This Mission is in the happy position of having an ample and assured water supply convenient to the mission. However, due to rapid expansion of the mission over a period of years, the utilization of this water has gradually deteriorated until there is insufficient water conveniently available for use when and where required throughout the mission.

This report, together with recommendations, will be divided into three sections, namely Domestic Reticulation, Pumping Arrangements (which will include a new causeway and flood gates) and Irrigation Requirements.

Each of these sections may be considered separately, but naturally enough they are all inter-related and to a certain extent dependent on one another.

**DOMESTIC RETICULATION.**

Basically water will be pumped from the Angurugu River by an independent pump and engine, through an independent rising main, which will form part of the reticulation, to an overhead storage tank which will supply head and storage when the pump is not operating.

While the pump is filling the overhead storage, it will also supply water to all parts of the reticulation i.e., pump through the reticulation. The pump and engine have been designed to fill the 25,000 gallon overhead tank in 8 hours. Thus pumping should only be required every second or third day, initially at least. Fire hydrants have only been shown on the 2" diameter galvanized pipe rising main. Elsewhere standpipes will have to suffice.

An indication of the size of pump required for the domestic supply is as follows:

- "Ajax" Centrifugal CMH (2" suction) 2.28 H.P. @ 2535 r.p.m.
- "Kelly & Lewis" Centrifugal Hi (2" suction) 3.6 H.P. @ 1685 r.p.m.
- "Harland Monoglide" Centrifugal 8801½ (2" suction) 3.1 H.P. @ 1880 r.p.m.
2.

These are types only and are not quoted as recommendations.

The variations in horsepower required are due to different speeds and that each type is only taken from a table and capacities vary slightly.

A suitable engine to drive (by means of a belt and varying pulley sizes to suit the speeds) any or the above type of pumps would be a Southern Cross Mark YB(3 H.P. at 900 r.p.m., 4 H.P. at 1200 r.p.m.) Diesel Engine.

The reason for quoting an engine, instead of an electric motor, will become apparent further on in this report.

The approximate total cost of the complete reticulation system, excluding services pipes to dwellings and house internal pipework, is as follows:

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump</td>
<td>£30</td>
</tr>
<tr>
<td>Engine</td>
<td>£100</td>
</tr>
<tr>
<td>Raising Main</td>
<td>£1150</td>
</tr>
<tr>
<td>Tank Stand</td>
<td>£850</td>
</tr>
<tr>
<td>Tank</td>
<td>£450</td>
</tr>
<tr>
<td>Reticulation</td>
<td>£300</td>
</tr>
<tr>
<td>Fittings(Valves, Hydrants etc.)</td>
<td>£100</td>
</tr>
<tr>
<td>Freight</td>
<td>£220</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>£1320</strong></td>
</tr>
</tbody>
</table>

This allows for no labour for installation, and will vary in accordance with actual freight charges.

All pipes should be laid with a minimum of 1'-6" of cover, and all valves complete with valve boxes to protect the valve stems.

**FLOODGATES:**

These floodgates combine a concrete roadbridge.

Various types of wall designs were considered, namely concrete gravity, beams and slab and multiple arch, but none were economically possible. Any of these type walls would be excessively heavy to contain a flood with safety. In other
3.

words it is not economically possible to allow for a major flood.

As floods do occur and at rather frequent intervals, they must be allowed for. Thus floodgates are proposed.

The structure will be essentially a concrete road bridge 10'-0" between kerbs supported on concrete piers at 20'0" o.w. The piers will be supported on concrete footings set directly onto rock. Abutments and wing walls will be essentially in accordance with standard bridge design and will be of the concrete gravity type. If a powerhouse is included (see later for comments) it could be placed in the fourth 20'-0" bay between the abutment and bridge support from the left hand bank (Mission side of the river). Along the upstream face of the piers, at right angles, to the river, will be a recessed concrete sill for use in wedging the floodgates in the closed position. The floodgates themselves may be made of local timber and pivoted so that they will open with say 1'-0" head of water above the top of the gates. The actual pivot point will depend naturally enough on the type of timber used and if the gate is to be steel framed. The gate pivots will be set into metal pivots in the concrete piers. The action of the gates will be such that as the depth of flooding increases, so does the angle of inclination of the gate, so that in a maximum flood, the gate may be horizontal before returning to its vertical position. After the flood has passed, the gates will return to the vertical position and wedges, operated by means of a handle and screw thread, may be closed at the sill thus forcing the gate against its seat. All that is necessary to free the gates in the event of a "flash" flood is for these wedges to be released. Thus a floodgate will pivot out of the way of a flood and may be locked in position to provide a relatively water tight wall retaining water to the depth required for pumping and hydro-electric power. Sixteen feet has been selected as this maximum depth.

The approximate layout of this floodgate, road bridge and piers is shown in Drawing No. W163.
ROAD BRIDGE.

