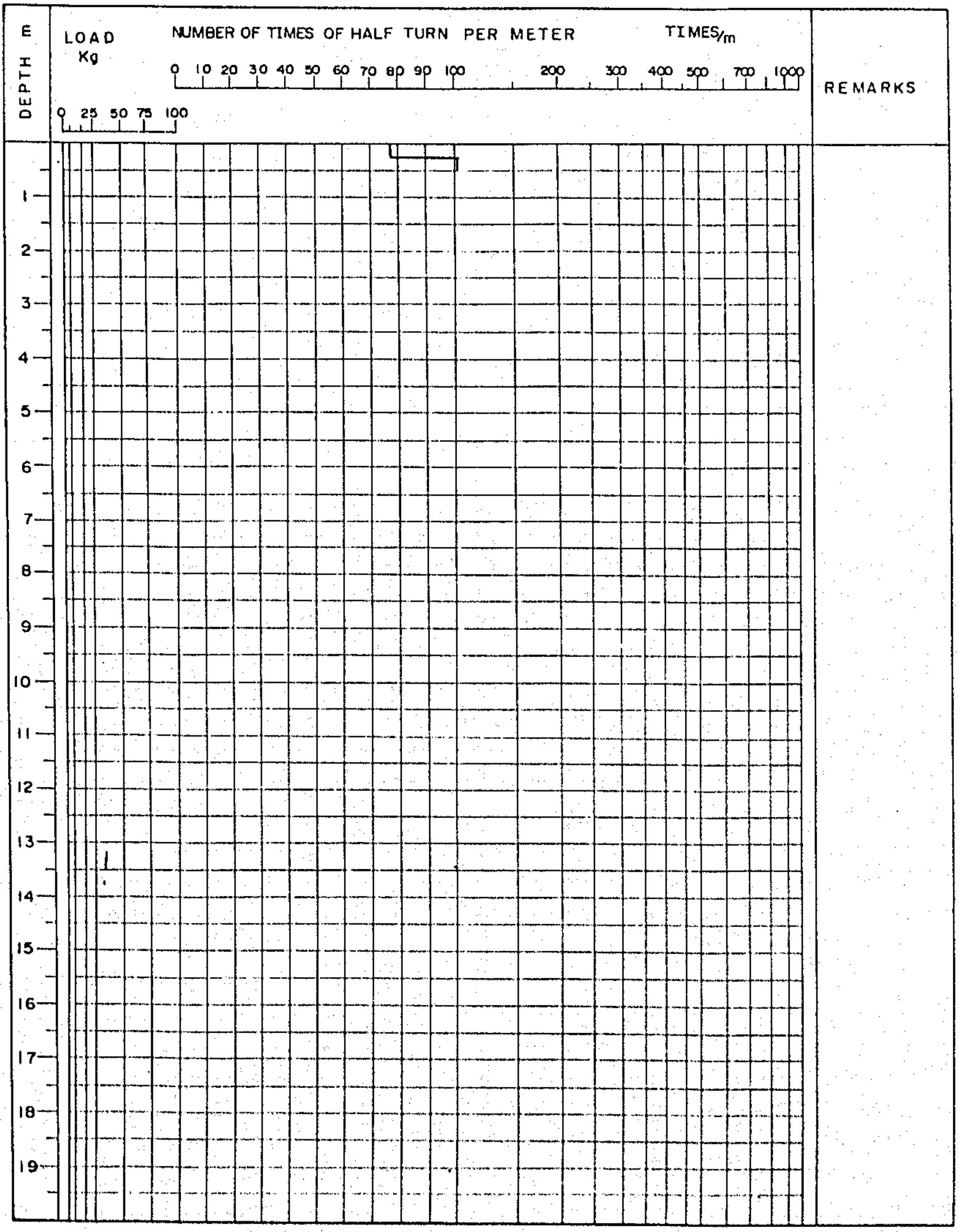
LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS N	LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS
100	3	25	0.25	12	1						
〃	3	〃	0.50	12							
〃	—	10	0.60	—							
〃	2	15	0.75	12							
〃	3	25	1.00	12	1						
〃	3	〃	1.25	12							
〃	4	〃	1.50	16							
〃	4	〃	1.75	16							
〃	5	〃	2.00	20	2						
〃	6	〃	2.25	24							
〃	5	〃	2.50	20							
〃	6	〃	2.75	24							
〃	7	〃	3.00	28	3						
〃	7	〃	3.25	28							
〃	10	〃	3.50	40	Sand						
〃	9	〃	3.75	36							
〃	8	〃	4.00	32	3						
〃	12	〃	4.25	48							
〃	11	〃	4.50	44							
〃	18	〃	4.75	72	6−7						

SWEDISH SOUNDING TEST

LOCATION WATANG LOMPULLE DATE 22 . March 1979

STATION NO 8 ELEVATION 16.5 m GROUND WATER LEVEL m

TOTAL DEPTH 0.5 m TESTED BY R , Nagata



SWEDISH SOUNDING TEST

LOCATION WATANG LOMPULLE | DATE 22, March 1979

STATION NO 8 . | ELEVATION 16.5 m | GROUND WATER LEVEL m

TOTAL DEPTH 0.5 m | TESTED BY R . Nagata

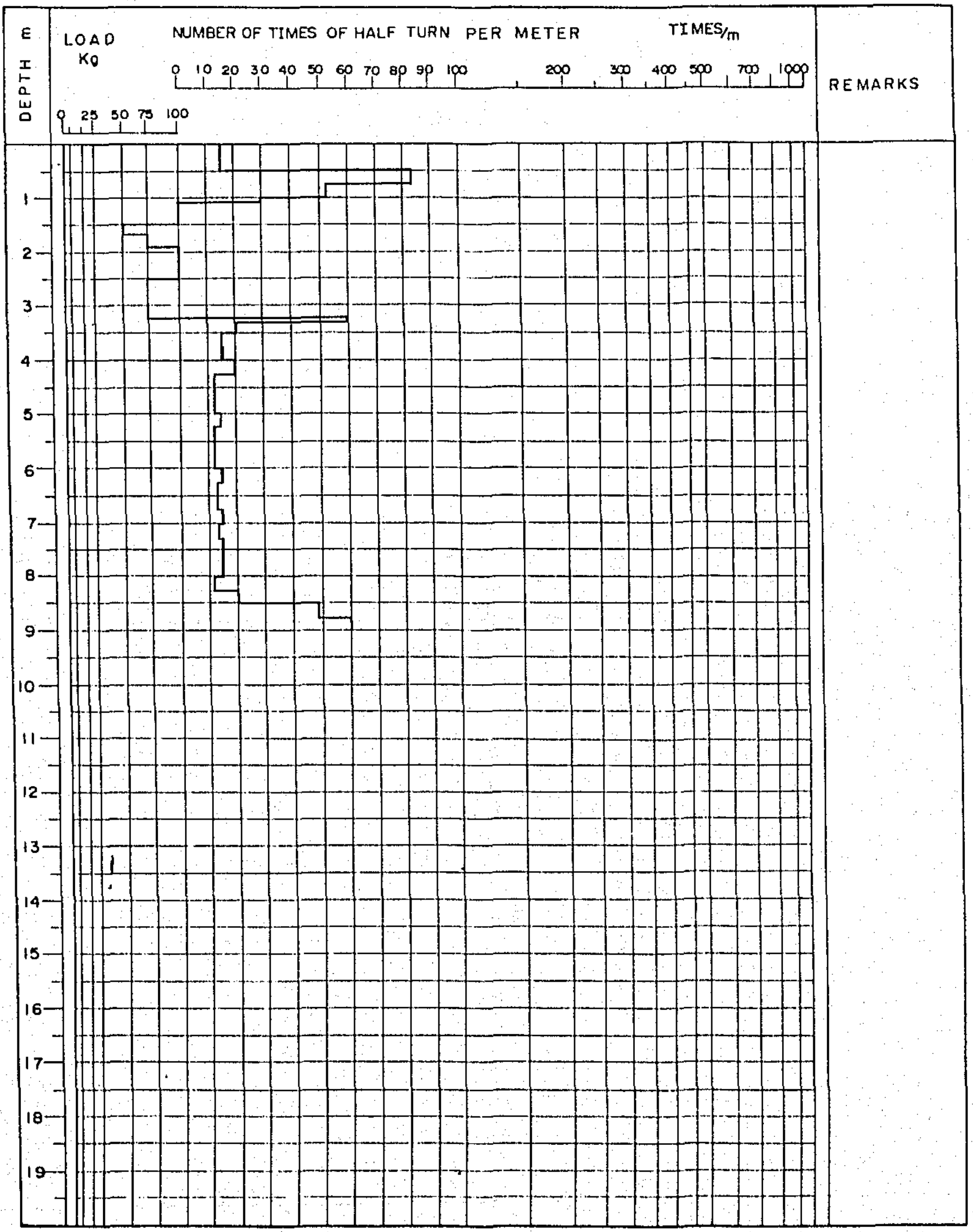
LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS N	LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS
100	18	25	0.25	78	8						
〃	26	25	0.50	104							
	twiee	(near	point)								
100	17	25	0.25	68							
〃	7	10	0.35	70							
				hard clay							

SWEDISH SOUNDING TEST

LOCATION LAKE TEMPE／TANOUNG　　DATE 21. March 1979

STATION NO. 9　　ELEVATION 9 m　　GROUND WATER LEVEL m

TOTAL DEPTH 9.00 m　　TESTED BY R , Nagata



SWEDISH SOUNDING TEST

LOCATION LAKE TEMPE／TANOUNG DATE 21 . March 1979

STATION NO 9. ELEVATION 9 m GROUND WATER LEVEL m

TOTAL DEPTH 9.00 m TESTED BY R.Nagata

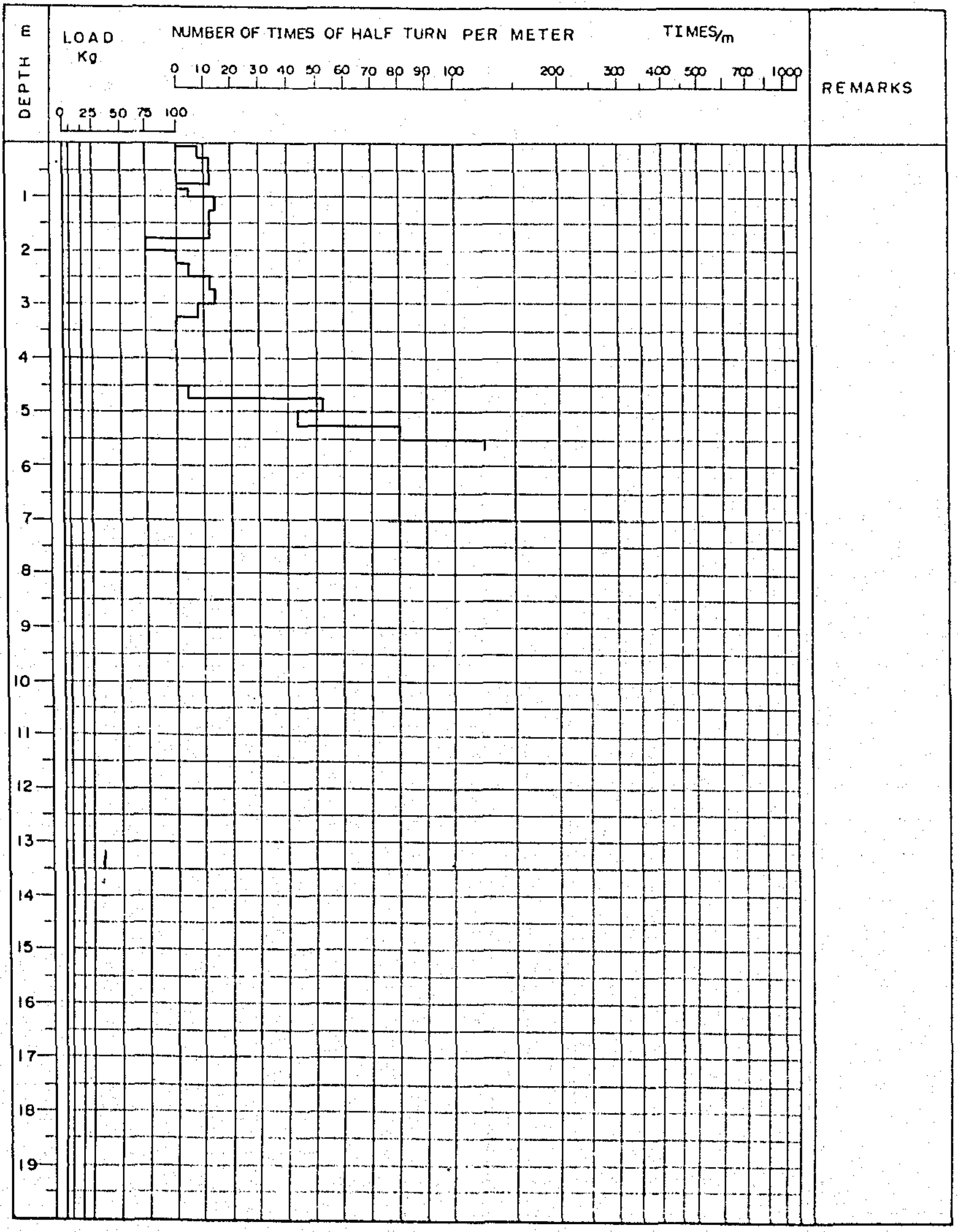
LOAD kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS	LOAD kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS
100	4	25	0.25	16		100	15	25	9.00	60	7
〃	4	〃	0.50	16							
〃	21	〃	0.75	84	sand						
〃	13	〃	1.00	52	5						
〃	3	10	1.10	30							
〃	—	40	1.50		cray						
50	–	20	1.70								
75	–	20	1.90								
100	–	60	2.50		0						
75	—	75	3.25								
100	3	5	3.30	60							
〃	4	20	3.50	20							
〃	4	25	3.75	16							
〃	4	〃	4.00	16	2						
〃	5	〃	4.25	20							
〃	3	〃	4.50	12							
〃	3	〃	4.75	12							
〃	3	〃	5.00	12	1						
〃	4	〃	5.25	16							
〃	3	〃	5.50	12							
〃	3	〃	5.75	12							
〃	3	〃	6.00	12	1						
〃	4	〃	6.25	16							
〃	3.5	〃	6.50	14							
〃	3.5	〃	6.75	14							
〃	4	〃	7.00	16	2						
〃	3.5	〃	7.25	14							
〃	4	〃	7.50	16							
〃	4	〃	7.75	16							
〃	4	〃	8.00	16	2						
〃	3	〃	8.25	12							
〃	5	〃	8.50	20	2						
〃	12	〃	8.75	48							

