COMMONWEALTH OF AUSTRALIA

DEPARTMENT OF NATIONAL DEVELOPMENT

BUREAU OF MINERAL RESOURCES GEOLOGY AND GEOPHYSICS

RECORDS:

1966/180

VILLAGE WATER SUPPLY SURVEY, MILNA BAY DISTRICT, 1966.

by

J.P. MacGregor

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C O N T E N T S.

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SUMMARY

A survey of the Milne Bay district was carried out between February and May 1966 by a team consisting of an engineer, a Public Health officer and a geologist, to advise on ways of improving village water supplies.

Recommendations were made regarding supplies for 127 villages, 4 Government stations and 13 mission stations. A summary of recommendations made for each settlement is given in Appendix III.

Four types of water supply schemes were considered. Most villages are located close to the coast, on unconsolidated sediments, and adequate supplies of fresh water can be obtained by constructing shallow, concrete-lined wells. Where adequate water supplies are available it was possible to recommend construction of a small gravity scheme. On islands composed of raised coral reef the water table is often very deep or the water is saline; consideration will have to be given to drilling or the provision of a rainwater catchment, in the form of large concrete or fibreglass tanks, in these situations. Because of their limited life it is considered that galvanised tanks are not suitable for village water supplies.

The importance is stressed of training personnel to supervise construction of water supply schemes and the recording of data on water quality and quantity.

INTRODUCTION

One of the most important factors in the development of health in the villages of Papua - New Guinea is the provision of safe supplies of good quality drinking water. The various Local Government Councils provide in their yearly estimates for the installation of improved water supplies, but in many cases they do not have the necessary knowledge of geological or engineering problems connected with the works to use the money to its best advantage.

During 1964 and 1965 an increasing number of requests for advice on village water supply problems were received by the Department of Public Works, Department of Public Health and Department of Lands, Surveys and Mines. At a meeting held in October 1965 between representatives of these Departments and a representative of the Department of District Administration, it was decided that the best way of dealing with the numerous requests was to establish a Village Water Supply Survey Team which would cover each District in turn. The team would provide the councils with a recommended programme for water supply improvement which would enable the Councils to plan their expenditure of this work for some years ahead. The team, consisting of an Engineering Geologist, an Engineer, and a Health Officer, would cover all aspects and types of scheme. Requests were to be handled by the Department of District Administration which would allocate priorities between districts and arrange detailed itineraries and transport for the surveys through the District Commissioners. It was hoped that, if the initial survey should prove successful, at least two Districts would be covered each year.

THE SURVEY OF MILNE BAY DISTRICT.

The team - J.P.MacGregor, Engineering Geologist, Department of Lands, Surveys and Mines, J.R.Lee, Local Government Engineer, Department of Public Works, and I. D. Lightfoot, Officer in Charge, Council Health Services, Department of Public Health, - made two visits to the Milne Bay District. The first visit between 28th February and 3rd April 1966 covered all Councils in the area other than the Kilivila Council, which was covered in the second visit between 19th and 26th May 1966.

During the survey the programme and transport were handled by the District Commissioner, Samarai, and the party was accompanied to each village by a Patrol Officer or Assistant District Officer from the Council area. In all, 144 places were visited and recommendations prepared. The places visited included 127 villages, 4 Government Stations and 13 Mission Stations. Recommendations were made for 126 sanitary wells, 6 bores, 8 gravity schemes, 6 rainwater catchments and 6 minor improvements. The itinerary is given in Appendix I, and village locations are shown on Plates 1 and 2.

METHOD OF WORK.

On arrival at each village, details of population, rainfall, water use, possible development, and location of present water supply were obtained.

The next step was to examine the existing water supply if practicable, and test the salinity of the water by the use of a portable conductivity meter. If the location of the present supply proved suitable, recommendations for the improvement and protection of the supply against pollution were prepared. If the supply was not suitable a survey of the area surrounding the village was carried out to locate a site for a better supply. In several places auger holes were sunk to determine the depth to groundwater and to confirm its quality. Where a surface scheme was proposed, preliminary engineering measurements were made in order to estimate quantities of materials and cost.

To assist in the future identification of village and site several photographs were taken which included the Local Government Councillor or some prominent villager. It was found in the latter part of the survey that the marking of well sites were aided considerably by the use of distinctively coloured marker posts.

As soon as possible after leaving the village, details of present supply and recommendations for improvement were prepared and given to the Sub-District Assistant District Commissioner with copies to the Local Government Council and the District Commissioner, Samarai. These recommendations include materials lists and estimated costs. At the end of the Survey the photographs were processed and mounted and forwarded together with specifications and materials lists for the surface schemes. A sample of a typical village report and recommendation, is given in Appendix II. Copies of all recommendations made in the survey are held by the District Commissioner, Samarai; Geological Office, Department of Lands, Surveys and Mines; Local Government Engineer, Department of Public Works, and Regional Medical Office, Department of Public Health, Port Moresby. Summaries of all recommendations are given in Appendix III.

TYPES OF SCHEMES

Although expenditure on water supply development is subsidised by the Department of Public Health, the income of the Councils is low and must be divided to cover the various requirements of the community and, where alternative schemes are possible, the major factor in determining which type of scheme should be used in a village supply is the cost which will fall on the Local Government Council.

Six types of scheme were considered by the team for use in the Milne Bay District. These were (a) pumped supply from storage, (b) gravity supply, (c) dug well, (d) drilled bore, (e) hydraulic ram from stream, and (f) rainwater catchment. Other methods such as desalination were not considered because of their high capital cost.

(a) Pumped Supply from Storage

This type of scheme involves the installation of a mechanical pump operated by an engine or windmill. The capital expense of these items (and the high running costs in the case of engines) combined with the difficulty of obtaining adequate maintenance in isolated areas make this scheme impracticable in most cases. In the Milne Bay District most villages are coastal and the necessary storage of good quality water is not available.

(b) Gravity Supply

By building a small dam across a perennial stream, a permanent supply of water can be carried cheaply to a nearby village. The construction of a storage area sufficient to last throughout the dry season would be very expensive; the 1-2 foot high dam acts merely as a collecting point. On several of the larger islands in the Milne Bay District moderate-sized perennial streams were found close to villages and this type of scheme was recommended. One major difficulty is the prevention of pollution from gardens or wild pigs. Details of construction of a standard small dam are given in Appendix IV.

(c) Dug Well

Provided that an adequate supply of good quality groundwater is available within 25 feet of the surface, the cheapest form of village water supply is a properly protected sanitary well fitted with a hand pump. The well is dug by local labour and lined with concrete pipes which are cast on the site. Where the underlying formation is strong, only the top 6 feet of the well need to be lined to avoid pollution from the surface. Plans for a standard sanitary well are given in Appendix V. A recent development in the construction of sanitary wells is the lining of the well by fibreglass liners instead of concrete pipes.

The cost of this lining is about 30% more expensive than the concrete, but the saving in weight, ease of handling and the saving in purchase of moulds is considerable, especially in areas where concrete aggregate is difficult to obtain. Final details of prices and delivery have yet to be obtained. In the Milne Bay District most of the villages are built on reef coral, sand bars or narrow coastal shelves, and wells were recommended in all cases where the water quality was expected to be suitable.

(d) Drilled Bore

In places where the groundwater is below 25 feet an alternative to rainwater catchment is a bore drilled by a percussion drilling rig. For village water supplies it is considered that a 4-inch diameter hole, fitted with a deep-well hand-pump, would be sufficient. The difficulty of shifting drilling equipment makes good access to the site a necessity. The cost of freighting the equipment to the area and employing an experienced drilling crew is high. However, drilling for water by the Mines Division, Department of Lands, Surveys and Mines, is subsidised by the Administration and it is thought that the cost to the local council for a 60-foot-deep bore would be of the order of $400.

The island of Kiriwina was found to be the only place in the Milne Bay District with the combination of deep groundwater, good access, and the need for several bores in reasonable proximity, which justified a recommendation for drilled bores, and they were recommended for villages on the higher part of the island. A recommended bore-pump fitting is given in Appendix VI.

(e) Hydraulic Ram from Stream

The use of an hydraulic ram instead of an engine-driven pump eliminates running costs and reduces maintenance but for the ram to work it is necessary to have a nearby stream with constant flow and steep gradient to provide power for the ram. No suitable sites were found in the Milne Bay District.

(f) Rainwater Catchment

In an area of relatively high rainfall the use of either roofs or specially constructed catchments is a sure source of good quality water. The greatest difficulty is providing adequate storage to supply the needs of the population during periods of drought. A village of 150 people, using one gallon of water per head, per day, for drinking and cooking only, requires a storage of 4,500 gallons to cover a 30-day drought, assuming that the tank was full at the beginning of the dry spell. In most parts of Papua - New Guinea there is a dry season of several months during which only light falls of rain can be expected.

Tankage should allow for a 4-5 month drought with negible replenishment - that is a 20,000 to 25,000 gallon storage for a village of 150 people. This storage provides water for drinking and cooking only.

Several types of tanks are used for storage of water in the Territory; galvanised iron, steel and concrete. Galvanised tanks are easy to construct but close to the sea their life varies between 4 and 6 years. Thus replacement costs are high and over a long period they are the most expensive form of storage. Steel tanks last longer than the iron tanks but their initial cost is considerably higher.

Concrete tanks last for the longest time if properly constructed but require careful supervision and expensive formwork. The Administration is considering the purchase of prefabricated steel formwork which could be loaned to the Councils for the construction of large concrete tanks. It is hoped that when this formwork is available a 30,000 gallon concrete tank with catchment could be built for a cost of the order of $1,000. This is expensive for a village supply but would solve the drinking water supply for a village up to 200 population for many years.

Investigation is being carried out into the possibility of the purchase of fibreglass tanks to replace the galvanised tanks. Fibreglass has the advantage of much longer life, easy repair and also resistance to earthquake shocks in a country of relatively high seismicity. However, ho details of performance and cost have yet been received.

In the Milne Bay District several islands, especially the Marshall Bennetts, Lusancays and some in the Calvados Chain, consist of low coral reef and do not appear to have any supply of good quality groundwater. In these areas rainwater catchments and storage were recommended; initially in the form of small tanks to assist the villagers in the wet season and, as a long term project, by the construction of large concrete tanks to provide fresh water throughout the year.

WATER QUALITY AND DEMAND

The recommended maximum amount of dissolved salts in drinking water is 1,000 parts per million (ppm); throughout the survey the team tried to keep the quality of the proposed water supplies within this limit. The salinity of each village supply was checked using a Tectron Salinity Bridge which, although not very accurate, gives a rapid indication of general water quality.