SWEDISH SOUNDING TEST

LOCATION BATU - BATU DATE 27 . Feb 1979

STATION NO 10 ELEVATION 7.5 m GROUND WATER LEVEL m

TOTAL DEPTH 5.64 m TESTED BY R . Nagata



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SWEDISH SOUNDING TEST

LOCATION BATU – BATU DATE 27 – Feb 1979

STATION NO 10. ELEVATION 7.5 m GROUND WATER LEVEL m

TOTAL DEPTH 5.64 m TESTED BY R. Nagata

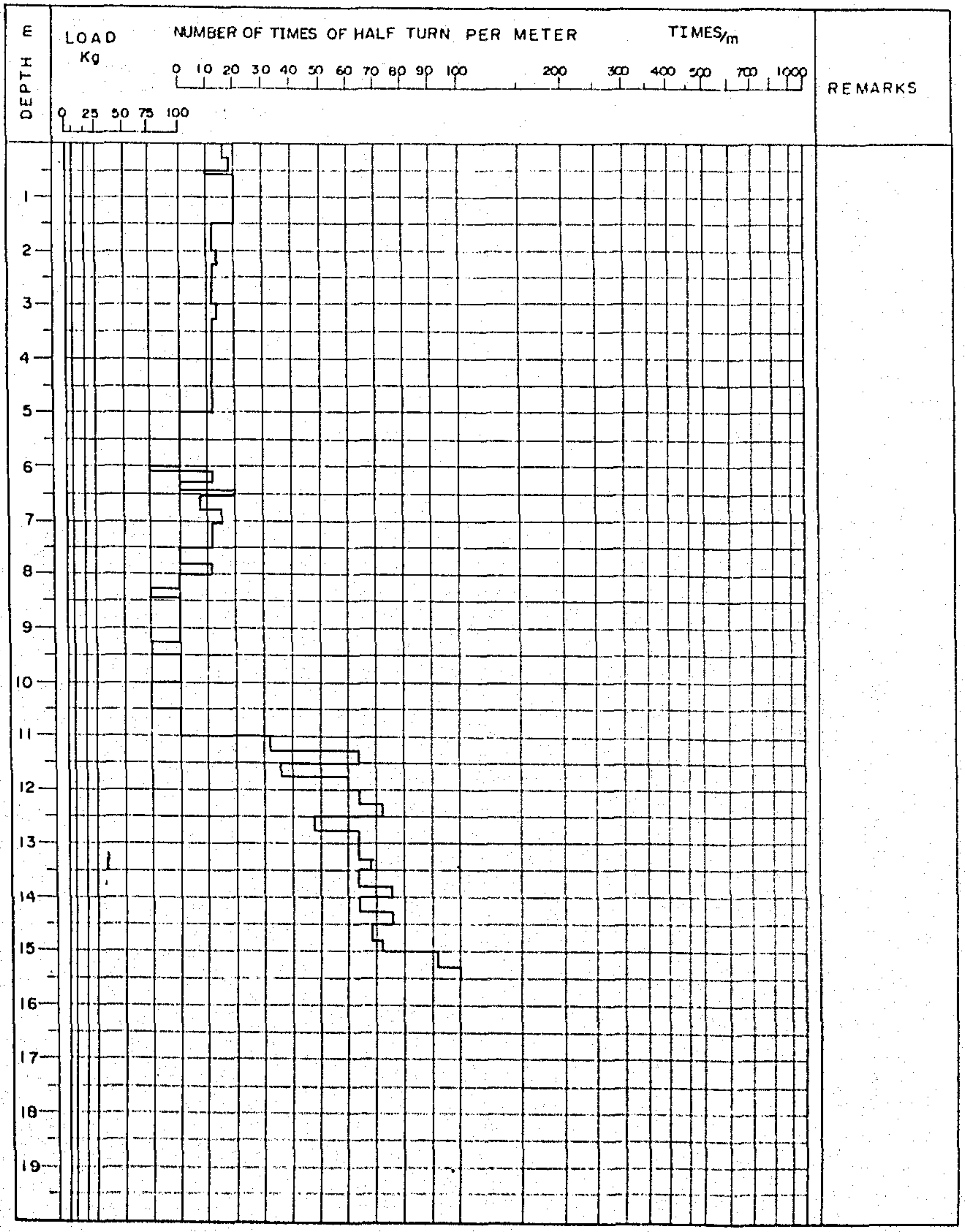
LOAD Kg	Number of Times of Half turn	Penetrated depth m	Penetrated Length cm	TIMES / m	REMARKS N	LOAD kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS
100	—	0.05	5	—	it–self						
〃	2	0.25	20	8							
〃	3	0.50	25	12	1						
〃	3	0.75	25	12							
〃	—	0.85	10	—							
〃	1	1.00	15	4	0						
〃	3.5	1.25	25	14	it–self						
〃	3	1.50	〃	12							
〃	3	1.75	〃	12							
75		2.00	〃		it–self						
100		2.25	〃		〃						
〃	1	2.50	〃	4							
〃	3	2.75	〃	12	1						
〃	3.5	3.00	〃	14							
〃	2	3.25	〃	8							
〃		3.50	〃		it–self						
〃		3.75	〃		〃						
〃		4.00	〃		〃						
〃		4.25	〃		〃						
〃		4.50	〃		〃						
〃	1	4.75	〃	4							
〃	13	5.00	〃	52	5						
〃	11	5.25	〃	44							
〃	20	5.50		80							
〃	18	5.64		125	sand and sgrave						
					N=11						

SWEDISH SOUNDING TEST

LOCATION TANRU TEDONG (−1.5 km from Bridge) DATE 2. March 1979

STATION NO 11 ELEVATION 1700 m GROUND WATER LEVEL m

TOTAL DEPTH 15.5 m TESTED BY R. Nagata



SWEDISH SOUNDING TEST

TANRU TEDONG

LOCATION (−1.5km/from Bridge) DATE 2 − 3 − 1979

STATION NO 11. ELEVATION 1700 m GROUND WATER LEVEL m

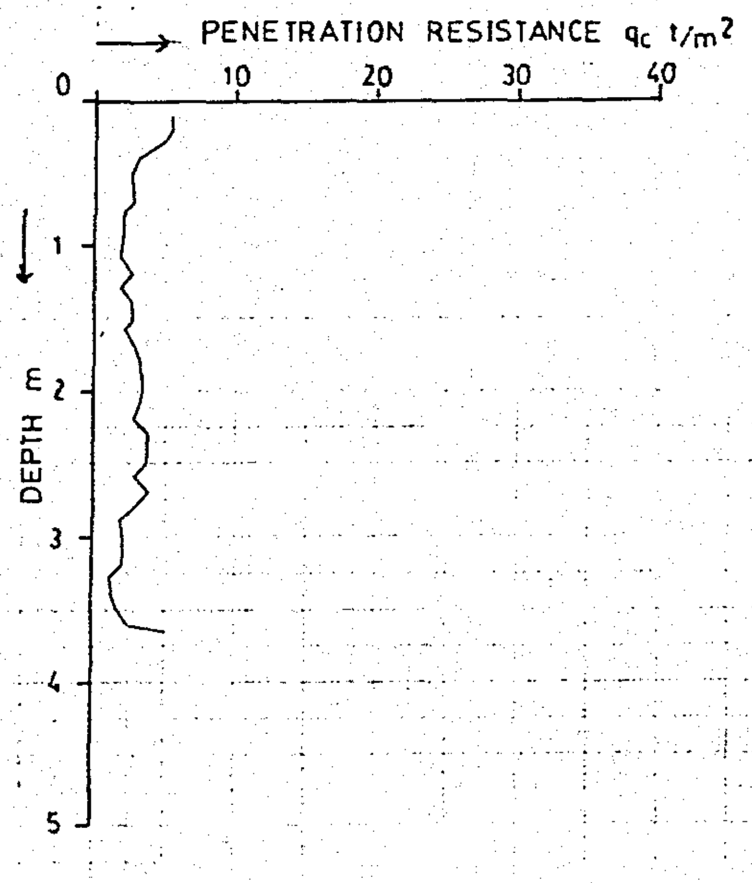
TOTAL DEPTH 15.5 m TESTED BY

LOAD kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS N
100	4	0.25	0.25	16	
〃	4.5	0.50	0.25	18	2
〃	0.5	0.55	0.05	10	
〃	4.0	0.75	0.20	20	
〃	5	1.00	0.25	20	
〃	5	1.25	〃	20	
〃	5	1.50	〃	20	2
〃	3	1.75	〃	12	
〃	3	2.00	〃	12	
〃	3.5	2.25	〃	14	
〃	3	2.50	〃	12	1
〃	3	2.75	〃	12	
〃	3	3.00	〃	12	
〃	3.5	3.25	〃	14	
〃	3	3.50	〃	12	1
〃	3	3.75	〃	12	
〃	3	4.00	〃	12	
〃	3	4.25	〃	12	
〃	3	4.50	〃	12	1
〃	3	4.75	〃	12	
〃	3	5.00	〃	12	
〃		5.25	〃		
〃		6.00	0.75		0
75		6.05	0.05		
100	2.5	6.25	0.20	12.5	
〃		6.40	0.15		0
〃	2	6.50	0.10	20	
〃	2	6.75	0.25	8	
〃	4	7.00	〃	16	
〃	3	7.25	〃	12	
〃	3	7.50	〃	12	1
〃		7.55	0.05		
〃		7.75	0.20		

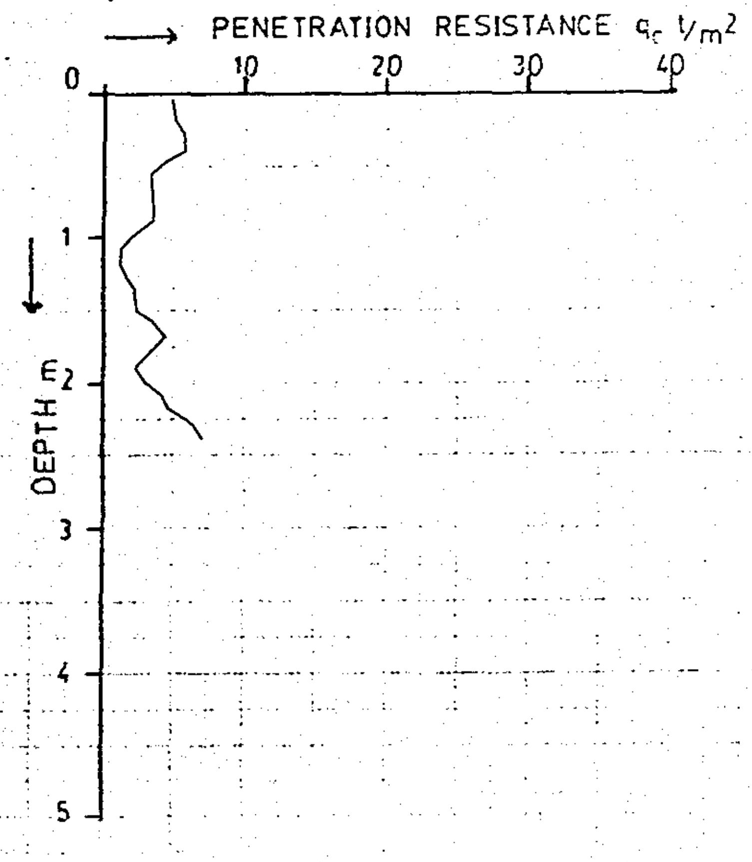
LOAD kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS
100	3	8.00	0.25		
〃		8.25	0.25		
75		8.45	0.20		
100		8.50	0.05		
〃		9.00	0.50		
〃		9.25	0.25		
75		9.45	0.20		
100		9.50	0.05		0
〃		10.00	0.50		
75		10.45	0.45		
〃		10.50	0.05		0
100		10.75	0.25		
〃		11.00	〃		
〃	8	11.25	〃	32	
〃	16	11.50	〃	64	7
〃	9	11.75	〃	36	
〃	15	12.00	〃	60	
〃	16	12.25	〃	64	
〃	18	12.50	〃	72	8
〃	12	12.75	〃	48	
〃	16	13.00	〃	64	
〃	16	13.25	〃	64	
〃	17	13.50	〃	68	7
〃	16	13.75	〃	64	
〃	19	14.00	〃	76	
〃	16	14.25	〃	64	
〃	19	14.50	〃	76	8
〃	17	14.75	〃	68	
〃	18	15.00	〃	72	
〃	23	15.25	〃	92	
〃	25	15.50	〃	100	11

CONE PENETRATION TEST

LOCATION Bila Righy fide DATE 3 March 1979
NO 12 TESTED BY R , Nagata
ELEVATION 8



LOCATION Lanafang DATE 3 March 1979
NO 13 TESTED BY R , Nagata
ELEVATION 9



CONE PENETRATION TEST

Location ______________________ Location ______________________

No 12 Date 3 - 3 - 1979 No ________ Date ____________

Elevation 8 m by R . Nagata Elevation ____________ by

Penetrated Deepth m	Gauge Value	qc kg/cm²	qu kg/cm²	N Value	Remark	Penetrated Deepth m	Gauge Value	qc kg/cm²	qu kg/cm²	N Value	Remark
0.1	9 0	5.6									
0.2	9 0	5.6	1.1								
0.3	8 0	5.0									
0.4	5 0	3.1	0.6								
0.5	4 2	2.6									
0.6	4 2	2.6	0.5								
0.7	4 5	2.8									
0.8	3 5	2.2	0.9								
0.9	3 7	2.3									
1.0	3 5	2.2	0.9	0.8 6							
1.1	3 2	2.0									
1.2	4 3	2.7	0.5								
1.3	3 2	2.0									
1.4	4 2	2.6	0.5								
1.5	4 5	2.8									
1.6	3 5	2.2	0.9								
1.7	4 5	2.8									
1.8	5 3	3.3	0.7								
1.9	5 4	3.4									
2.0	5 4	3.4	0.7	0.8 0							
2.1	5 0	3.1									
2.2	4 5	2.8	0.6								
2.3	6 0	3.9									
2.4	5 8	3.7	0.7								
2.5	5 8	3.7									
2.6	4 5	2.8	0.6								
2.7	5 8	3.8									
2.8	4 5	2.8	0.6								
2.9	3 0	1.9									
3.0	3 3	2.0	0.9	0.8 3							
3.1	3 2	2.0									
3.2	3 0	1.9	0.9								
3.3	1 1	0.9									
3.4	1 8	1.2	0.2								
3.5	2 3	1.5									
3.6	3 6	2.3	0.5	0.5 3							
3.6 5	8 0	5.0									

qc : Cone bearing capacity = 5 qu = 10 C = 3.5 N

qu : Allowable soil pressure C : cohesion kg/cm². N : N - value

CONE PENETRATION TEST

Location ____________ Location ____________

No 13 Date 3 - 3 - 1979 No ______ Date ______

Elevation 9 m by R. Nagata Elevation ______ by

Penetrated Deepth m	Gauge Value	qc kg/cm²	qu kg/cm²	N Value	Remark	Penetrated Deepth m	Gauge Value	qc kg/cm²	qu kg/cm²	N Value	Remark
0.1	75	4.7									
0.2	80	5.0	1.0								
0.3	90	5.6									
0.4	90	5.6	1.1								
0.5	70	4.3									
0.6	50	3.1	0.6								
0.7	50	3.1									
0.8	50	3.1	0.6								
0.9	50	3.1									
1.0	35	2.2	0.4	1.0							
1.1	22	1.4									
1.2	18	1.1	0.2								
1.3	22	1.4									
1.4	25	1.7	0.3								
1.5	25	1.7									
1.6	55	3.5	0.7								
1.7	70	4.3									
1.8	4.8	2.9	0.6								
1.9	35	2.2									
2.0	53	3.3	0.6	0.5							
2.1	70	4.3									
2.2	75	4.7	0.9								
2.3	100	6.2									
2.35	110	6.9	1.4	0.5							

qc : Cone bearing capacity = 5 qu = 10 C = 3.5 N

qu : Allowable soil pressure C : cohesion kg/cm². N : N - value

SWEDISH SOUNDING TEST

LOCATION EMPAGAE

DATE 22. March 1979

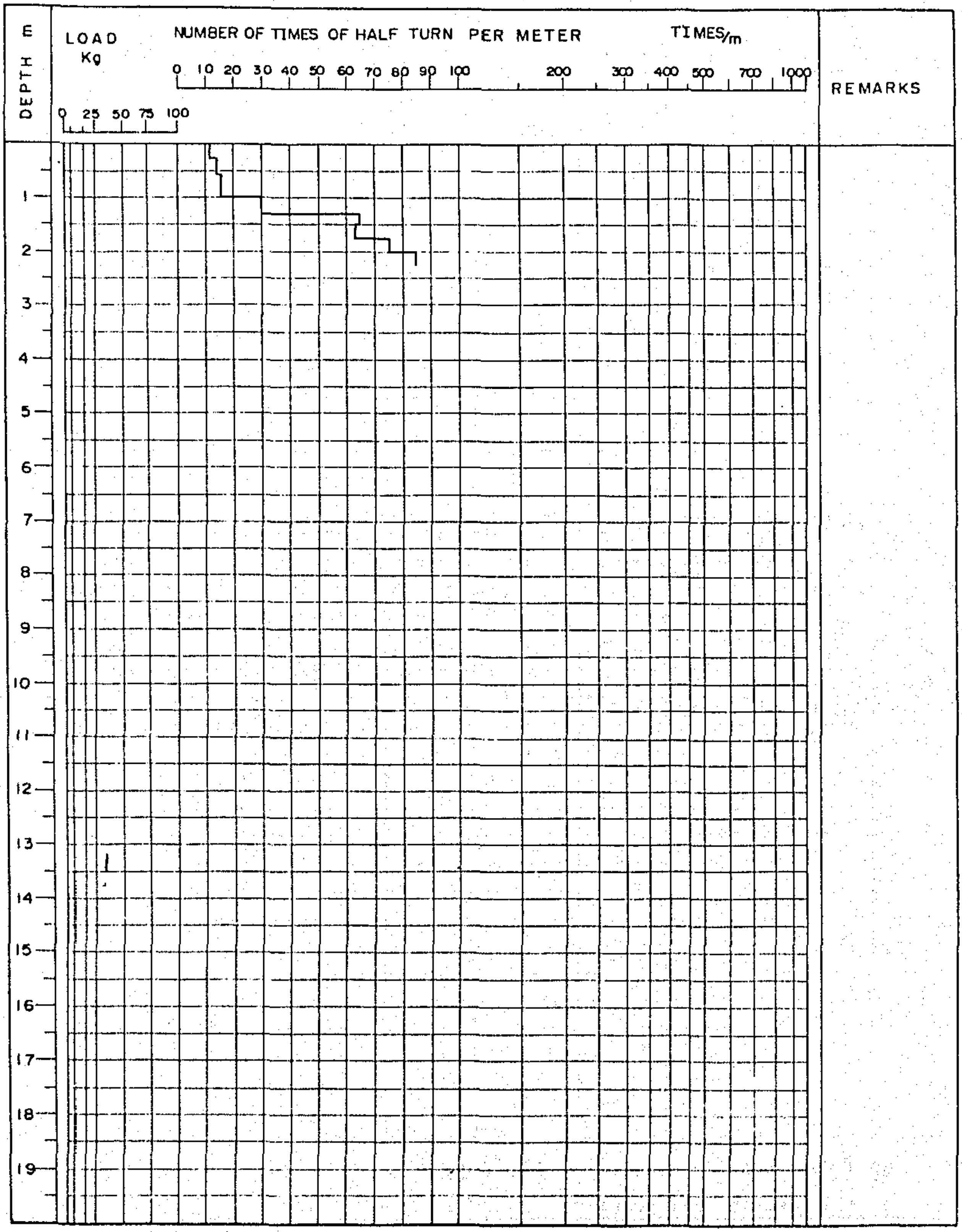
STATION NO. 14

ELEVATION 13 m

GROUND WATER LEVEL m

TOTAL DEPTH 2.25 m

TESTED BY R. Nagata



P

SWEDISH SOUNDING TEST

LOCATION EMPAGAE DATE 22 March 1979

STATION NO 14. ELEVATION 13 m GROUND WATER LEVEL m

TOTAL DEPTH 225 m TESTED BY R. Nagata

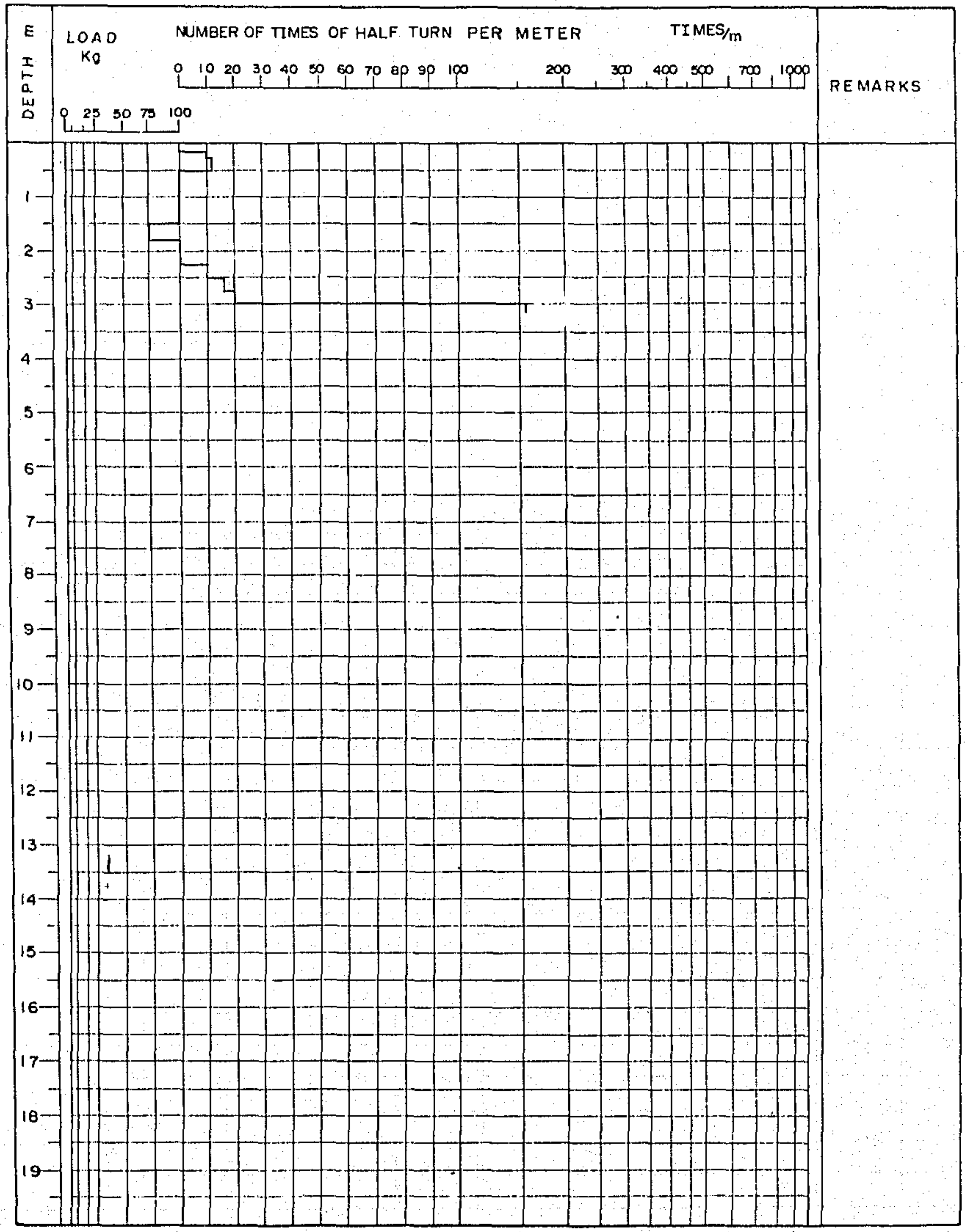
LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS	LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS
100	3	25	0.25	12	sand						
〃	3.5	25	0.52	14	gravel						
〃	4	25	0.75	16	〃						
〃	4	25	1.00	16	〃						
〃	9	30	1.30	30							
〃	13	20	1.50	65	5						
〃	16	25	1.75	64							
〃	18	25	2.00	76							
〃	17	25	2.25	85	7						