It was found that many of the present village supplies were often extremely salty, with water containing as high as 7,000 ppm of dissolved salts being used for drinking. In such cases the water is often mixed with rainwater or coconut juice to improve its quality. On some islands

it is unlikely that the salt content of the best available groundwater is much less than 2,000 ppm but this is preferable to the extremely saline water being used at present.

It had been hoped that a portable kit for determining the bactereological content of the water could be obtained but this was not available and remarks had to be restricted to assessment of pollution risk in the area.

In the recommendations an estimated water demand for each village is given. This is the total estimated requirements for drinking, cooking and washing for the population, assuming normal increase over the next few years. The actual supply required for drinking and cooking would be 10% to 15% of this amount, but as the quantity of fresh water available increases the individual demand will rise. Most villagers wash in the sea, but, as better and more plentiful water supplies are provided, the use of fresh water for washing should be encouraged as soap can then be used and health standards improved.

WATER SUPPLY PROBLEMS - COUNCIL AREAS

Louisiade Council

With the exception of one village on Misima Island, all villages visited in the Louisiade Council Area were situated on the islands to the south - the Deboyne Islands and the Calvados Chain. These islands are mostly underlain by either volcanic or metamorphic rocks and are fairly high and well-wooded. The villages are built on coastal alluvial shelves and sand bars; little difficulty was found in locating close to the centre of population sources of fresh water with a nearby hill catchment. For two villages BROOKER (4)* and GALANA-NIMOA (19), it was possible to recommend the improvement of existing gravity supplies from nearby streams.

The island of Sabari presented difficulty as it is a long low coral island forming part of the northern reef of the Calvados Chain. Fresh water for the three villages on the island is brought by canoe from the island of Hemenai several miles to the south. Examination of several coral caves in the centre of the island showed that apart from difficulty of access, the water quality in them was unacceptable. It was recommended that two rainwater catchments with large concrete storage tanks should be constructed as the only possible practical means of providing fresh water.

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* Numbers after village names refer to Plate 1.

Bwanabwana Council

The villages visited in the Bwanabwana Council area comprised the islands of the Engineer Group with the addition of WARI(21), KITAI(22) and DAWSON(27). In all cases there was little difficulty in finding suitable sites for wells - either close to present supplies or on sandy shelves with large hill-catchments nearby. All the islands seem to be volcanic in origin apart from KITAI(22) which is composed of coralline sand.

Duau Council

The main part of the population of south-eastern Normanby Island is spread along the coast in numerous hamlets which obtain their water supplies from many small streams that run from the mountains in the centre of the island. The coastal shelves are narrow and there are few centres of population. Wells were recommended at the Council Headquarters, BUNAMA(32) and ISUMIAMIU(33) while a simple gravity scheme should solve the water problems at GULEGULEU(31) School.

Dobu Council

The Dobu Council area is divided into 4 sections - northern Normanby, South-Eastern Fergusson, the Amphlett Islands, and the islands off the east coast of Normanby and Fergusson including Dobu, NEUMARA(42) and SANAROA(46). Each of these areas was visited and each presented different water supply problems. On Northern Normanby the situation is similar to the Duau Council area, but on Southern Fergusson the villages are underlain by pumice from the nearby dormant volcanoes, mixed with bands of coral. In some areas water can easily be obtained at shallow depth on the coastal shelf. In the western side of Dobu Island a coral and pumice shelf provides shallow potable water but on the north the proximity of deeply eroded pumice valleys and hot springs makes the location of a suitable groundwater supply for GAMORLAINE(40) difficult. It may be necessary to resort to rainwater catchment in this area. On the south-eastern side of the island the small village of EGADOI(41) is built at the foot of a high pumice cliff and it is considered that rather than spend money on investigation of a possible water supply the village should be moved. The Amphletts are high volcanic islands and suitable well sites were found on the coastal shelves. At GUMUANA-URASI(49) a small gravity scheme was recommended from a stream some 3,500 feet along the coast from the village.

Woodlark Area.

In the Woodlark area the Marshall Bennett Islands, the LAUGHLINS (53), YANABA(50), EGUM(51) and ALCESTER(54) were visited in addition to GUASOPA STATION(52). Apart from EGUM(51), all these islands are underlain by coral. In the LAUGHLINS(53) and at YANABA(50) the coral is covered by sand bars which should hold reasonable quality water, but the other islands

consist of coral reefs which have been elevated several hundred feet above the sea. As the coral is very porous it is unlikely that the water table on the islands is much above sea level so any hole drilled from the plateau on top of the islands would have to be very deep. At ALCESTER(54) the village is built on a narrow coastal shelf and a well was sited close by, but on GAWA(55), KWAIAWATTA(57) and IWA(56) the villages are from 200 to 400 feet above sea level. Access to the top of these islands is very difficult - in one place by use of ladders - and deep drilling would be uneconomic. It is, however, possible that a high perched, water table, formed by some clay bands on the coral is present and one well has been sited on GAWA(55) to find out if this occurs. For the other villages the only immediate solution is to sink wells on the narrow coastal shelf, the wells should improve the quality of the water supplies if not the ease of access to them. As funds become available the construction of rainwater catchments on these islands should be considered.

West Fergusson Council

The western part of Fergusson Island is similar to Normanby, with high mountains giving numerous streams which supply the many small hamlets along the coast. No difficulty was found in locating well sites on the coastal shelf in the villages which were visited. The securement of the village spring was recommended at IBWANANIU(63).

Goodenough Council

On the northern and eastern side of Goodenough Island a broad alluvial plain between the mountains and the sea provides an excellent source of good quality groundwater. On the southern and western sides the situation is similar to Normanby and Fergusson. The island of WAGIFA(73), off the south-eastern corner of Goodenough, is of volcanic origin and contains an almost circular fresh-water swamp. Two wells were sited on the side of the swamp but if no adequate aquifer is located it may be necessary to sink a well on the coastal shelf away from the swamp area.

Suau Council

The southern coast of Papua between Samarai and Mullins Harbour contains several fiord-like inlets. Most of the villages visited in this area are situated on the narrow headlands between the inlets. The underlying rock is volcanic and it was possible to find well-sites on sand-bars and alluvial shelves near the villages. The Council Chambers at RUMULEI(83) are built on the top of a volcanic ridge and it seems unlikely that groundwater could be obtained at shallow depth on the Council land. It may be necessary to sink a well in the next valley - on the way to the village of ISUDAU.

Milne Bay Sub-District

At GARUAHI(80) the Maramatama Council Headquarters is built on one of several gravel terraces which should contain good water supplies; at BUBULETA(91) a coastal sand and gravel bar between the hamlets is the best spot for communal supply. The village of GABOGABUNE(92) is situated on a silty coastal plain and a good water-bearing stratum may be difficult to locate. IANIANINI(93) village is built inland, on the top of a ridge, and is a suitable site for a drilled bore but it is unlikely that it would be possible to bring a drilling rig to the area for only one hole. The trial sinking of a well in a nearby creek was proposed but if this fails the best solution would be to improve the rainwater catchment from the houses.

Kilivila Council

All the Trobriand Islands are composed of coral and the water supplies for the 48 villages visited in the Kilivila Council area are divided into several groups which illustrate the various problems associated with obtaining groundwater from coral islands.

The northern part of Kiriwina island is shaped somewhat like a tilted plate with its rim on the north-eastern side reaching a height of over 60 feet for several miles. Villages on this elevated rim obtain their water either from tidal springs on the coast or from deep caves in the coral. On the southern and western side the rim is low enough for wells to be dug to water but in the north-east the water table is about 50-60 feet deep and 6 bores were recommended for villages in this area. Throughout the island there is a good system of roads so that access for the drilling rig should be no problem. Within the rim, in the centre of the island, there are several swamps with a shallow groundwater-table - probably caused by accumulation of silt and clay within the coral rim. The villages in this area will have little difficulty in finding good supplies of fresh water. Because of the permeability of the clean washed coral at the coast, although there is a strong flow of fresh water in springs below high tide level when the tide is out, it is likely that the salt content of the water inland is affected for some distance by a corresponding flow from the sea at high tide. Therefore, it was recommended that villages in this situation should sink wells on the landward side of the village. It may be found that the water is still brackish at high tide and in that case the wells should be moved several hundred feet farther from the sea. In all cases it would be preferable to excavate a hole in the coral to test the salinity before installing the concrete pipes.

The water supply situation on the island of Kaileuna is similar to that on Kiriwina.

On Kitava the 6 villages, with a combined population of over 1,000, are built several hundred feet above the sea and obtain their water from tidal springs on the coast. The situation is similar to the Marshall Bennett Islands. It was recommended that, initially small rainwater catchments be installed in each village and that in the future provision be made for the construction of several large rainwater storage schemes.

The islands of KUIAUA and MUNAWATA, on the other hand, consist of very low coral reefs. The salinity of the present water supply is very high and although wells were sited in the most likely place to strike fresh water probably consideration will have to be given to the construction of rainwater catchments on these islands.

CONCLUSIONS

As a result of the survey of the Milne Bay District it can be concluded that, for this area:

1. In most cases the best and cheapest solution for a safe sanitary village water supply is a concrete-lined well.

2. In most villages good water supplies can be obtained at shallow depths.

3. Water problems are less acute on the larger islands than on the smaller islands.

4. The biggest water problems are found on coral islands, especially those on which the coral reef has been elevated some distance above the sea.

5. Where conditions are suitable a small gravity scheme can be economically constructed.

RECOMMENDATIONS

1. As a considerable number of wells will have to be sunk in the area, representing some hundreds of concrete pipes, each council should purchase a pipe mould. Details of the possibility of using fibreglass liners will be circulated to the Councils as soon as they are finalised.

2. As the construction of pipes and properly built wells is a skilled job, steps should be taken to train well-supervisors, to be employed either by the Administration or the Councils, to take charge of this work. The construction of the total programme of wells would keep several supervisors fully employed for a considerable time. They could subsequently be employed in other Districts and in helping to construct the additional wells required to satisfy the demands of an increasing population.

3. During construction of the wells, when water is struck a 1-pint sample should be forwarded to the Senior Resident Geologist, P.O. Box 778, Port Moresby, for testing, together with details of location of well and depth to water. Results of this testing can normally be given by return of post.

4. The moulds for the large concrete rainwater storage tanks are expensive and should be purchased by the Administration and hired out to the Councils for individual projects. This purchase should be given a high priority as the villages which require this type of supply have no suitable alternative source of water.

5. Rain gauges should be installed in as many locations as possible. Local Council clerks should be encouraged to maintain rainfall records, and schools could help considerably by installing stations which would, in addition to the data produced, have an educational value of benefit to future generations.

ACKNOWLEDGEMENTS

The part played in the survey by Mr. Julian R. Lee, Local Government Engineer, Department of Public Works is gratefully acknowledged. In addition to preparing estimates and carrying out the engineering investigations required for surface water supply schemes, he drafted most of the plans for the individual recommendations.