SWEDISH SOUNDING TEST

LOCATION TETEAJI DATE 22. March 1979

STATION NO. 15 ELEVATION 8.5 m GROUND WATER LEVEL m

TOTAL DEPTH 3.15 m TESTED BY R. Nagata



SWEDISH SOUNDING TEST

LOCATION TETEAJI DATE 22 March 1979

STATION NO 15. ELEVATION 8.5 m GROUND WATER LEVEL m

TOTAL DEPTH 3.15 m TESTED BY R. Nagata

LOAD Kg	Number of Times of Half turn	Penetrated depth m	Penetrated Length cm	TIMES / m	REMARKS N	LOAD kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS
100	–	20	0.20								
〃	0.5	5	0.25	10							
〃	3	25	0.50	12	1						
〃	–	100	1.50		silt						
75	–	25	1.75								
100	–	50	2.25								
〃	2.5	25	2.50	10	1						
〃	4	25	2.75	16							
〃	5	25	3.00	20	soft sand						
〃	25	15	3.15	160	hard						
					(stone)						
	twice	(near point)									
25	–	20	0.2		soft sand						
50	–	20	0.4								
100	4	10	0.5	16							
〃	?	30	0.8								
〃	–	20	1.00		sand						
〃	4	25	1.25	16	barace						
〃	3	25	1.50	12							
〃	3	25	1.75	12							
〃	4	25	2.00	16	1						
〃	16	25	2.25	64							
〃	20	5	2.30	400	(stone)						

SWEDISH SOUNDING TEST

LOCATION WATTAE

DATE 21. March 1979

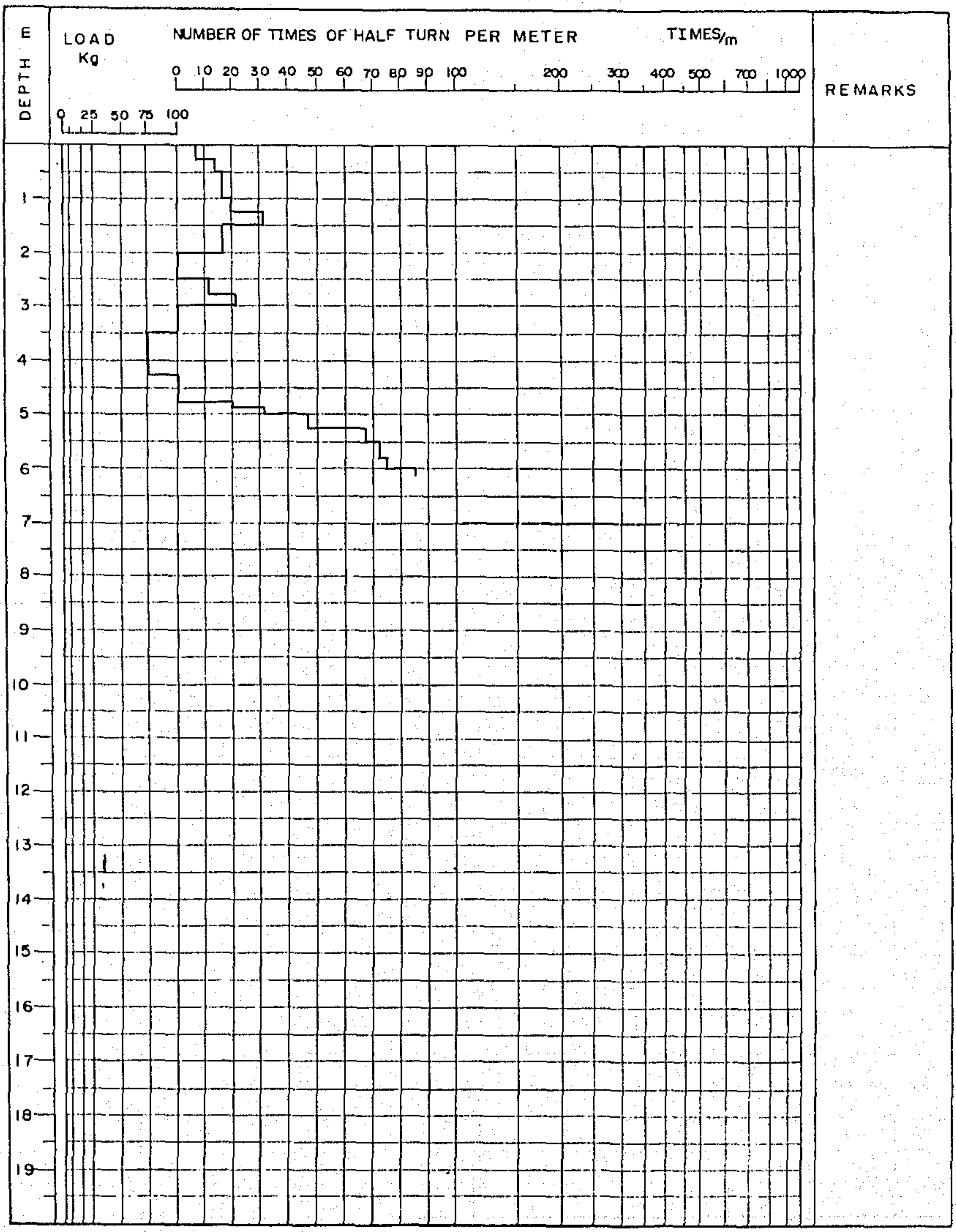
STATION NO. 16

ELEVATION 9 m

GROUND WATER LEVEL m

TOTAL DEPTH 6.15 m

TESTED BY R. Nagata



P

SWEDISH SOUNDING TEST

LOCATION WATTAE DATE 21. March 1979

STATION NO 16, ELEVATION 9 m GROUND WATER LEVEL m

TOTAL DEPTH 6.15 m TESTED BY R. Nagata

LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS	LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS
100	2	25	0.25	8							
〃	3.5	25	0.50	14	1						
〃	8	50	1.00	16							
〃	5	25	1.25	20	sand						
〃	8	25	1.50	32	grovase						
〃	4	25	1.75	16							
〃	4	25	2.00	16	1						
〃	—	50	2.50	—							
〃	3	25	2.75	12							
〃	5.5	25	3.00	22							
〃	—	50	3.50	—	0						
75	—	75	4.25								
100	—	25	4.50		0						
〃	—	20	4.70								
〃	1	5	4.75	20							
〃	8	25	5.00	32							
〃	12	25	5.25	48							
〃	17	25	5.50	68	7						
〃	18	25	5.75	72							
〃	19	25	6.00	76							
〃	13	15	6.15	86	8						

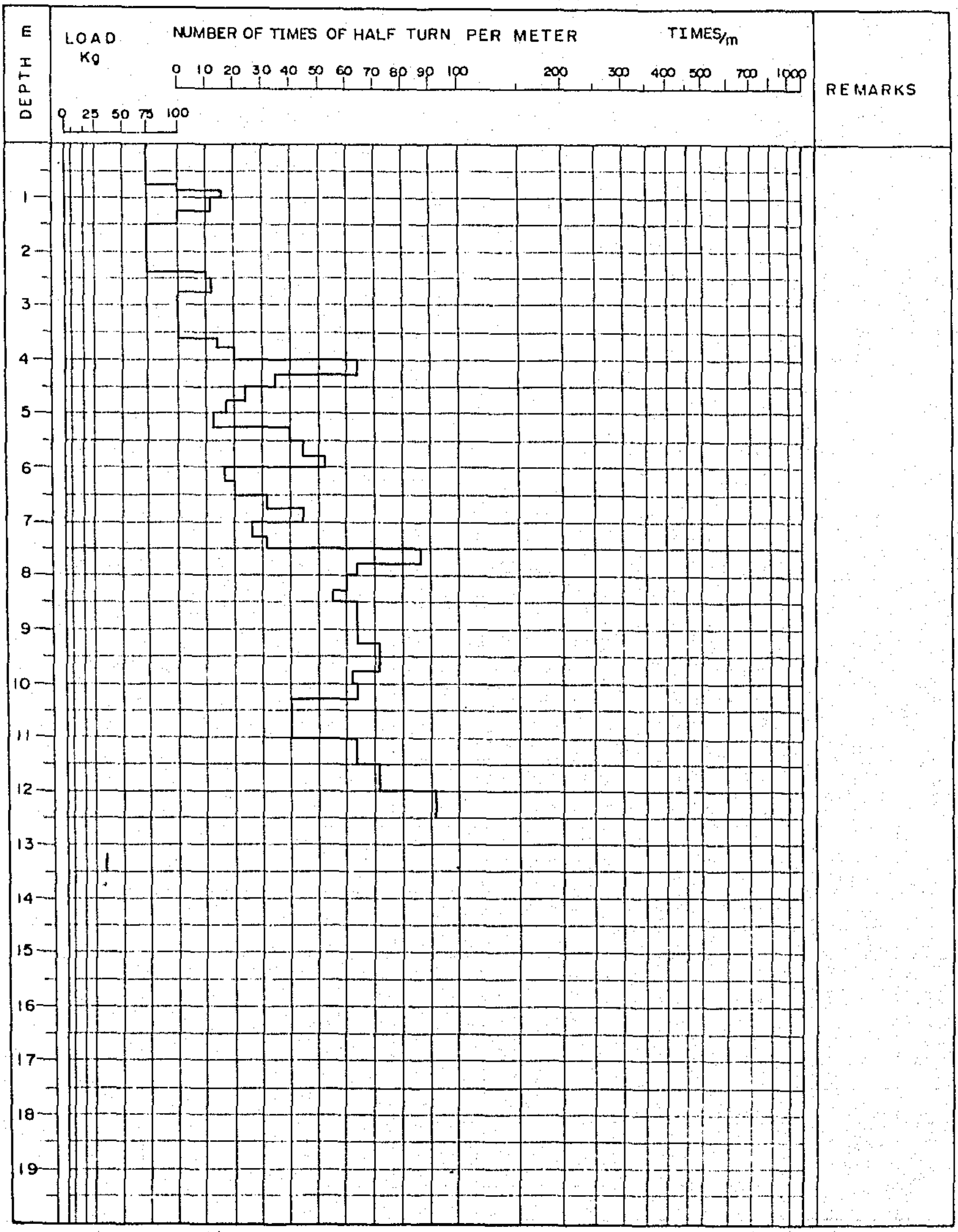
SWEDISH SOUNDING TEST

LOCATION Desa hempa Kampung Tosampa

DATE 11. April 1979

STATION NO. 17 ELEVATION 7 m GROUND WATER LEVEL m

TOTAL DEPTH 12.50 m TESTED BY R. Nagata



SWEDISH SOUNDING TEST

LOCATION Desa hempa Kampung Tosampa

DATE 11 April 1979

STATION NO 17. ELEVATION 7 m GROUND WATER LEVEL m

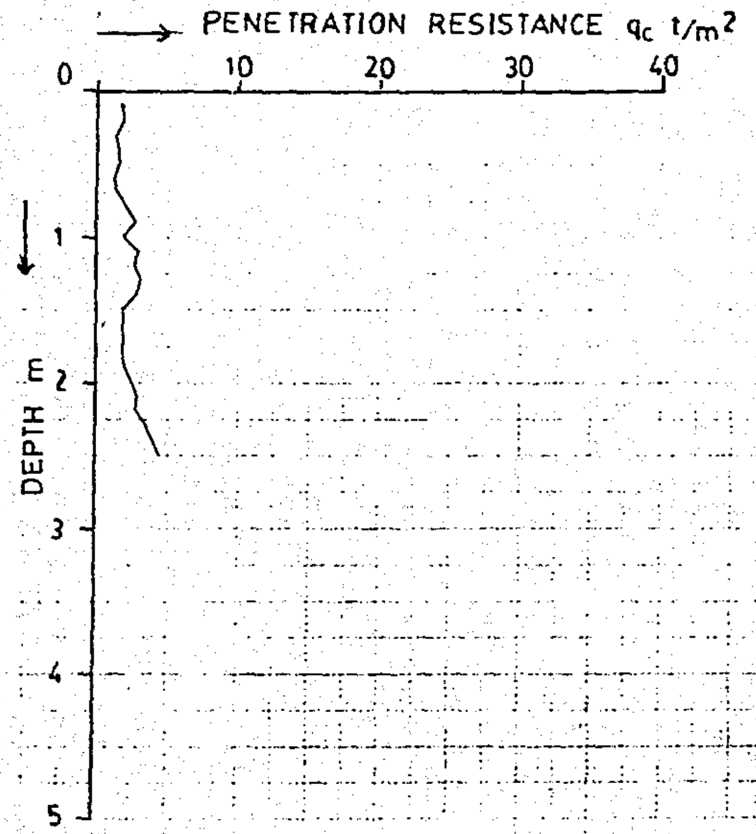
TOTAL DEPTH 12.50 m TESTED BY R. Nagata

LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS N
75		55	0.55		
〃		20	0.75		
100		13	0.88		
〃	2	12	1.00	16	2
〃	3	25	1.25	12	
〃		〃	1.50		
75		50	2.00		0
〃		40	2.40		
100	1	10	2.50	10	
〃	3	25	2.75	12	
〃		75	3.50		0
〃		15	3.65		
〃	1.5	10	3.75	15	
〃	5	25	4.00	20	2
〃	16	〃	4.25	64	
〃	9	〃	4.50	36	
〃	6	〃	4.75	29	
〃	4.5	〃	5.00	18	2
〃	3	〃	5.25	12	
〃	10	〃	5.50	40	
〃	11	〃	5.75	44	
〃	13	〃	6.00	52	5
〃	4.5	〃	6.25	18	
〃	5	〃	6.50	20	
〃	8	〃	6.75	32	
〃	11	〃	7.00	44	4
〃	7	〃	7.25	28	
〃	8	〃	7.50	32	
〃	22	〃	7.75	88	
〃	16	〃	8.00	64	6
〃	15	〃	8.25	60	
〃	14	〃	8.50	56	
〃	16	〃	8.75	64	
100	16	25	9.00	64	6
〃	16	〃	9.25	64	
〃	18	〃	9.50	72	
〃	18	〃	9.75	72	
〃	15.5	〃	10.00	62	6
〃	16	〃	10.25	64	
〃	10	〃	10.50	40	
〃	10	〃	10.75	40	
〃	10	〃	11.00	40	4
〃	16	〃	11.25	64	
〃	16	〃	11.50	64	
〃	18	〃	11.75	72	
〃	18	〃	12.00	72	8
〃	23	〃	12.25	92	
〃	23	〃	12.50	92	

CONE PENETRATION TEST

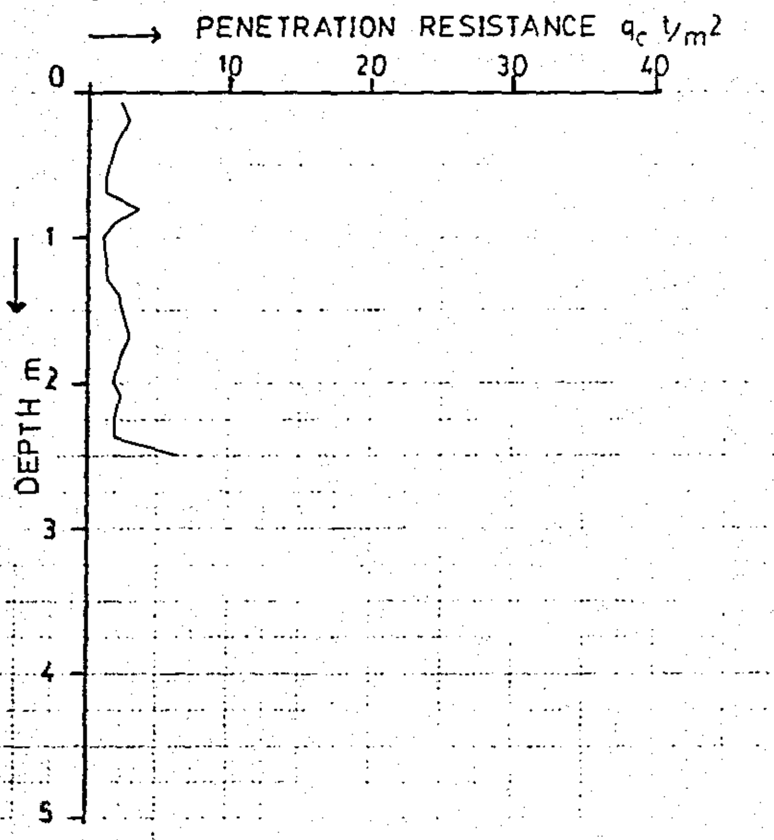
LOCATION Cenranac 6 L3k DATE 11 April 1979
17 NO 17 - 1 TESTED BY R , Nagata

ELEVATION 7



LOCATION Cenranae 6 13k DATE 11 April 1979
NO 17 - 2 TESTED BY R , Nagata

ELEVATION 7



CONE PENETRATION TEST

Location Oenranae 6 1.3 kL　　Location - do -

No 17 - 1　Date 11 April 1979　　No 17 - 2　Date - do -

Elevation 7　by R. Nagata　　Elevation 7　by - do -

Penetrated Deepth m	Gauge Value	qc kg/cm²	qu kg/cm²	N Value	Remark	Penetrated Depth m	Gauge Value	qc kg/cm²	qu kg/cm²	N Value	Remark
0.1	29	1.8									
0.2	32	2.0	0.4								
0.3	21	1.3									
0.4	25	1.5	0.3								
0.5	26	1.6									
0.6	22	1.3	0.3								
0.7	26	1.6									
0.8	35	2.1	0.4								
0.9	42	2.7									
1.0	29	1.9	0.4	0.51							
1.1	49	3.0									
1.2	44	2.8	0.6								
1.3	51	3.2									
1.4	49	3.0	0.6								
1.5	29	1.9									
1.6	30	1.9	0.4								
1.7	34	2.0									
1.8	29	1.9	0.4								
1.9	32	2.0									
2.0	40	2.5	0.5	0.71							
2.1	45	2.9									
2.2	48	2.8	0.6								
2.3	55	3.5									
2.4	60	3.8	0.8	1.00							
2.5	70	4.3									

qc : Cone bearing capacity = 5 qu = 10 C = 3.5 N

qu : Allowable soil pressure　　C : cohesion kg/cm².　N : N - value

CONE PENETRATION TEST

Location Desa hempa Kampuny Tosampa — Location

No 17 - 2 Date — No Date

Elevation by — Elevation by

Penetrated Deep-th m	Gauge Value	qc kg/cm^2	qu kg/cm^2	N Value	Remark	Penetrated Depth m	Gauge Value	qc kg/cm^2	qu kg/cm^2	N Value	Remark
0.1	40	2.5									
0.2	45	2.9	0.6								
0.3	40	2.5									
0.4	30	1.9	0.4								
0.5	28	1.8									
0.6	21	1.3	0.3								
0.7	21	1.3									
0.8	59	3.8	0.8								
0.9	34	2.0									
1.0	19	1.2	0.2	0.66							
1.1	19	1.2									
1.2	22	1.3	0.3								
1.3	24	1.4									
1.4	36	2.1	0.4								
1.5	39	2.5									
1.6	41	2.6	0.5								
1.7	49	3.0									
1.8	40	2.5	0.5								
1.9	35	2.1									
2.0	30	1.9	0.4	0.60							
2.1	39	2.4									
2.2	34	2.0	0.4								
2.3	30	1.9									
2.4	30	1.9	0.4	0.57							
2.5	96	6.1									