Mr. Ian W. Lightfoot, Officer-in-Charge, Council Health Services, Department of Public Health, apart from advice on health, pollution and general sanitation of water supplies, supervised the sinking of auger holes and controlled and maintained the outboard motor used on the survey.

The itinerary, transport, accommodation and other details of the survey were arranged by the Acting District Commissioner, Milne Bay District, Mr. J. Emmanuel, the Senior Local Government Officer, Mr. P. Gall, and members of the Staff of the Department of District Administration stationed in the Milne Bay District. Many of these Officers accompanied the team for part of the survey and their assistance is very much appreciated.

APPENDIX I

VILLAGE WATER SUPPLY SURVEY MILNE BAY - ITINERARY

FIRST SECTION

(Numbers in brackets refer to position indicated on Plate 1)

February 28th	Team flew from Port Moresby to Gurney Airstrip, Milne Bay. Boarded MV 'Manuguna' for Bwagaoia, Misima, via Samarai.
March 1st	Samarai to Bwagaoia
2nd	BOROMA(1), PANAPOMPOM(2), PANEATE(3)
3rd	BROOKER(4), YAUVITAN-MOTORINA(5), PANAEWAU-MOTORINA(6), BWARAKILAM-BAGAMAN(7), KEU-BAGAMAN(8), PANAMARA(9).
4th	KUANAK(10), TAMPANI-PANAWINA(11), MOMANILA-PANAWINA(12), TANDEI-SABARI(13), EBANAHINA-SABARI(14), MAHO-SABARI(15), NIGAHAU(16), GRASS ISLAND (17).
5th	BALAINA-JOANNET(18), GALANA-NIMOA(19), NIMOA CATHOLIC MISSION(20).
6th	Bwagaoia to Wari
7th	AMANELIAN-WARI(21)
8th	KITAI(22), TUBETUBE-SLADE(23), NARUARUARI-SKELTON(24), KWARAIWA-WATTS(25), TEWATEWA-HUMMOCK(26), KOIGAUGAU-DAWSON(27)
9th	BADELAI(28), SEHULEA STATION(29)
10th	BARUADA METHODIST MISSION(30), GULEGULEU SCHOOL(31), BUNAMA(32)
11th	ISUMIAMIAU-SEWA BAY(33), BWAKERA SCHOOL(34), UBUIA HANSENIDE COLONY(35), BUDOIA CATHOLIC MISSION(36)
12th	EPEPOIA(37), BWAOIA(38), SEUALENA-DOBU(39), GAMORLAINE-DOBU(40), EGADOI-DOBU(41), NEUMARA(42), NUMANUMA(43), SAWA-EDI(44), PAPAOI(45).
13th	Esa'ala to Samarai
14th	In Samarai
15th	ETANA-SANAROA(46)
16th	DILIA-WAWIWA(47), NABWAGETA-TOBOA(48), GUMUANA-URASI(49),
17th	YANABA(50)
18th	EGUM(51), GUASOPA STATION(52)
19th	BODIBOD-LAUGHLINS(53)
20th	NESIKWABA-ALCESTER(54), GAWA(55)
21st	IWA(56), KWAIWATTA(57)
22nd	Kulumadau to Esa'Ala
23rd	PATANITANI(58)
24th	IAMALELE No.1(59), MAPAMOIWA STATION(60), FAIAIANA(61), AILULUAI(62), IBWANANIU(63).

March	25th	BOLUBOLU STATION(64), LOWER WATALUMA(65), IDAKAMANAI(66), VIVIGANI(67), BELEBELE(68).
	26th	DIDIAU(69), KALOKALO(70), FAIAVA(71), WAILAGI METHODIST MISSION(72), WAGIFA ISLAND(73), WIFALA-BWAIDOGA(74).
	27th	ABOLA(75), MORATAU(76), TARAKWARURA ANGLICAN MISSION(77), MENAPI ANGLICAN MISSION(78).
	28th 29th	BOIANAI ANGLICAN MISSION (79), GARUAHI(80), EAST CAPE METHODIST MISSION(81), SIDEIA CATHOLIC MISSION(82)
	30th	RUMULEI(83)
	31st	GADAISU(84), PANOPANO-BONABONA(85), TABOINA-ALOALO(86), MONINI-ISUISU(87).
April	1st	SUAU ISLAND(88), MODEWA(88), ILOILO(90)
	2nd	In Samarai
	3rd	BUBULETA(91), GABOGABUNE(92), IANIANINI(93), Team flew Gurney to Port Moresby

SECOND SECTION
(For Locations see Plate 2)

May	19th	Team flew Port Moresby to Losuia, TUKWAUKWA, KAIBOLA SCHOOL, GUSOETA CATHOLIC MISSION, IDEAKEKA, IUWADA, KAPWANI
	20th	KITAVA-KUMWAGEA, WAPAIYA, LALELA No 1, LALELA No 2, OKOBULULA No 1, OKUBULULA No 2.
	21st	Kaileuna - KAISIGA, BULAKWA, KADUWAGA, TAUWEMA, GIWA, KOMA, KIUAUA ISLAND, MUNUWATA ISLAND
	22nd	In Losuia
	23rd	GILIBWA, OKINAI, VAKUTA
	24th	KAIBOLA, MWATAWA, LABATA, TUBOADA, BOITALU, IALAKA, BUDAILAKA, LUYA, MUTAWA, OTAWATAU CATHOLIC MISSION, LILUTA, WASAPOLA, KAIMWAMWALA, KUDAKABILYA, WABUTAMA, GUMILABABA
	25th	MOLIGILAGI, KAITUVI, OSAPOLA, IALIMA No 1, IALIMA No 2, OKUPUKOPU, OKAIBOMA, OIABI METHODIST MISSION, MULOSAIDA, KAVATARIA, TEYAVA, OIVEYOVA
	26th	Team flew Losuia to Port Moresby.

A P P E N D I X I I

SAMPLE OF VILLAGE REPORT - YAUVITAN-MOTORINA

TERRITORY OF PAPUA & NEW GUINEA

SURVEY OF VILLAGE WATER SUPPLIES.....MILNE BAY..... DISTRICT

VILLAGE.....YAUVITAN-MOTORINA...

COUNCIL.....Louisiade.....

CENSUS DIVISION..Calvados Chain.

SUB-DISTRICT.....Misima.....

POPULATION.....40.....

ACCESS...Boat from Buagaela.....

.....4 hours.....

HEADMAN/COUNCILLOR..JOE KOTO....

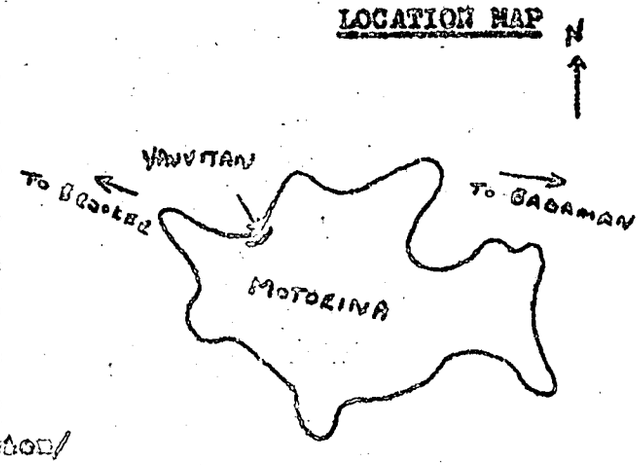
.....

WATER USE - Domestic/School/Mission/
Hospital/First Aid/Stock/Irrigation

PROJECTED DEVELOPMENT.....Nil....

ESTIMATED DEMAND.....500 GPd.....

LOCATION MAP



PRESENT SUPPLY

RAINFALL.....About 80 inches.....

WET SEASON From.....to.....

TYPE.....Dug Well.....

DISTANCE FROM VILLAGE...100 yds.

TRANSPORT.....Truck.....

YIELD/RATE OF FLOW..50 gal/min..

QUALITY - Chemical...300 ppm....

Bacteriological.....

PROTECTION.....Nil.....

REMARKS....Path pollution risk..

.....Hole dug in stream bed.....

.....Does not dry up.....

DRY SEASON From.....to.....

TYPE.....

DISTANCE FROM VILLAGE.....

TRANSPORT.....

YIELD/RATE OF FLOW.....

QUALITY - Chemical.....

Bacteriological.....

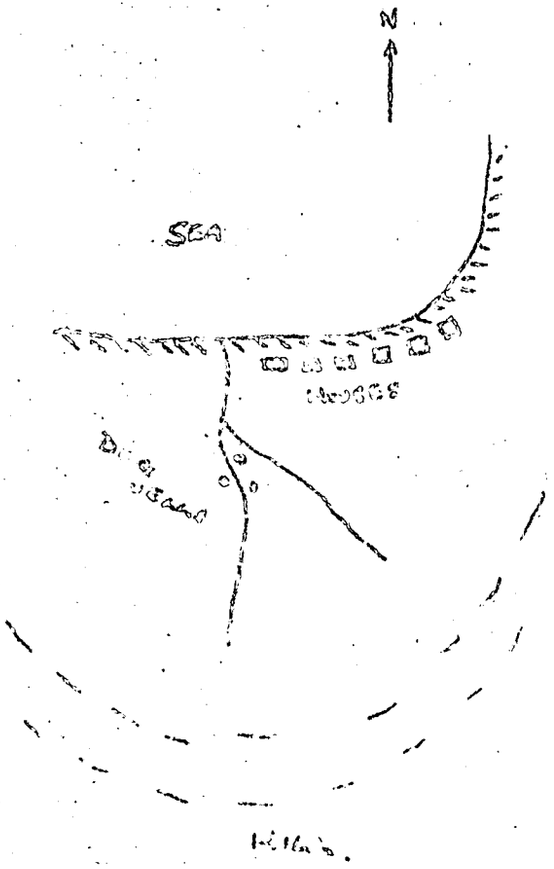
Protection.....

REMARKS.....

.....

.....

LOCATION MAP



T E R R I T O R Y O F P A P U A A N D N E W G U I N E A

SURVEY OF VILLAGE WATER SUPPLIES.....MILNE BAY.....DISTRICT

VILLAGE.....YAUVITAN-MOTORINA...

RECOMMENDATIONS

TYPE OF RECOMMENDED SCHEME - Pumped/Gravity/Well/Bore/Hydraulic-Ram/Rainwater-Catchment

LOCATION OF NEW SUPPLY.....30 yards behind tradestore at westerm.....
.....end of village.....

DISTANCE FROM VILLAGE.....

ACCESS.....

SITE KNOWN TO.....MIVIU.....

TYPE OF AQUIFER.....Sand and gravel on land side of sand bar.....

DETAILS OF SCHEME.....Sanitary well as per Standard PHD drawings -
.....10 feet deep.....
.....Suitable sand and gravel available.....

MATERIALS REQUIRED.....As per plans - 3-4 feet concrete pipes.....

LABOUR REQUIRED.....Local.....

SUPERVISION.....Local Council Executive Committee.....

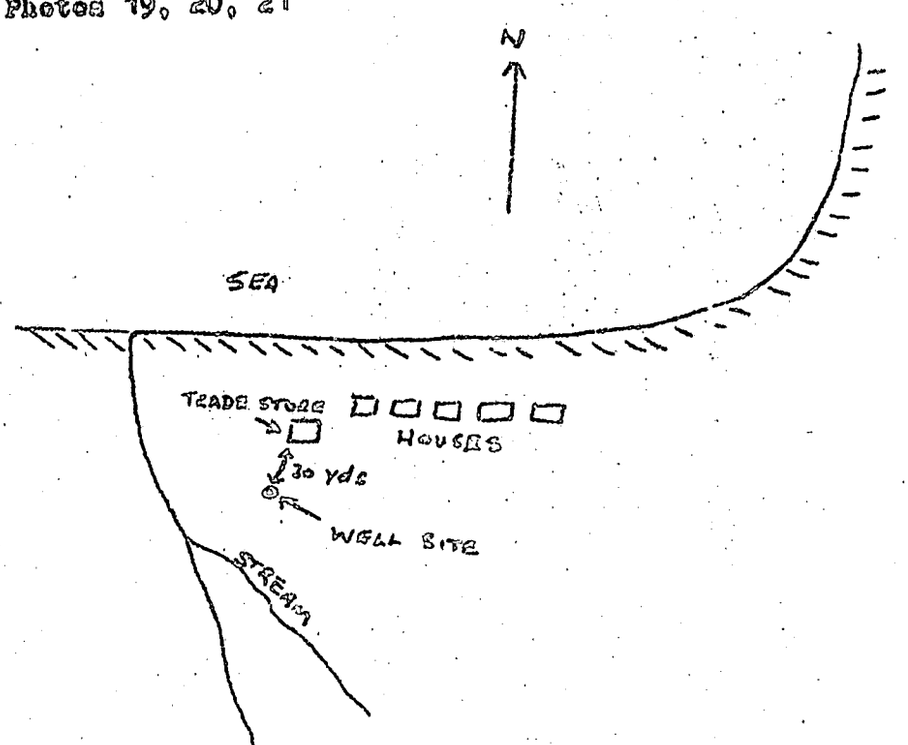
ESTIMATED COST ($).....100.....

ALTERNATIVE SCHEME.....Other suitable sites close to stream but
.....difficult to provide adequate drainage from them.....

PRIORITY.....Moderate.....Signed...J.P.MacGregor..Date....3/3/66...

LOCATION MAP

Film 1 Photos 19, 20, 21



G.S.Form 7

YAUVITAN-MOTORINA - LOUISIADE COUNCIL

1/19 YAUVITAN VILLAGE

1/20 MIVIU AT PRESENT WATERHOLE

1/21 MIVIU AT WELL-SITE. TRADESTORE IN BACKGROUND

APPENDIX III

SUMMARY OF RECOMMENDATIONS FOR COUNCILS

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - LOUISIADE COUNCIL AREA

VILLAGE	POPULATION	TYPE OF SCHEME	NO. OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
BAILAINA-JOANNET (18)	110	Well	2	$100	Moderate	Jointed shale-beside present waterhole.
BOROMA (1)	60	Well	2	$100	High	Coral reef-behind western end of village.
BROOKER (4)	100	(a) Gravity	-	$160	Moderate	Improvement of dam and replacement of pipe-line.
		(b) Well	5	$120	Moderate	Sandy shelf - in village.
BWARAKILAM-BAGAMAN (7)	50	Well	4	$120	Moderate	Sand-bar - beside present water-hole.
EBANAHINA-SABARI (14)	100	Rainwater Catchment	-	$1600	High	30,000 gal tank and catchment - no alternative supply. Share with TANDEI-SABARI.
GALANA-NIMOA (19)	60	Gravity	-	$50	Moderate	Rebuilding of dam and repair of pipe-line.
GRASS ISLAND-WANIM (17)	150	Well	4	$120	Moderate	Sandy shelf - behind rest house.
KEU-BAGAMAN (8)	50	Well	3	$100	Moderate	Coral sand bar - norther end of village.
KUANAK (10)	50	Well	3	$100	Moderate	Valley alluvium - behind village.
MAHC-SABARI (15)	200	Rainwater Catchment	-	$2000	High	40,000 gal tank and catchment - no alternative supply.
MOMANILA-PANAWINA (12)	80	-	-	$20	Low	Improvement of present supply.
NIGAHAU (16)	120	Well	3	$100	High	Sandy shelf - between village and Aid Post.
PANAEWAU-MOTORINA (6)	150	Well	3	$100	High	Alluvium - beside school.
PANAMARA (9)	60	Well	3	$100	Moderate	Coral sand shelf - in village.
PANAPOMPOM (2)	150	Well	3	$120	Moderate	Coral sand bar - in village.

VILLAGE	POPULATION	TYPE OF SCHEME	NO. OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
PANEATE (3)	750	(a) Well	-	$50	High	Deepening and covering of existing well at eastern end of village.
		(b) Well	2	$80	High	Coral reef - behind Aid Post.
		(c) Well	2	$120	High	Sandy shelf - western end of village.
TAMPANI-PANAWINA (11)	20	-	-	$20	Low	Improvement present supply.
TANDEI-SABARI (13)	80	-	-	-	-	Share rainwater catchment with EBANAHINA-SABARI.
YAUVITAN-MOTORINA (5)	40	Well	3	$100	Moderate	Sand bar - western end of village.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - STATION SUPPLIES

VILLAGE	POPULATION	TYPE OF SCHEME	NO. OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
BOLUBOLU STATION (64)	200	Well and Windmill	8	$7000 plus reticulation	High	Sand and gravel plan. Water pumped from well to tank and then reticulated.
GUASOPA STATION (52)	100	(a) Well	3	$100	High	Coral reef - beside patrol post.
		(b) Well	3	$100 plus	High	Coral reef - at police barracks.
		(c) Well	3	$100 labour	High	Coral reef - at government school.
MAPAMIOWA STATION (60)	500	Gravity	-	$1200 plus labour	Moderate	Rebuilding of dam and replacement and realignment of pipe-line in existing scheme.
SEHULEA STATION (29)	30	(a) Gravity	-	$170 plus	Moderate	Rebuild dam and replace pipe-line in existing scheme.
		(b) Well	5	$120 labour		Sand shelf - near police barracks.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - MISSIONS

VILLAGE	POPULATION	TYPE OF SCHEME	NO. OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
BARUABA METHODIST MISSION (30)	250	(a) Well	3	$100 plus	High	Sandy shelf - near first-aid post.
		(b) Well	3	$100 labour	High	Sandy shelf - near playing field.
BOIANAI ANGLICAN MISSION (79)	300	(a) Well	4	$80 plus	Moderate	Gravel beach - in front of residence.
		(b) Rainwater Catchment	-	$1200 labour	Moderate	2-15,000 gal underground concrete tanks fed from Church catchment.
BUDOIA CATHOLIC MISSION (36)	150	Well	4	$100 plus labour	High	Pumice shelf - in front of convent.
EAST CAPE METHODIST MISSION (81)	150	Well	4	$50 plus labour	Moderate	Coral reef - beside existing well behind school.
GUSOETA CATHOLIC MISSION	250	Well	2	$80 plus labour	Moderate	Coral reef - beside road to Losuia.
MENAPI ANGLICAN MISSION (78)	200	(a) Well	5	$100 plus labour	Moderate	Coral shelf - beside church.
		(b) Improvement of well	-	$60	Moderate	Coral shelf - concrete cover on existing well plus pump.
NIMOA CATHOLIC MISSION (20)	300	(a) Well	3	$100 plus	Moderate	Sandy shelf - beside present well.
		(b) Rainwater Catchment	-	$100 labour	Moderate	'Visqueen' roof on existing concrete tank.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - MISSIONS (Contd)

VILLAGE	POPULATION	TYPE OF SCHEME	NO. OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
OIABI METHODIST MISSION	280	Well	2	$80 plus labour	Moderate	Coral reef - beside teacher's houses.
OTAWATAU CATHOLIC MISSION (LILUTA)	100	Well	2	$80 plus labour	Moderate	Coral reef - west side of playground.
SIDEIA CATHOLIC MISSION (83)	750	(a) Gravity	-	$400 plus	Moderate	Rebuilding dam and replacement of existing pipe.
		(b) Well	2	$50 lab.	Moderate	Sandy shelf - behind boat shed.
		(c) Rainwater Catchment	-	$1100	Moderate	2-30,000 gal tanks from new church.
TARAKWARURU ANGLICAN MISSION (77)	150	Well	5	$100 plus labour	Moderate	Coral reef - beside playing field.
USUIA HANSENIDE COLONY (35)	200	(a) Well	5	$90 plus	High	In valley south of hospital - western catchment.
		(b) Well	5	$90 labour	High	In valley south of hospital - eastern catchment.
WAILAGI METHODIST MISSION (72)	250	Well	5	$100 plus labour	High	Coral reef - beside hospital.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - DUAU COUNCIL AREA

VILLAGE	POPULATION	TYPE OF SCHEME	NO OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
BADELAI - COUNCIL H.Q. (28)	20 res. 200 occ.	Well	5	$140	Moderate	Sand bar - on land side of Chambers.
BUNAMA (32)	400 in hamlets	Well	3	$100	Low	Sandy coastal shelf - beside rest house.
GULEGULEU (29) School	100	Gravity	-	$ 90	Moderate	Dam and pipeline from creek.
ISUMIAMIAU - SEWA BAY (33)	200 in hamlets	Well	3	$100	Low	Sandy shelf - in hamlet SW of rest house.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - DOBU COUNCIL AREA