qc : Cone bearing capacity = 5 qu = 10 C = 3.5 N

qu : Allowable soil pressure C : cohesion kg/cm^2. N : N - value

SWEDISH SOUNDING TEST

LOCATION Desa Uadukelleng Kampung hapacecang

DATE 11. 4 – 1979

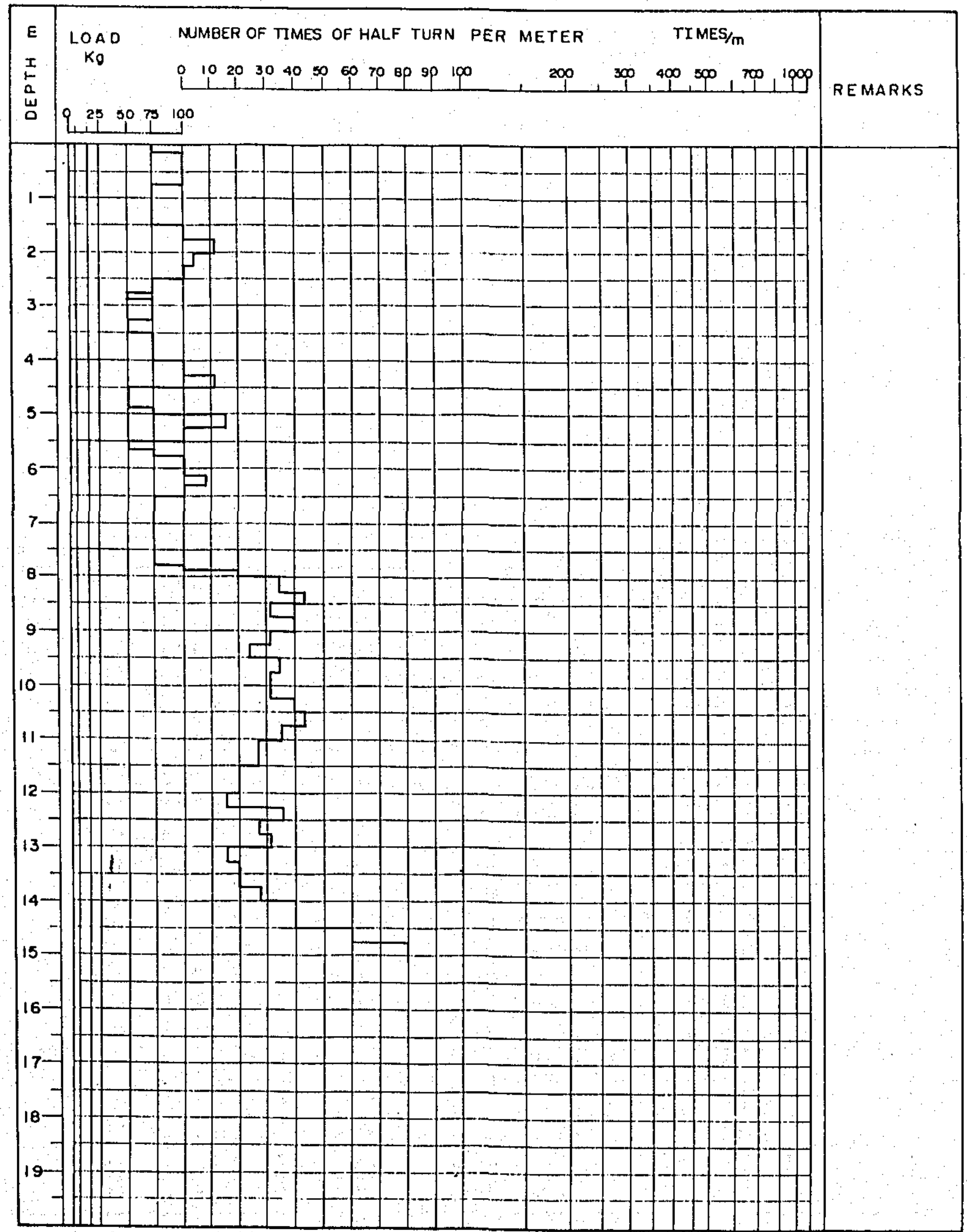
STATION NO. 18

ELEVATION m

GROUND WATER LEVEL m

TOTAL DEPTH 15.05 m

TESTED BY IR.Snpriys.Tk



SWEDISH SOUNDING TEST

LOCATION Desa Uadnkelleng Kampung hapacecang DATE 11 – 4 – 1979

STATION NO 18. ELEVATION 7 m GROUND WATER LEVEL m

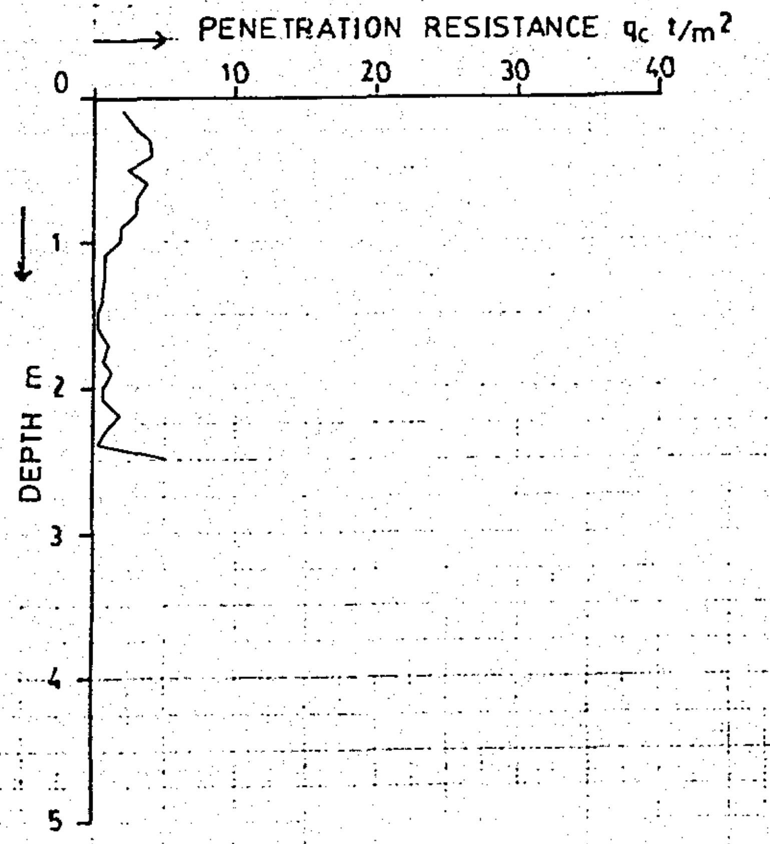
TOTAL DEPTH 15.05 m TESTED BY

LOAD Kg	Number of Times of Half turn	Penetrated depth m	Penetrated Length cm	TIMES/m	REMARKS	LOAD kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES/m	REMARKS
75		15	0.15			75		25	7.25		
100		10	0.25			〃		〃	7.50		
〃		25	0.50			〃		〃	7.75		
〃		〃	0.75			100		5	7.80		
75		〃	1.00		0	〃	4	20	8.00	20	~~2~~ clay
〃		〃	1.25			〃	9	25	8.25	36	
〃		〃	1.50			〃	11	〃	8.50	44	
100		〃	1.75			〃	8	〃	8.75	32	
〃	3	〃	2.00	12	1	〃	10	〃	9.00	40	4
〃	1	〃	2.25	4		〃	8	〃	9.25	32	
〃		〃	2.50			〃	6	〃	9.50	24	
75		〃	2.75			〃	9	〃	9.75	36	
50		15	2.90			〃	8	〃	10.00	32	3
75		10	3.00		0	〃	8	〃	10.25	32	
〃		25	3.25			〃	10	〃	10.50	40	
50		〃	3.50			〃	11	〃	10.75	44	
75		〃	3.75			〃	9	〃	11.00	36	4
〃		〃	4.00		0	〃	7	〃	11.25	28	
100		〃	4.25			〃	7	〃	11.50	28	
〃	3	〃	4.50	12		〃	5	〃	11.75	20	
50		〃	4.75			〃	5	〃	12.00	20	2
〃		15	4.90			〃	4	〃	12.25	16	
75		10	5.00		0	〃	9	〃	12.50	36	
100	4	25	5.25	16		〃	7	〃	12.75	28	
〃		〃	5.50			〃	8	〃	13.00	32	3
50		13	5.63			〃	4	〃	13.25	16	
75		12	5.75			〃	5	〃	13.50	20	
100		25	6.00		0	〃	5	〃	13.75	20	
〃		13	6.13			〃	7	〃	14.00	28	3
〃	2	12	6.25	8		〃	10	〃	14.25	40	sand
〃		25	6.50			〃	10	〃	14.50	40	
75		〃	6.75			〃	15	〃	14.75	60	
75		〃	7.00		0	〃	20	〃	15.00	80	9
						100	5	5	15.05	80	

CONE PENETRATION TEST

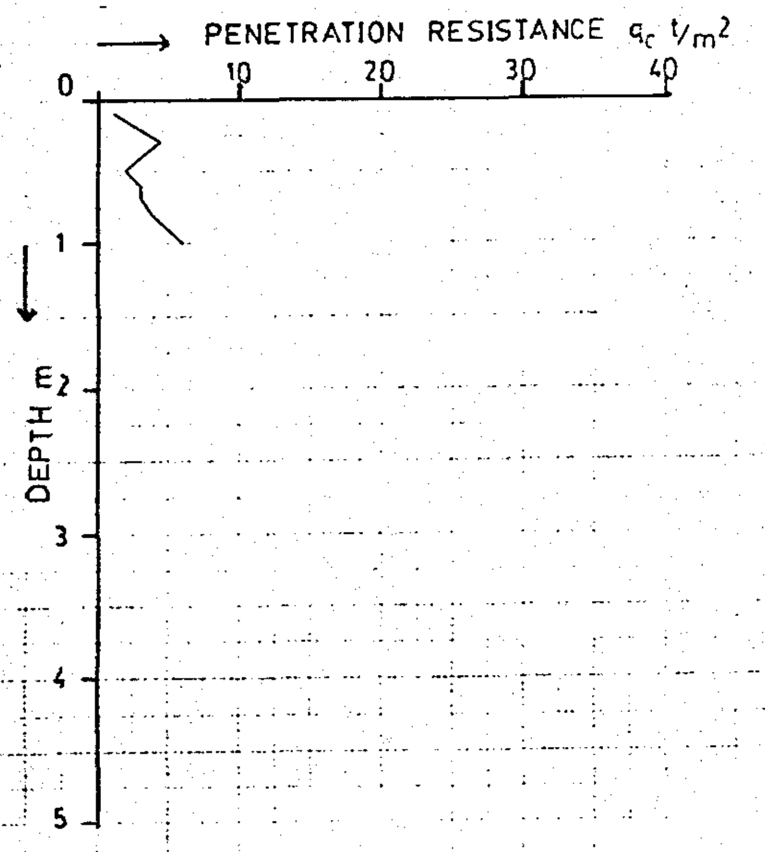
LOCATION Madnkelleng DATE 11 – 4 – 1979
18 NO 2 Poirt 5 TESTED BY R , Nagata

ELEVATION 7



LOCATION Madnkelleng DATE 11 – 4 – 1979
NO 2 Poirt 2 TESTED BY R , Nagata

ELEVATION 7



CONE PENETRATION TEST

Location ____________________ Location ____________________

No 18 − 1 Date 11 − 4 − 1979 No ________ Date ____________

Elevation 7 m by Elevation ________ by

Penetrated Deepth m	Gauge Value	qc kg/cm^2	qu kg/cm^2	N Value	Remark	Penetrated Depth m	Gauge Value	qc kg/cm^2	qu kg/cm^2	N Value	Remark
0.1	22	1.3									
0.2	50	3.1	0.6								
0.3	75	4.8									
0.4	50	3.1	0.6								
0.5	35	2.1									
0.6	51	3.2	0.6								
0.7	52	3.3									
0.8	60	3.8	0.8	0.93							
0.9	95	6.0									

qc : Cone bearing capacity = 5 qu = 10 C = 3.5 N

qu : Allowable soil pressure C : cohesion kg/cm^2. N : N − value

CONE PENETRATION TEST

Location ______ Location ______

No 1 8 − 2 Date R . N a g a t a No ______ Date ______

Elevation 7 m by Elevation ______ by

Penetrated Deep-th m	Gauge Value	qc kg/cm^2	qu kg/cm^2	N Value	Remark	Penetrated De-epth m	Gauge Value	qc kg/cm^2	qu kg/cm^2	N Value	Remark
0.1	3 6	2.2									
0.2	5 0	3.1	0.6								
0.3	6 0	3.8									
0.4	6 5	4.1	0.8								
0.5	4 0	2.5									
0.6	6 0	3 8	0.8								
0.7	5 0	3.1									
0.8	5 1	3.2	0.6								
0.9	3 0	1.9									
1.0	3 0	1.9	0.4	0.9 1							
1.1	1 5	0.9									
1.2	1 3	0.7	0.1								
1.3	1 3	0.7									
1.4	1 2	0.6	0.1								
1.5	6	0.2									
1.6	1 1	0.3	0.1								
1.7	2 0	1.2									
1.8	1 5	0.9	0.2								
1.9	2 4	1.4									
2.0	1 2	0.6	0.1	0.1 7							
2.1	1 2	0.6									
2.2	3 1	2.0	0.4								
2.3	1 5	0.9									
2.4	1 0	0.3	0.1	0.3 6							
2.5	9 0	5.8									