VILLAGE	POPULATION	TYPE OF SCHEME	NO OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
BWAKERA SCHOOL (34)	160	Gravity	-	$800	High	Dam and pipe line from creek.
BWAOIA (38)	20 res.	Well	3	$100	Low	Pumice and sand shelf - beside Women's Club.
DILIA-WAWIWA (47)	50	Well	4	$100	Moderate	Jointed volcanics - in village.
EGADOI-DOBU (41)	50	-	-	-	-	No economic scheme.
EPEPOIA- Council H.Q. (37)	20 res. 200 occ.	Well	2	$100	High	Coral sand shelf - beside Chambers.
ETANA-SAMAROA (46)	160 in hamlets	Well	3	$100	Moderate	Coral sand and reef - at cross-roads between hamlets
GAMORLAINE-DOBU (40)	200 in hamlets	Well	3	$100	High	Pumice - coastal shelf behind village.
GUMANA-URASI (49)	60	Gravity	-	$750	Moderate	Dam and pipeline from creek
NABWAGETA-TOBOA (48)	80	Well	4	$100	Moderate	Jointed volcanics - beside present waterhole
NEUMARA (42)	20 res. 50 occ.	Well	3	$100	Moderate	Pumice and sand bar - behind village.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - DOBU COUNCIL AREA (contd)

VILLAGE	POPULATION	TYPE OF SCHEME	NO OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
NUMANUMA (43)	250	Well	4	$120	High	Coastal sandy plain - in village beside aid post.
PAPAOI (45)	50 res. 200 occ.	Well	4	$100	Moderate	Pumice and sand shelf - beside rest house.
SAWA-EDI (44)	300	Well	5	$140	High	Pumice shelf - behind village.
SEUALENA-DOBU (39)	250 in hamlets	Well	2	$100	Moderate	Pumice and sand bar - behind rest house.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - WEST FERGUSSON COUNCIL AREA

VILLAGE	POPULATION	TYPE OF SCHEME	NO OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
AILULUAI (62)	500 in hamlets	Nil	-	-	-	Water supply from river adequate.
DIDIAU (69)	100 in hamlets	Well	4	$100	Low	Coastal plain - beside rest house.
FAIAIANA (61)	400 in hamlets	Nil	-	-	-	Water supply from river adequate.
IAMALELE No. 1 (59)	300 in hamlets	Well	4	$100	Moderate	Sandy plain - beside Aid Post.
IBWANANIU (63)	300 in hamlets	Improvement	-	$ 35	Low	Improvement and protection of existing spring.
KALOKALO (70)	250 in hamlets	Well	4	$100	Low	Coastal plain - at crossroads between hamlets.
PATANITANI Council H.Q. (58)	750 in hamlets	Well	3	$100	Moderate	Coral reef - beside Council Chambers.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - GOODENOUGH COUNCIL AREA

VILLAGE	POPULATION	TYPE OF SCHEME	NO OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
ABOLO (75)	400 in 11 hamlets	(a) Improvement	-	$ 20	Moderate	Cleaning and protection of existing spring.
		(b) Well	3	$ 100	Moderate	On coastal shelf - behind village .
BELEBELE (68)	250	Well	4	$100	Moderate	Coastal plain - beside village.
FAIAVA (71)	150 in hamlets	Well	3	$100	Moderate	Sandy plain - in village.
IDAKAMANAI (66)	150	Well	4	$100	High	Beside creek - bottom of hill from village.
MORATAU (76)	400 in hamlets	Well	3	$100	Moderate	Gravelly coastal plain - in village.
VIVIGANI (67)	100	Well	4	$100	Moderate	Coastal plain - beside village.
WAGIFA (73) Island	300 in hamlets	(a) Well	4	$100	High	On northern margin of fresh water swamp.
		(b) Well	4	$100	High	At eastern end of swamp near outlet.
LOWER WATALUMA (65)	120	Well	5	$120	High	Coastal plain - in village.
WIFALA-BWAIDOGA (74)	150 in hamlets	Well	3	$100	High	Coral shelf - behind rest house.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - SUAU COUNCIL AREA

VILLAGE	POPULATION	TYPE OF SCHEME	NO OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
GADAISU (84)	100	Well	3	$100	High	Fine sand - 120 yds north of village.
ILOILO (90)	200 in hamlets	Well	4	$100	High	Sand and slope wash - in village.
MODEWA (89)	200	Well	4	$100	High	Sand bar - in village.
MONINI-ISOISU (87)	250 in hamlets	Well	4	$100	Moderate	Coral sand - in village.
PANOPANO-BONABONA (85)	120 in hamlets	Well	3	$100	Low	Sand bar - 100 yds east of village.
RUMULEI-SUAU Council H.Q. (83)	20 and 240 in ISUDAU	Well	3	$100	Moderate	Broken lava - 100 yds east of Chambers.
SUAU Island (88)	300 in hamlets	Well	3	$100	High	Broken volcanic rock - 100 yds behind Church.
TABOINA-ALOALO (86)	240 in hamlets	Well	3	$100	High	Sand bar - in village.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - BWANABWANA COUNCIL AREA

VILLAGE	POPULATION	TYPE OF SCHEME	NO OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
AMANELIAN-WARI (21)	450	(a) Well	3	$120	Moderate	Sandy shelf - behind jetty.
		(b) Well	3	$120	Moderate	Sandy shelf - western end of village.
KITAI (22)	70	Well	2	$100	Moderate	Coral sand bar - in village.
KOIAGAUGAU-DAWSON (27)	60	Well	3	$120	Moderate	Coral sand shelf - behind school.
KWARAIWA-WATTS (25)	200 in hamlets	(a) Well	3	$120	Moderate	Sandy shelf - southern side of ridge.
		(b) Well	4	$130	Moderate	Sandy shelf - northern side of ridge.
NARUARUARI-SKELETON (24)	70	Well	3	$120	Moderate	Coral sand bar - behind church in village.
TEWATEWA-BUMMOCK (26)	50	Well	3	$120	Moderate	Sandy shelf - in village.
TUBETUBE-SLADE (23)	100	Well	2	$100	Moderate	Sand and broken rock - beside present well.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - WOODLARK AREA

VILLAGE	POPULATION	TYPE OF SCHEME	NO OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
BODIBOD-LAUGHLINS (53)	150 in hamlets	Well	5	$100	High	Sand bar - in village.
EGUM (51)	70	Well	3	$100	Moderate	Jointed volcanics - beside existing spring.
GAWA (55)	400 in hamlets	(a) Well	2	$100	High	Coral reef - beside Aid Post.
		(b) Well	2	$100	High	Coral reef - near fishing village.
IWA (56)	450 in hamlets	Well	2	$100	High	Coral shelf - at foot of cliff below village.
KWAIWATTA (57)	70	Well	2	$100	Moderate	Coral shelf - at foot of hill below village.
NESIKWABU-ALCESTER (54)	70	Well	2	$100	High	Coral reef - in village.
YANABA (50)	60	Well	4	$100	High	Sand bar - in village.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - MILNE BAY SUB-DISTRICT

VILLAGE	POPULATION	TYPE OF SCHEME	NO OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
BUBULETA (91)	100 in hamlets	Well	2	$80	Moderate	On gravel bar - in village.
GABOGABUNE (92)	100	Well	3	$100	Moderate	On silty plain - in village.
GARUANI- (80) MARAMATAMA COUNCIL H.Q.	20 res. 200 occ.	Well	5	$120	Low	On gravel bar - in front of Chambers.
IANIANINI (93)	100	Well	3	$100	High	In creek bed - west of village.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - KILIVILA COUNCIL AREA

VILLAGE	POPULATION	TYPE OF SCHEME	NO OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
BOITALU	150	Well	2	$80	Moderate	Coral reef - in village.
BUDUAILAKA	70	Well	2	$80	Moderate	Coral reef - in village.
BULAKWA-KAILEUNA	60	Well	2	$80	High	Sand bar - at northern end of village.
GILIBWA	40	Well	2	$80	High	Sand bar - in village.
GIWA-KAILEUNA	60	Well	2	$80	Moderate	Coral reef - behind village.
GUMILABABA	300	Well	2	$80	Moderate	Coral reef - in village.
IALAKA	250	Well	2	$80	Moderate	Coral reef - in village.
IALIMA No 1	60	Well	2	$80	Low	Coral reef - in village.
IALIMA No 2	50	Well	2	$80	Low	Coral reef - in village.
IDEALEKA	40	Bore	-	$400	Low	High on coral reef - in village.
IUWADA	80	Bore	-	$400	High	High on coral reef - in village.
KADUWAGA-KAILEUNA	350	Well	2	$80	High	Coral reef - behind village.
KAIBOLA	100	Bore	-	$400	High	High on coral reef - in village.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - KILIVILA COUNCIL AREA (contd)

VILLAGE	POPULATION	TYPE OF SCHEME	NO OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
KAIBOLA SCHOOL	60	Well	3	$ 100	Moderate	Sand bar - 50 yards south of school.
KAIMWAMWALA and KUDAKABILYA	110 80	Well	2	$ 80	Moderate	Coral reef - 150 yds KAIMWAMWALA - 50 yds KUDAKABILYA
KAISIGA-KAILEUNA	100	Well	2	$ 80	High	Sand bar - at southern end of village.
KAITUVI	90	Well	2	$ 80	Moderate	Coral reef - in village.
KAPWANI	80	Well	3	$100	High	Sand bar - 300 yds north of village.
KAMWAGE-KITAVA	about 1,000	Rainwater catchment	-	$200	High	(Initially 2,000 gal tank per village. (Later consideration should be given for (30,000 gallon concrete tanks between two (villages.
WAPIAYA-KITAVA		"	-	$200	"	
LALELA No 1-KITAVA		"	-	$200	"	
LALELA No 2-KITAVA		"	-	$200	"	
OKOBULULA No 1-KITAVA		"	-	$200	"	
OKOBULULA No 2-KITAVA		"	-	$200	"	
KOMA-KAILEUNA	240	Well	2	$ 80	Low	Coral reef - in village.
KUIAVA and MUNUWATA	150 130	Well Well	2 2	$ 80 $ 80	High High	Coral reef - behind village. Coral reef - behind village.
LABAIA	80	Bore	-	$400	High	High on coral reef - in village.
LILUTA and WASAPOLA	150 90	Well	2	$ 80	Moderate	Coral reef - In Liluta - 50 yds WASAPOLA

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - KILIVILA COUNCIL AREA (contd)

VILLAGE	POPULATION	TYPE OF SCHEME	NO OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
LUYA	200	Well	2	$80	Moderate	Coral reef - in village.
MOLIGILAGI	90	Bore	-	$400	High	Too high on coral reef for well. In village.
MULOSAIDA and KAVATARIA	460 480	Well	2	$80	High	Coral reef - behind KAVATARIA. Other wells will be necessary.
MUTAWA	230	Well	2	$80	High	Coral reef - south side of village.
MWATAWA	240	Bore	-	$400	Moderate	High on coral reef - in village.
OIVEYOVA	240	Well	2	$80	High	Coral reef - 70 yds north of village.
OKAIBOMA	250	Well	2	$80	High	Coral reef - in village.
OKINAI-VAKUTA Is.	70	Well	2	$80	High	Sand bar - in village.
OKUPUKOPU	230	Well	2	$80	Moderate	Coral reef - in village.
OSAPOLA	80	Well	2	$80	Moderate	Coral reef - in village.
TAUWEMA-KAILEUNA	160	Well	2	$80	High	Coral reef - 30 yds behind centre of village.
TEYAUA	180	Well	2	$80	High	Coral reef - 100 yds North of village.

SUMMARY OF SURVEY OF VILLAGE WATER SUPPLIES - KILIVILA COUNCIL AREA (contd)

VILLAGE	POPULATION	TYPE OF SCHEME	NO OF PIPES	ESTIMATED COST	PRIORITY	REMARKS
TUBOADA	200	Well	2	$80	Moderate	Coral reef - in village.
TUKWAUKWA	600	(a) Well	2	$80	High	Coral reef - east side of village.
		(b) Well	2	$80	High	Coral reef - west side of village.
VAKUTA - Vakuta Is.	360	(a) Improvement	-	$200	High	Sealing of existing concrete tanks.
		(b) Well	2	$80	Moderate	Coral reef - in village.
WABUTAMA	180	Well	2	$80	Moderate	Coral reef - in village.

APPENDIX IV

SMALL DAM CONSTRUCTION

DEPARTMENT OF PUBLIC WORKS

KONEDOBU - PAPUA

METHOD OF CONSTRUCTION

SMALL DAMS

By "small water dam" it is meant dams not higher than 3 ft. 6 ins. and not wider than 10 ft. up top. These dams can be built either of rocks and concrete or of concrete alone. A concrete dam is dearer but will hold the water better.

Dams up to 5 ft. high and 15 ft. wide up top should have an arc mesh sheet extending along the whole face of the dam. Other details as shown below. DO NOT attempt any larger dams without engineering assistance.

CONCRETE

A. Mortar used for filling between rocks should be made of:-

2 parts by volume of clean sand

with

1 part by volume of fresh cement.

B. Concrete used for dams should be made of:-

3 parts by volume crushed rock 3/4 ins. maximum size.
2 parts by volume clean sand.
1 part by volume cement.

All concrete should be rammed well using steel rods about 1/4 ins. diameter. Do not use excess of water as the water will evaporate leaving porous pockets in the concrete.

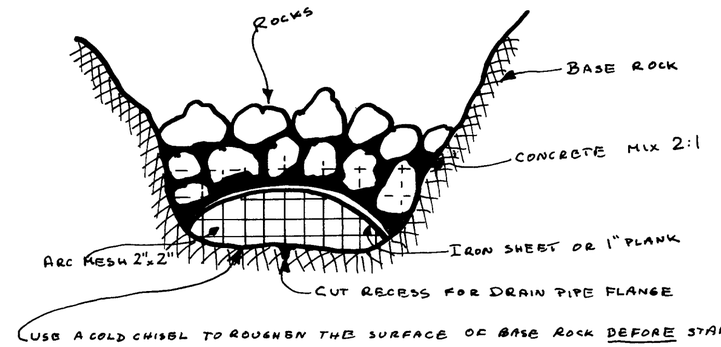
STRAINER

This is not shown on the sketches. They are only needed when the water is to be piped down from the dam. A constant flow dam, where water not used is run down to waste does not require copper mesh strainers. A dam for piped water projects MUST be fitted with a strainer.

The sketches which follow, show step by step construction methods.

SMALL DAMS

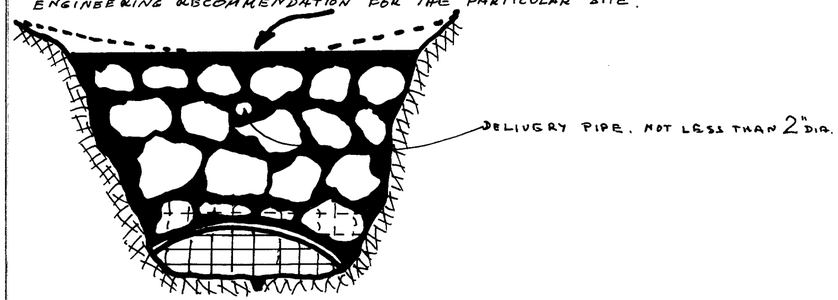
START BUILDING THE DAM. LET THE WATER GO THROUGH AND UNDER THE "BRIDGE" MADE OF CORRUGATED IRON OR 1" PLANK.

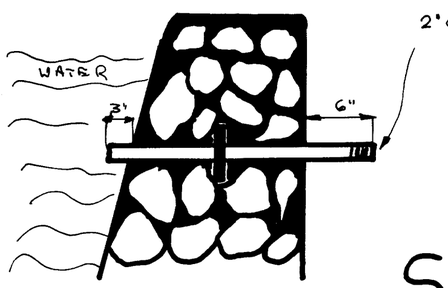


USE A COLD CHISEL TO ROUGHEN THE SURFACE OF BASE ROCK BEFORE STARTING ON THE MASONARY WORK

STAGE 1

FINISH THE TOP OF THE DAM EITHER STRAIGHT OR CURVED, DEPENDING ON THE ENGINEERING RECOMMENDATION FOR THE PARTICULAR SITE.





STAGE 2

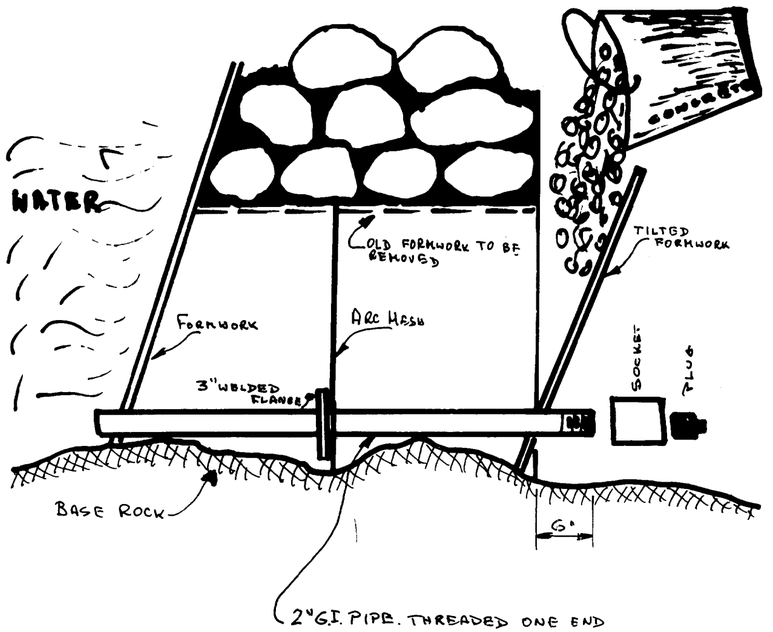
FIT THE DRAIN PIPE AT THE VERY BOTTOM OF THE DAM UNDER THE ARC MESH. THE FLANGE TO FIT IN THE RECESS CUT OUT WITH A COLD CHISEL IN THE BASE ROCK

BOX UP THE BOTTOM PART BY PLACING A WATER TIGHT BOARD UP-STREAM WITH A HOLE FITTING SNAGELY ROUND THE DRAIN PIPE. THE BOARD DOWN-STREAM SHOULD BE PITTED AT AN ANGLE ALLOWING THUS THE BOX TO BE FILLED WITH CONCRETE FROM THE TOP.

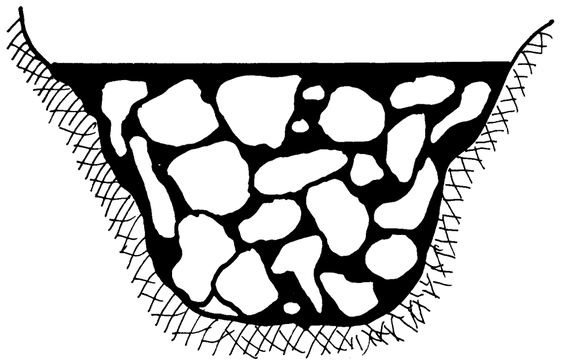
THE DRAIN PIPE IS LEFT OPEN TO ALLOW FLOW OF WATER FROM BEHIND THE DAM.

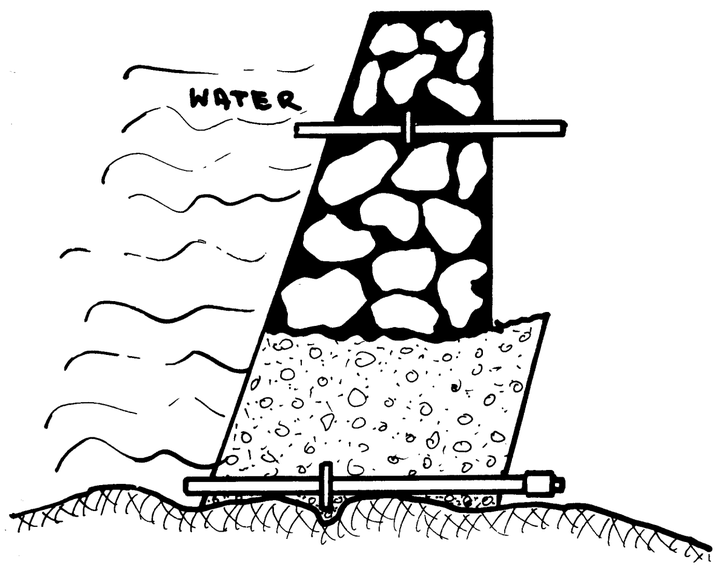
THE SUCCESS OF THE OPERATION DEPENDS ON:-

1. CONCRETE BEING NOT TOO SLOPPY
2. FILLING THE BOX SLOWLY, RAMMING THE CONCRETE ALL THE TIME WITH A IRON ROD ABOUT 3/8" DIA. IF NOT RAMMED PROPERLY AIR POCKETS WILL BE LEFT BEHIND AND THE DAM WILL LEAK.



STAGE 3.