qc : Cone bearing capacity = 5 qu = 10 C = 3.5 N

qu : Allowable soil pressure C : cohesion kg/cm^2. N : N − value

SWEDISH SOUNDING TEST

LOCATION Kampung Salopokko Desa Ugr Kec Salaug Poru

DATE 12• 4 – 1979

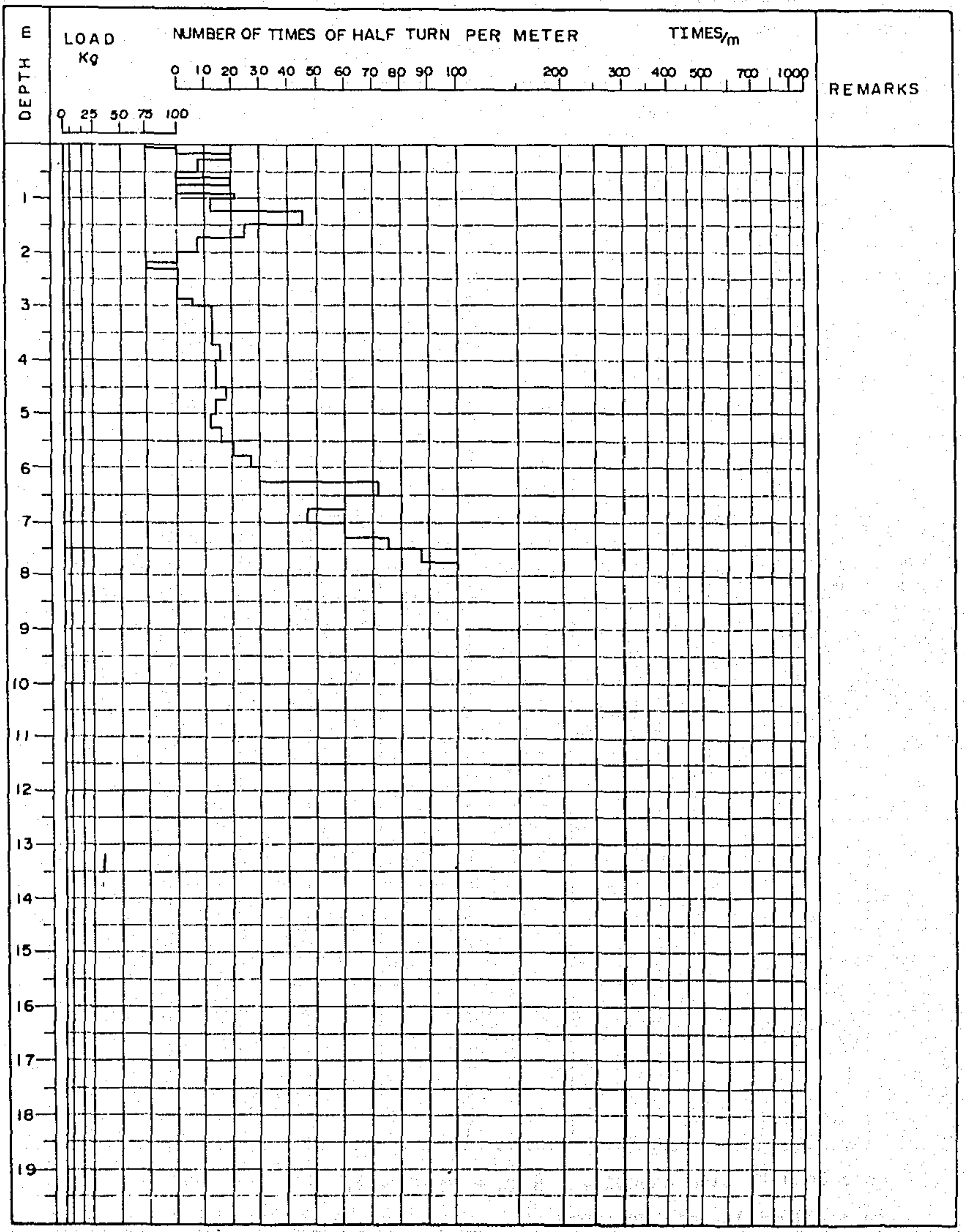
STATION NO 19

ELEVATION 7.5 m

GROUND WATER LEVEL m

TOTAL DEPTH 7.80 m

TESTED BY IR, Snpriya, TR



SWEDISH SOUNDING TEST

LOCATION

DATE 12 − 4 − 1979

STATION NO 19. ELEVATION 7.5 m GROUND WATER LEVEL m

TOTAL DEPTH 7.80 m TESTED BY

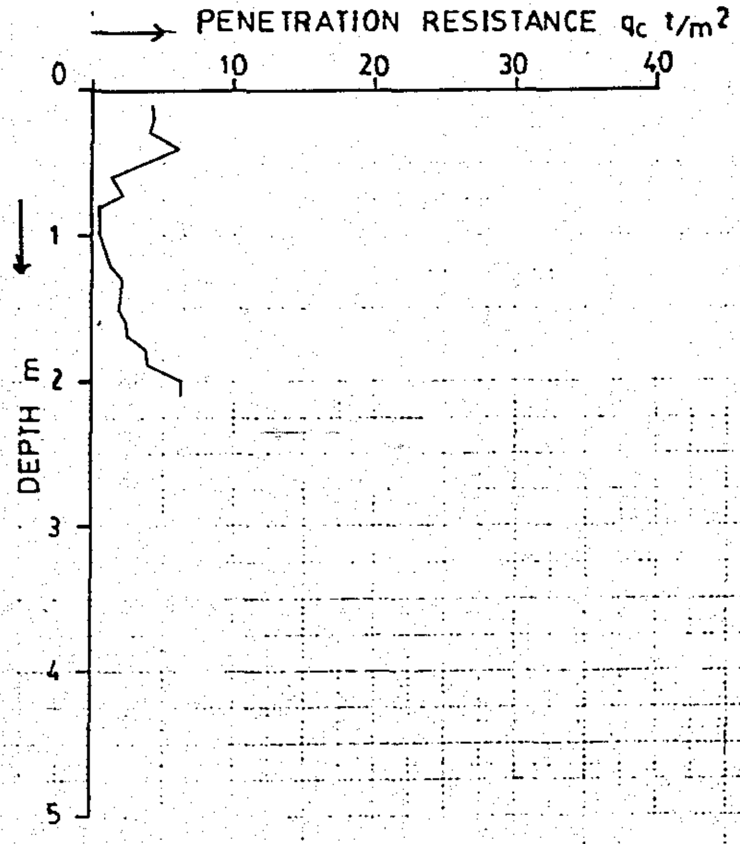
LOAD kg	Number of Turns of Half turn	Penetrated Depth cm	Penetrated Length m	TIMES / m	REMARKS	LOAD kg	Number of Turns of Half turn	Penetrated Depth cm	Penetrated Length m	TIMES / m	REMARKS
75		10	0.10			100	15	25	6.75	60	
100		5	0.15			〃	12	〃	7.00	48	5
〃	2	10	0.25	20		〃	15	〃	7.25	60	
〃	2	25	0.50	8		〃	19	〃	7.50	76	
〃		15	0.65			〃	22	〃	7.75	88	
〃	2	10	0.75	20		〃	5	5	7.80	100	11
〃		18	0.93								
〃	1.5	7	1.00	21	2						
〃	3	25	1.25	12							
〃	11.5	〃	1.50	46							
〃	6	〃	1.75	24							
〃	2	〃	2.00	8							
〃		20	2.20		0						
75		5	2.25								
〃		5	2.30								
100		20	2.50								
〃		25	2.75								
〃		15	2.90								
〃	1.5	10	3.00	6	0						
〃	3	25	3.25	12							
〃	3	〃	3.50	12							
〃	3	〃	3.75	12							
〃	4	〃	4.00	16	2						
〃	3.5	〃	4.25	14							
〃	3.5	〃	4.50	14							
〃	4.5	〃	4.75	18							
〃	3.5	〃	5.00	14	1						
〃	3	〃	5.25	12							
〃	4	〃	5.50	16							
〃	5	〃	5.75	20							
〃	7	〃	6.00	28	3						
〃	7.5	〃	6.25	30							
〃	18	〃	6.50	72							

CONE PENETRATION TEST

LOCATION Salopokko DATE 12 – 4 – 1979

NO 19 – 1 TESTED BY R . Nagata

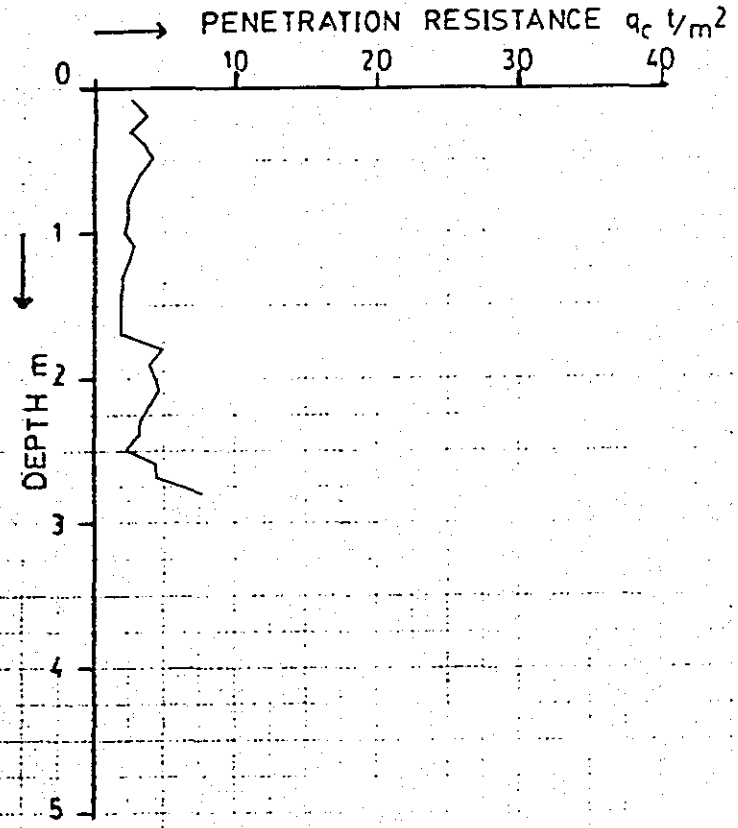
ELEVATION 7.5



LOCATION Salopokko DATE 12 – 4 – 1979

NO 19 – 2 TESTED BY R . Nagata

ELEVATION 7.5



CONE PENETRATION TEST

Location ____________ Location ____________

No 19.1 Date 12 - 4 - 1979 No ______ Date ______

Elevation 7.5 by R, Nagata Elevation ______ by

Penetrated Deep-th m	Gauge Value	qc kg/cm²	qu kg/cm²	N Value	Remark	Penetrated De-epth m	Gauge Value	qc kg/cm²	qu kg/cm²	N Value	Remark
0.1	68	4.2									
0.2	68	4.2	0.8								
0.3	63	4.0									
0.4	85	6.3	1.3								
0.5	60	3.8									
0.6	25	1.5	0.3								
0.7	35	2.1									
0.8	11	0.3	0.1								
0.9	11	0.3									
1.0	11	0.3	0.1	0.74							
1.1	18	1.0									
1.2	22	1.3	0.3								
1.3	35	2.1									
1.4	35	2.1	0.4								
1.5	30	1.9									
1.6	39	2.4	0.5								
1.7	41	2.5									
1.8	60	3.8	0.8								
1.9	60	3.8									
2.0	85	6.3	1.3	0.94							
2.1	105	6.3									

qc : Cone bearing capacity = 5 qu = 10 C = 3.5 N

qu : Allowable soil pressure C : cohesion kg/cm². N : N - value

CONE PENETRATION TEST

Location ____________ Location ____________

No 19.2 Date 12 - 4 - 1979 No ______ Date ______

Elevation 7.5 by R. Nagata Elevation ______ by

Penetrated Deepth m	Gauge Value	qc kg/cm²	qu kg/cm²	N Value	Remark	Penetrated Deepth m	Gauge Value	qc kg/cm²	qu kg/cm²	N Value	Remark
0.1	42	2.6									
0.2	61	3.9	0.8								
0.3	40	2.5									
0.4	55	3.5	0.7								
0.5	67	4.2									
0.6	52	3.3	0.7								
0.7	42	2.7									
0.8	37	2.3	0.5								
0.9	38	2.4									
1.0	36	2.2	0.4	0.89							
1.1	41	2.6									
1.2	40	2.5	0.5								
1.3	30	1.9									
1.4	31	1.9	0.4								
1.5	31	1.9									
1.6	30	1.9	0.4								
1.7	31	1.9									
1.8	76	4.9	1.0								
1.9	62	3.9									
2.0	64	4.1	0.8	0.89							
2.1	64	4.3									
2.2	59	3.8	0.8								
2.3	47	3.0									
2.4	45	2.9	0.6								
2.5	38	2.4									
2.6	66	4.2	0.8								
2.7	68	4.2									
2.8	120	7.6	1.5	1.32							

qc : Cone bearing capacity = 5 qu = 10 C = 3.5 N

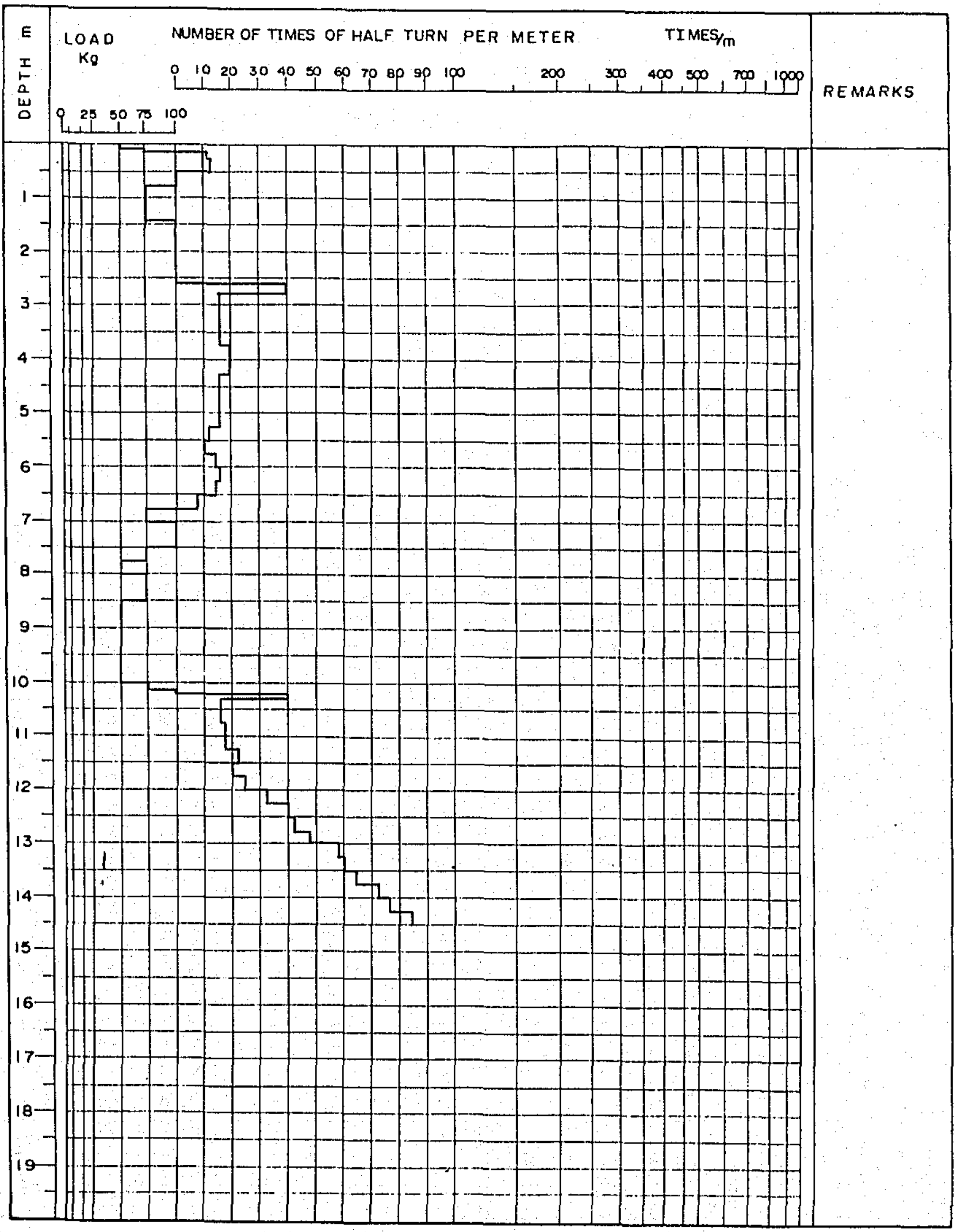
qu : Allowable soil pressure C : cohesion kg/cm². N : N - value