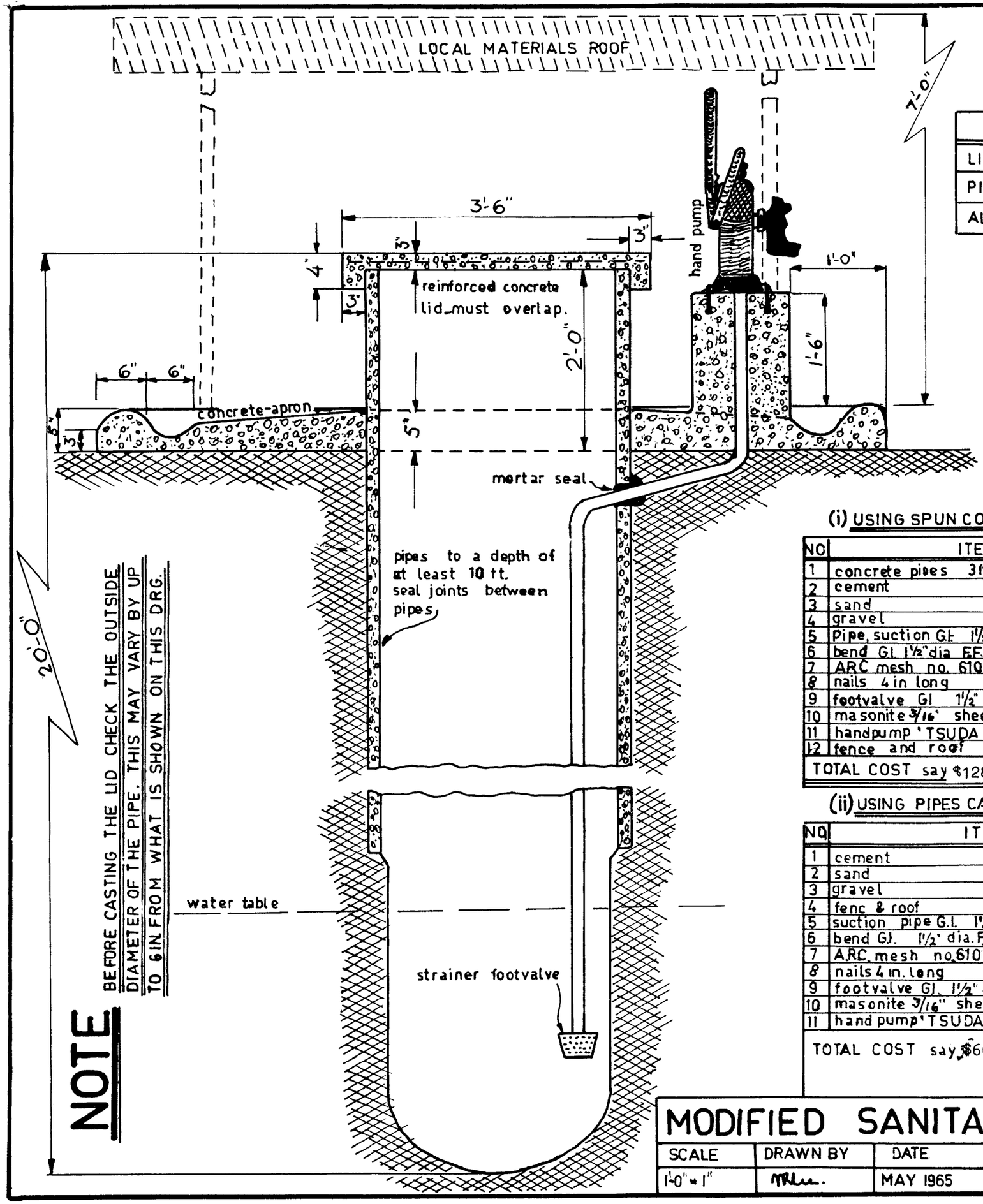


CROSSECTIONAL VIEW
FINISHED DAM

STAGE 4

APPENDIX V

MODIFIED SANITARY SHALLOW WELL



CONCRETE MIXES

ITEM	MIX agr. : sand : cem.	REMARKS
LID	3 : 2 : 1	standard—use 3/4" agr.
PIPES	3 : 0 : 1	porous — use 3/8 agr.
ALL OTHERS	4 : 2 : 1	standard—use 3/4" agr.

MATERIALS

(i) USING SPUN CONCRETE PIPES

NO	ITEM	UNIT	Q-TY	PRICE	TOTAL $
1	concrete pipes 3ft. dia 4ft. long wt. 240 lbs/l. ft.	l.ft.	12	$12.83	82.00
2	cement	bag	6	1.55	9.35
3	sand	cu.yd	3/4	Local	Price
4	gravel	cuyd	1 1/4	"	"
5	Pipe, suction G.I. 1½" dia.	ft.	23	0.30	6.90
6	bend G.I. 1½" dia F.F. 135 degrees	1	2	0.90	1.80
7	ARC mesh no. 610	sq.yd.	15	0.25	0.40
8	nails 4 in long	lb.	2	0.15	0.30
9	footvalve GI 1½" dia with strainer	1	1	1.10	1.10
10	masonite 3/16" sheet 4ft.×12ft.	sq.ft.	48	0.9	4.00
11	handpump 'TSUDA SHIKI" Japan.	1	1	20.50	20.50
12	fence and roof			Local	Price

TOTAL COST say $128.00 local materials + labour + freight ..... SAY, $160.00

(ii) USING PIPES CAST ON SITE

NO	ITEM	UNIT	Q-TY	PRICE	TOTAL £
1	cement	bag	14	1.55	21.70
2	sand	cu.yd.	1.5	Local	Price
3	gravel	" "	2.5	"	"
4	fenc & roof	—	—	"	"
5	suction pipe G.I. 1½" dia	ft	23	0.30	6.90
6	bend G.I. 1½" dia. F & F.	1	2	0.90	1.80
7	ARC mesh no. 610	sq.yd.	15	0.25	3.70
8	nails 4 in. long	lb.	2	0.15	0.30
9	footvalve GI. 1½" dia. with strainer	1	1	1.10	1.10
10	masonite 3/16" sheet 4ft.×12 ft.	sq.ft.	48	0.9	4.00
11	hand pump 'TSUDA SHIKI" Japan.	1	1	20.50	20.50

TOTAL COST say $60.00 + local materials + labour + freight.
say, $90.00.

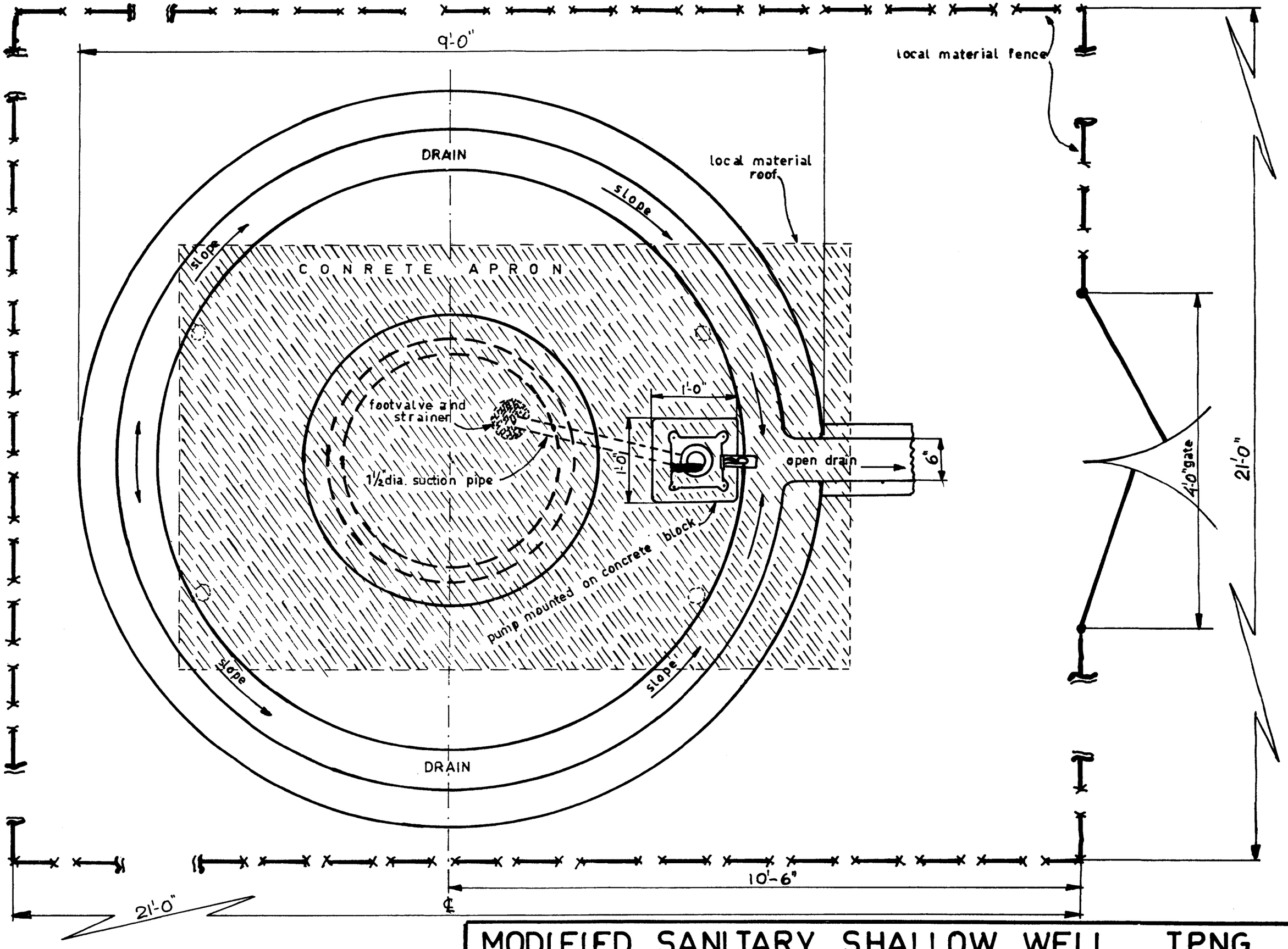
NOTE

BEFORE CASTING THE LID CHECK THE OUTSIDE DIAMETER OF THE PIPE. THIS MAY VARY BY UP TO 6 IN FROM WHAT IS SHOWN ON THIS DRG.

MODIFIED SANITARY SHALLOW WELL. T.P.N.G.