SWEDISH SOUNDING TEST

LOCATION Salopokko DATE 12・4−1979

STATION NO. 20 ELEVATION 6.5 m GROUND WATER LEVEL m

TOTAL DEPTH 14.50 m TESTED BY R. Nagata



P

SWEDISH SOUNDING TEST

LOCATION Salopokko DATE 12 − 4 − 1979

STATION NO 20. ELEVATION 6.5 m GROUND WATER LEVEL m

TOTAL DEPTH 14.50 m TESTED BY R. Nagata

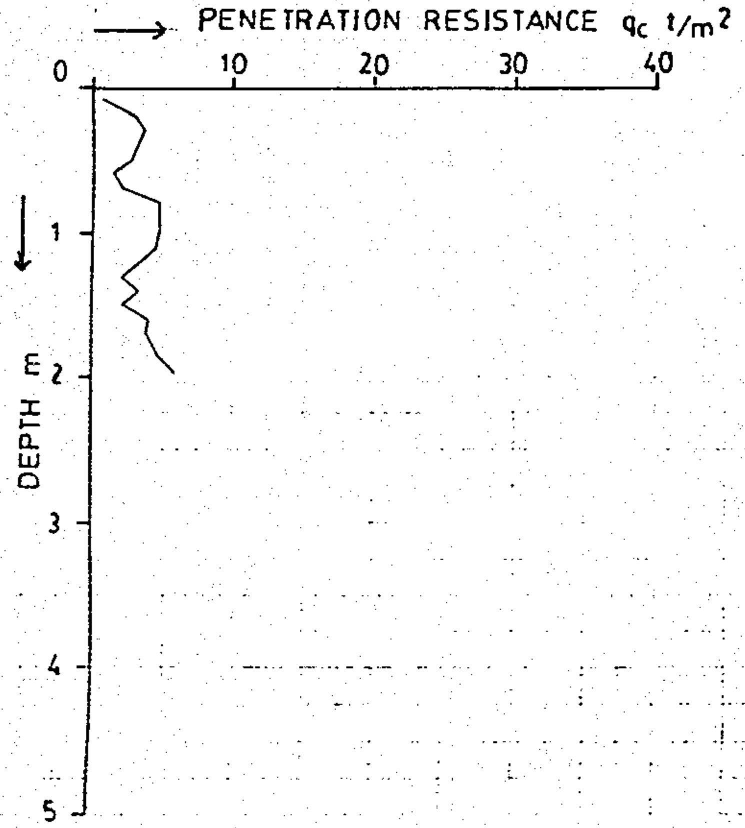
LOAD Kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS	LOAD kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS
50		5	0.05			100		25	7.50		
75		2	0.07			75		5	7.55		
100	2	18	0.25	11		75		20	7.75		
〃	3	25	0.50	12		50		25	8.00		0
〃		〃	0.75			75		〃	8.25		
75		〃	1.00		0	75		〃	8.50		
〃		〃	1.25			50		〃	8.75		
〃		20	1.45			〃		〃	9.00		0
100		5	1.50			〃		〃	9.25		
〃		25	1.75			〃		〃	9.50		
〃		〃	2.00		0	〃		〃	9.75		
〃		〃	2.25			〃		〃	10.00		0
〃		〃	2.50			75		13	10.13		
〃		10	2.60			100		7	10.20		
〃	3	15	2.75	40		〃	2	25	10.25	40	
〃	4	25	3.00	16	2	〃	4	〃	10.50	16	
〃	4	〃	3.25	16		〃	4	〃	10.75	16	
〃	4	〃	3.50	16		〃	4.5	〃	11.00	18	2
〃	4	〃	3.75	16		〃	4.5	〃	11.25	18	
〃	5	〃	4.00	20	2	〃	5.5	〃	11.50	22	
〃	5	〃	4.25	20		〃	5	〃	11.75	20	
〃	4	〃	4.50	16		〃	6	〃	12.00	24	2
〃	4	〃	4.75	16		〃	8	〃	12.25	32	
〃	4	〃	5.00	16	2	〃	10	〃	12.50	40	
〃	4	〃	5.25	16		〃	10.5	〃	12.75	42	
〃	3	〃	5.50	12		〃	12	〃	13.00	48	5
〃	2.5	〃	5.75	10		〃	14.5	〃	13.25	58	
〃	3.5	〃	6.00	14	1	〃	15	〃	13.50	60	
〃	4	〃	6.25	16		〃	16	〃	13.75	64	
〃	3.5	〃	6.50	14		〃	18	〃	14.00	72	8
〃	2	〃	6.75	8		〃	19	〃	14.25	76	
75		〃	7.00		0	〃	21	〃	14.75	84	
100		〃	7.25								

CONE PENETRATION TEST

LOCATION Salopokko DATE 12 – 4 – 1979

20 NO 20 – 1 TESTED BY

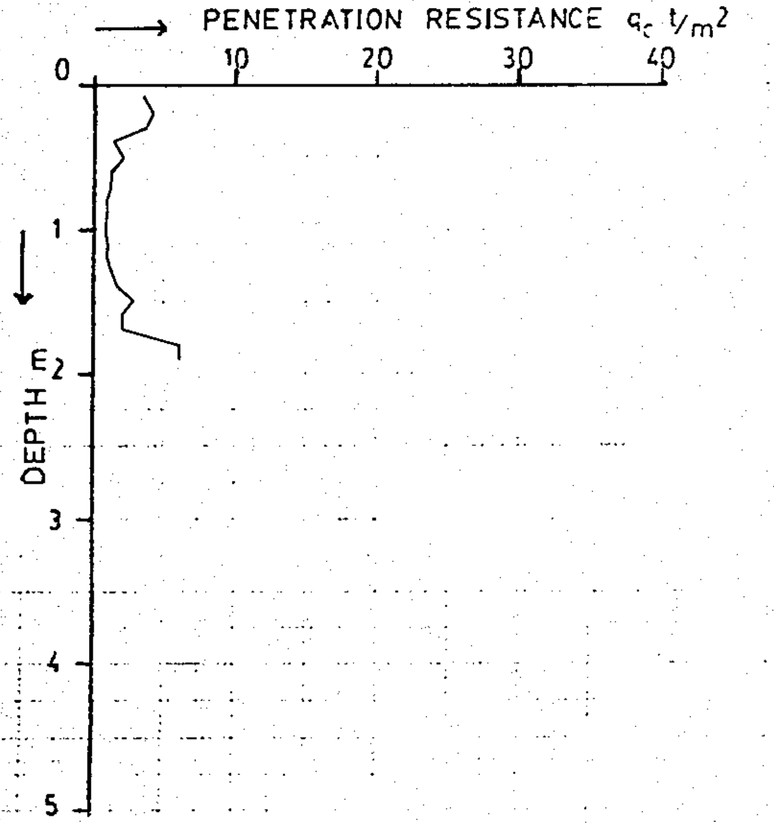
ELEVATION 6.5



LOCATION Salopokko DATE 12 – 4 – 1979

NO 20 – 2 TESTED BY

ELEVATION



P

CONE PENETRATION TEST

Location ______ No 20 − 1 Date 12 − 4 − 1979 Elevation ______ by ______

Penetrated Deep-th m	Gauge Value	qc kg/cm^2	qu kg/cm^2	N Value	Remark
0.1	16	1.0			
0.2	44	2.8	0.6		
0.3	56	3.6			
0.4	54	3.4	0.7		
0.5	45	2.9			
0.6	24	1.4	0.3		
0.7	36	2.2			
0.8	75	4.8	1.0		
0.9	75	4.8			
1.0	75	4.8	1.0	1.03	
1.1	70	4.3			
1.2	51	3.2	0.6		
1.3	31	2.0			
1.4	51	3.1	0.6		
1.5	36	2.2			
1.6	59	3.8	0.8		
1.7	57	3.7			
1.8	70	4.3	0.9		
1.9	80	5.0			
2.0	89	5.8	1.2	1.17	

Location ______ No ______ Date ______ Elevation ______ by ______

Penetrated De-epth m	Gauge Value	qc kg/cm^2	qu kg/cm^2	N Value	Remark

qc : Cone bearing capacity = 5 qu = 10 C = 3.5 N

qu : Allowable soil pressure C : cohesion kg/cm^2. N : N − value

CONE PENETRATION TEST

Location ____________ Location ____________

No 20 − 2 Date 12 − 4 − 1979 No ______ Date ______

Elevation 6 5 m by Elevation ______ by

Penetrated Deepth m	Gauge Value	qc kg/cm²	qu kg/cm²	N Value	Remark	Penetrated Deepth m	Gauge Value	qc kg/cm²	qu kg/cm²	N Value	Remark
0.1	59	3.7									
0.2	67	4.2	0.8								
0.3	60	3.8									
0.4	25	1.5	0.3								
0.5	31	2.0									
0.6	23	1.4	0.3								
0.7	21	1.2									
0.8	15	0.9	0.2								
0.9	16	0.9									
1.0	14	0.8	0.2	0.51							
1.1	15	0.9									
1.2	18	0.9	0.2								
1.3	21	1.2									
1.4	30	1.9	0.4								
1.5	43	2.7									
1.6	33	2.0	0.4								
1.7	34	2.0									
1.8	95	6.0	1.2	0.16							
1.9	95	6.0									

qc : Cone bearing capacity = 5 qu = 10 C = 3.5 N

qu : Allowable soil pressure C : cohesion kg/cm². N : N − value

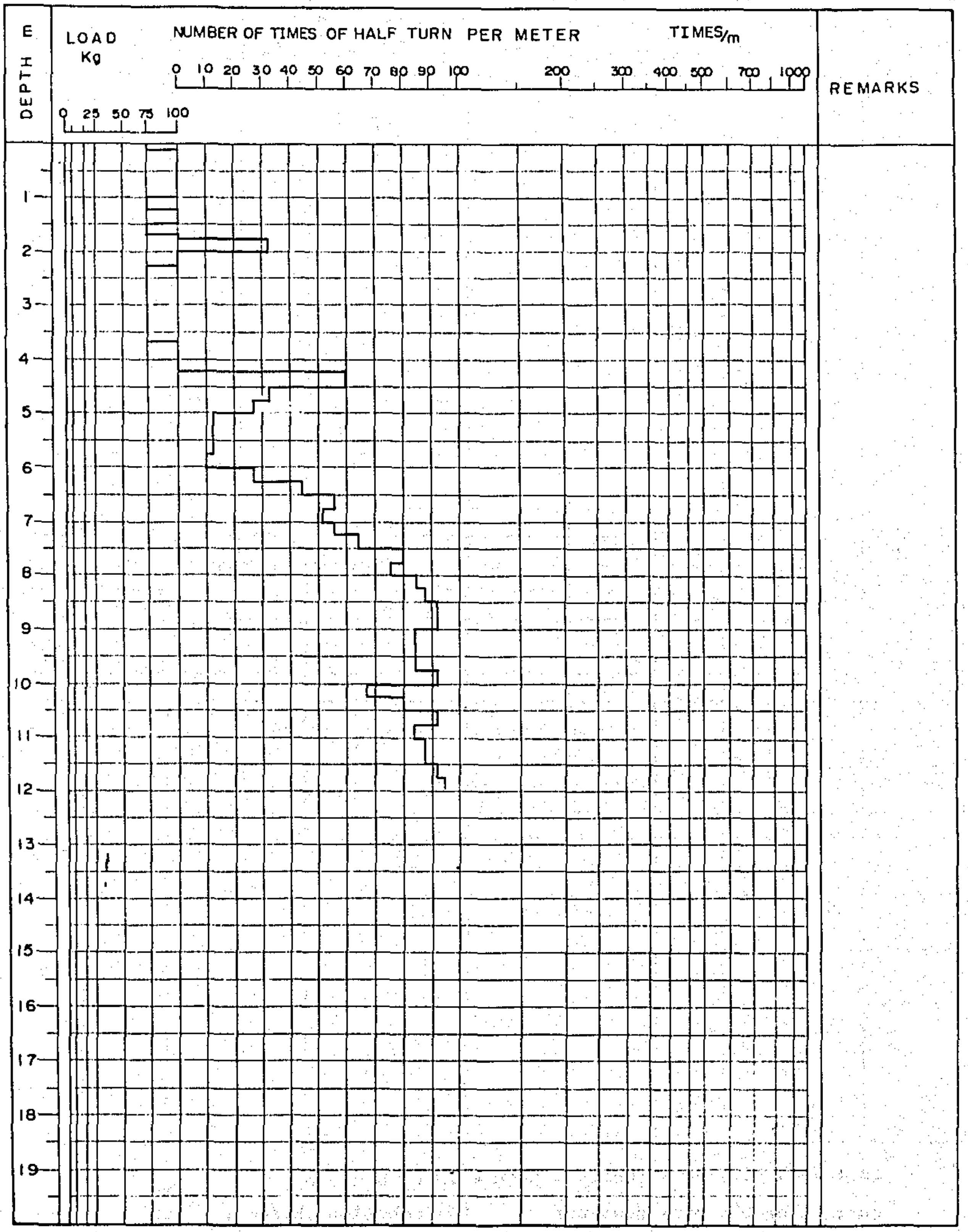
SWEDISH SOUNDING TEST

LOCATION Tancung Puray Kampung Luraboya

DATE 10 . April 1979

STATION NO. 21 ELEVATION 7 m GROUND WATER LEVEL m

TOTAL DEPTH 11.93 m TESTED BY R . Nagata



SWEDISH SOUNDING TEST

LOCATION

DATE 10 April 1979

STATION NO 21, ELEVATION 7 m GROUND WATER LEVEL m

TOTAL DEPTH 11.93 m TESTED BY R. Nagata

LOAD kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length cm	TIMES / m	REMARKS	LOAD kg	Number of Times of Half turn	Penetrated Depth m	Penetrated Length (m)	TIMES / m	REMARKS
75		15	0.15			100	20	25	7.75	80	
100		10	0.25			″	19	″	8.00	76	8
″		25	0.50			″	21	″	8.25	84	
″		50	1.00		0	″	22	″	8.50	88	
75		20	1.20			″	23	″	8.75	92	
100		5	1.25			″	23	″	9.00	92	10
″		25	1.50			″	21	″	9.25	84	
75		20	1.70			″	21	″	9.50	84	
100		5	1.75			″	21	″	9.75	84	
″		25	2.00	32	0	″	23	″	10.00	'92	9
″		″	2.25			″	17	″	10.25	68	
75		″	2.50			″	20	″	10.50	80	
″		″	2.75			″	23	″	10.75	92	
″		″	3.00		0	″	21	″	11.00	84	9
″		50	3.50			″	22	″	11.25	88	
″		20	3.70			″	22	″	11.50	88	
100		5	3.75			″	23	″	11.75	92	
″		25	4.00		0	″	24	18	11.93	96	10
″		″	4.25								
″	15	″	4.50	60							
″	8	″	4.75	32							
″	7	″	5.00	28	3						
″	3	″	5.25	12							
″	3	″	5.50	12							
″	3	″	5.75	12							
″	2.5	″	6.00	10	1						
″	7	″	6.25	28							
″	11	″	6.50	44							
″	14	″	6.75	56							
″	13	″	7.00	52	5						
″	14	″	7.25	56							
″	16	″	7.50	64							