SCALE	DRAWN BY	DATE
1'-0" = 1"	NRLee.	MAY 1965

SHEET 1 OF 2



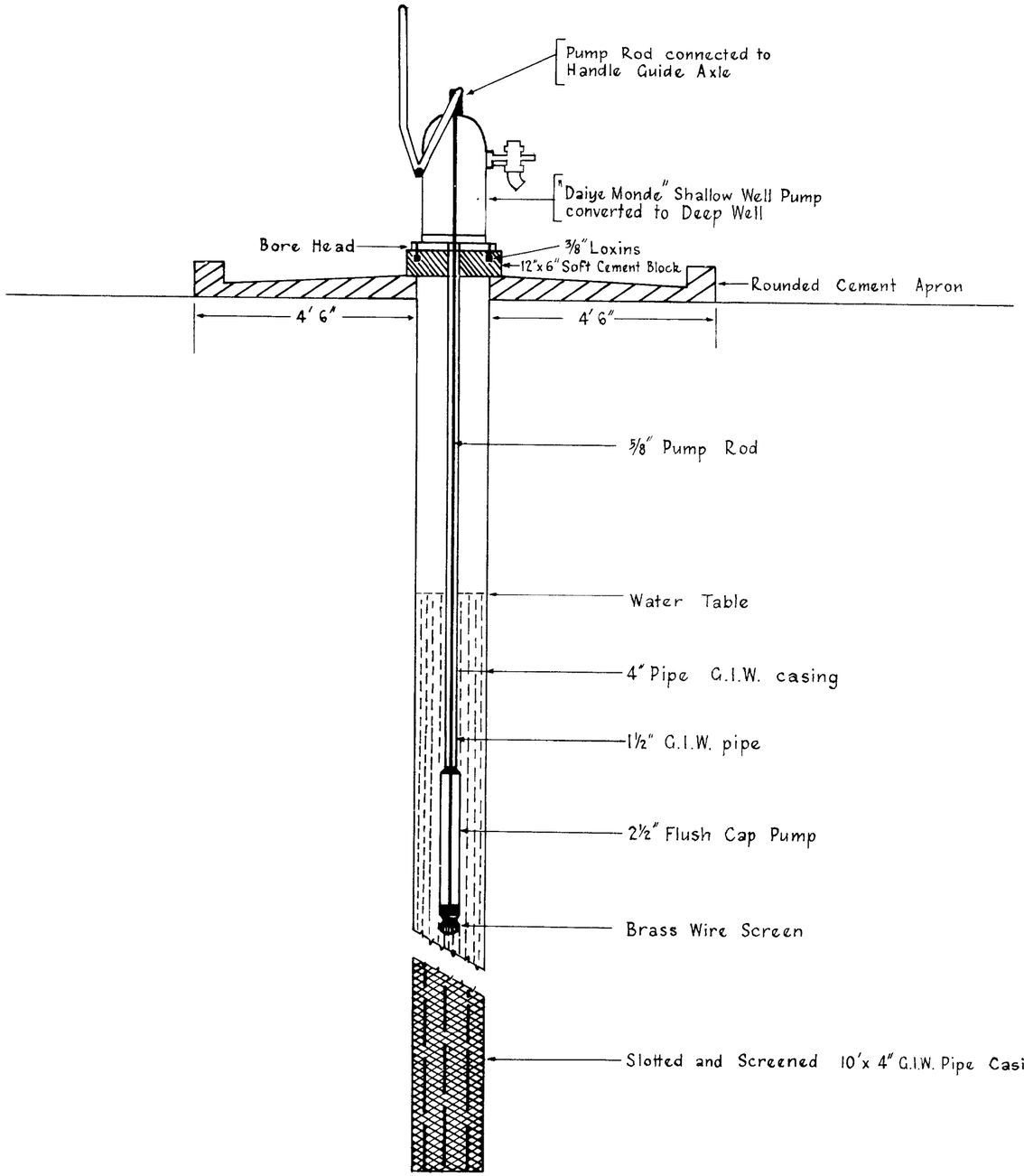
MODIFIED SANITARY SHALLOW WELL T.P.N.G.

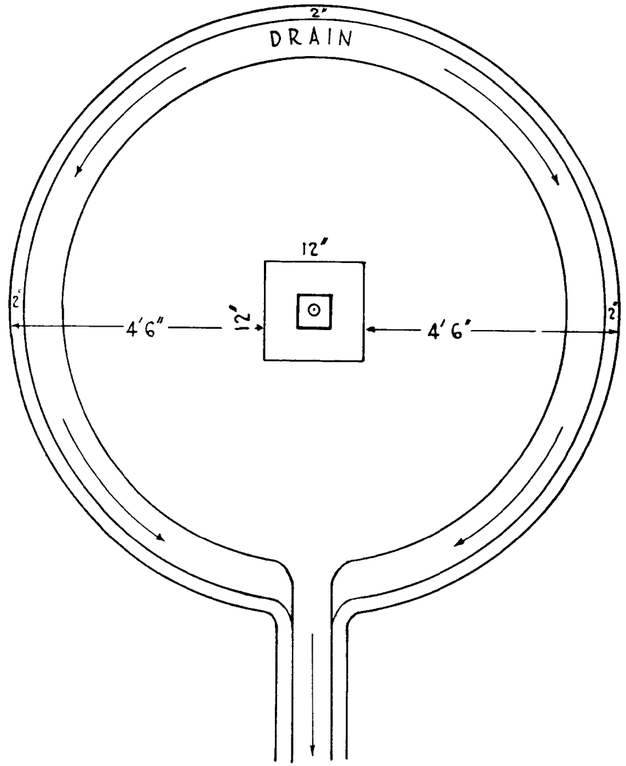
DRAWN BY	DATE	SCALE
MRLee.	MAY 1965	1'-0" = 1"

SHEET 2 OF 2

APPENDIX VI

MODIFIED DEEP WELL BORE





MATERIALS

NO	ITEM
1	cement
2	sand
3	gravel
4	masonite
5	hand pump "Daiye Monde"

MODIFIED DEEP WELL BORE T.P.N.G.

VILLAGE WATER SUPPLIES

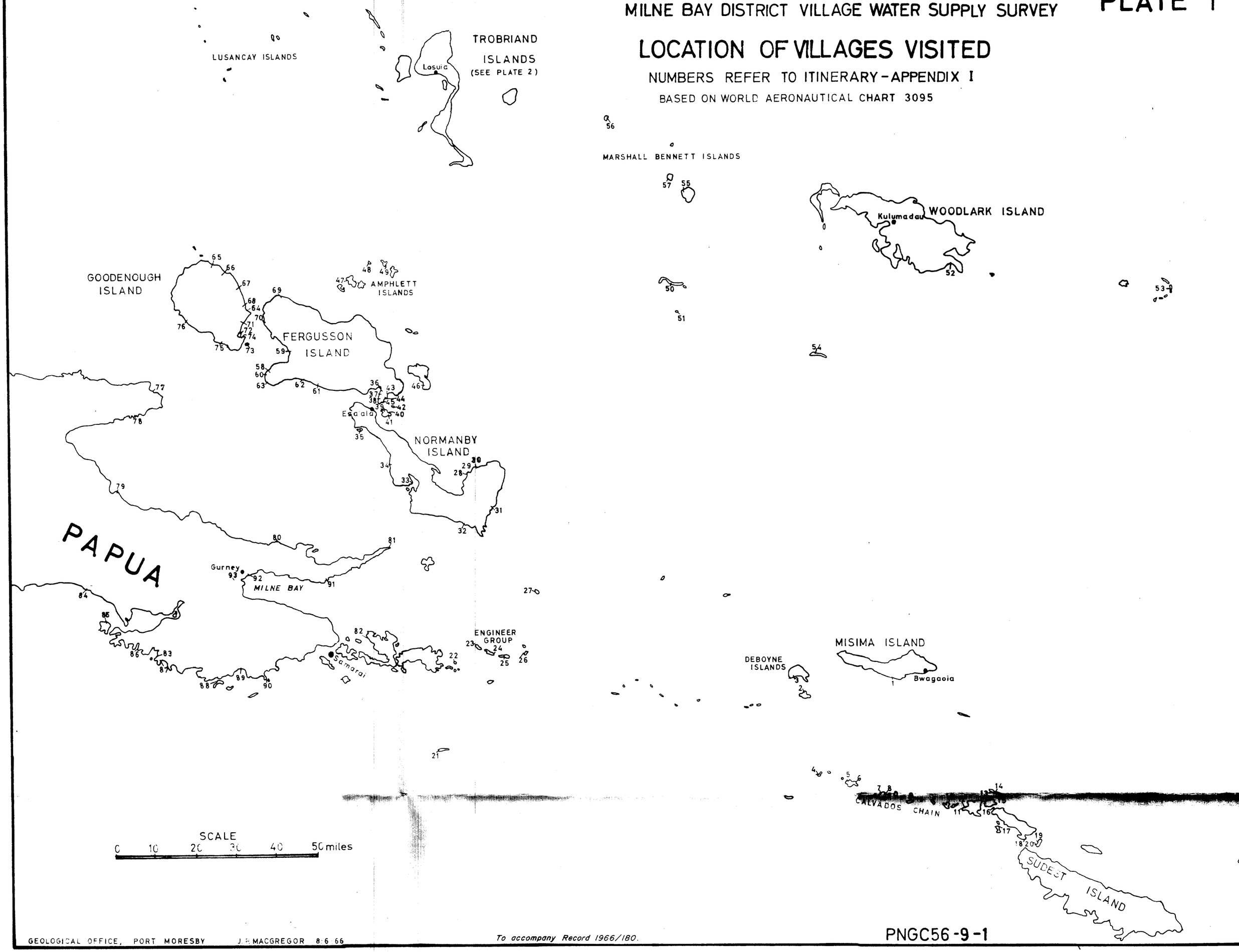
PLATE 1

MILNE BAY DISTRICT VILLAGE WATER SUPPLY SURVEY

LOCATION OF VILLAGES VISITED

NUMBERS REFER TO ITINERARY - APPENDIX I

BASED ON WORLD AERONAUTICAL CHART 3095



GEOLOGICAL OFFICE, PORT MORESBY J.F.MACGREGOR 8:6:66

To accompany Record 1966/180.

PNGC56-9-1


PLATE 2
ISLANDS
KADAI Is
TUMA Is.
BOIMWAGA Is.
BURIWADA Is.
LUSANCAY CENSUS DIVISION
NAKWABA Is.
KAILEUNA Is.
LABI Is.
MUNUATA Is.
KUIAUA Is.
IOANA Is.
KIBU Is.
NUBIAM Is.
KILIWILA CENSUS DIVISION
SIA Is.
KAIBOLA SCHOOL
KAPWANI
BOMARU PT
LIGHT HOUSE
KIRIWINA Is.
EAST SHORE
KITAVA CENSUS DIVISION
BOLI PT
MAMAMADA PT
UKUSOI PT
LOSUIA
BOMAPOU Is
KAIBOMA CENSUS DIVISION
WAGWAMA BAY
OKOBULULA
WALUMA
TALAIGASI
WAPAIYA
URATU Is.
CAMEPOON'S HOUSE
SCHOOL
LALELA
KUMWAGEA
KITAWA Is.
SINAKETA
KUMILABWAGA
MUWA Is.
KABUNAKAU PT
IAGA Is.
NANAULI Is.
GILIBWA
KASLAMAKA PASSAGE
SOUTH KIRIWINA CENSUS DIVISION
VAKUTA Is.
VAKUTA
KAULAKA HAMLET
To accompany Record 1966/180.
P.W.D. TERRITORY OF PAPUA AND NEW GUINEA
LOSUIA S/D
SCALE 1 : 120,000