The road bridge will be designed in concrete to be integral with the piers. The bridge itself will be of multiple span design with inverted beams, i.e., the side beams will be placed above the road level and will serve as kerbs also. As stated previously the bridge will be 10'0" between kerbs (at pavement level) and approximately 12'0" overall. Scuppers will be provided in the kerbs and the design will be based on actual expected loadings (i.e., timber trailers).

Some approach work will be necessary but this has been kept to a minimum by adopting 16'-0" as the depth of water to be retained by the floodgates in their closed position.

PUMPING INSTALLATION.

The domestic pump and engine may be located in any convenient position, bearing in mind that the shortest suction line is the one that gives the least trouble.

It is recommended that the new pump and engine be located approximately in the same position as the existing engine. It is expected that the water level should never (except perhaps in an extreme and lengthy drought) fall below the top of the floodgates, thus the suction lift will be negligible. It is thought that the short suction line will be more advantageous than the risk of flood inundation and damage will be disadvantageous.

The approximate total cost of the road bridge, piers and floodgates is as follows:

Concrete: 270 cubic yards required for footings, sills, wing walls, abutments, piers and roadway.
- Cement - 1540 bags at £2 each £3080
- Steel - 8 tons at £100 per ton £800
- Sand - 135 cyds. labour and aggregate 270 cyds. fuel only etc. £100

Flood Gates: Assuming the use of local timber as much as possible, steel framed £8,000 £9380

Say £6,000
This price does not include any concrete for the power house, or any power house equipment. No estimate of these items is contemplated at this stage.

HYDRO-ELECTRIC POWER

Power Available

Quantity of water available may be assumed to be equal to the flow in August, 1958. This was approximately calculated as 20 cubic feet per second or 10 million gallons per day.

It may also be assumed that the 20 cfs will always be available at 16 feet head, the height to the top of the flood gates.

Therefore minimum power available

\[ = \frac{20 \times 62.5 \times 16}{550} = 36.4 \text{ H.P} \]

\[ = 27 \text{ kW} \]

This assumes 100% efficiency which will not be so. It may be assumed that the overall plant efficiency will not exceed 60-70%

Therefore the power output will not exceed

\[ = 27 \times 0.65 = 17.5 \text{ kilo watts} \]

There will be a very large capital expenditure, to produce this small quantity of power and unless it will be sufficient to answer all power requirements at the Mission for some considerable time in the future, I do not feel as though I could recommend this outlay. It may be said that money is being "wasted" each year for fuel, which could be saved if hydro power is available, but without possible power consumption figures, I am unable to carry out an economic appreciation on this aspect.

At this stage no further design and costs will be taken out for the power station until this project becomes firmer.

IRRIGATION REQUIREMENTS

No detail work has been carried out for irrigation pump and engine size, pumping mains and spray lines as there are still many unknowns.

There are several areas which could be put under irrigation immediately. These are definite in area but I have
6.

no idea of the type of proposed crop or crops to be grown. Also there are other areas where irrigation is proposed and definite boundaries will be required for these areas. Also the type of crops to be grown will be required. Until this information is available it will be impossible to detail the ultimate irrigation layout. It will serve no purpose to provide equipment of capacity adequate for the present, but inadequate for future requirements. If some programme for extension is given, various capacity units can be quoted and it will then remain with the Mission to select the unit to meet a certain expansion and their pocket.

The general arrangement for the irrigation system will be as follows:

The pump and engine to be located approximately in the same position as the existing units, capacities to suit.

The feeder main to follow the approximate same line as the existing main to the garden area. Branch mains to each area to suit the general crop requirements.

It is proposed to extend the feeder main into the main garden area in a straight line continuation. This length will naturally depend on how much of the garden area it is expected to open up. Feeder main diameter will naturally depend on the demand to be made upon it, and cannot be calculated at this stage.

The following may be taken as a summary of my recommendations for placing the utilisation of the water supply of Groote Nylandt Mission on a sound footing for a considerable time into the future i.e., to allow for Mission expansion.

1. Existing domestic reticulation to be disconnected.
2. New pump, engine, rising main, overhead tank and stand and reticulation to be in accordance with Drawing No. W162.
3. Internal household reticulation may remain.
4. Existing causeway be closed.
5. New concrete roadbridge and flood gates to be constructed across the Angurugu River adjacent to the
existing pump house.

6. If economically acceptable, and sufficient power available for future Mission requirements, construct hydro-electric power station within the new road bridge.

7. Place cleared areas under spray irrigation. Sufficient area to be irrigated to make the mission self-supporting for green vegetables and possibly for cattle (dairy) fodder.

(G. MASON)
Senior Engineer,
Planning and Investigation,
18 MAY 1959

NOTE: This report to be read in conjunction with that prepared by B. Watts, Hydrographer, Stream Gauging Section; and the following drawings are appended:

W160 - Survey of Angurugu River and Mission.
W161 - Survey of Mission Area
W162 - Mission Details and Proposed Retention.
W163 - Floodgates and Road Bridge.
W164 - Causeway and Tapp Crossing Cross Sections.
NOTES ON GROOTE EYLANDT
TAKEN DURING A VISIT OF H.M.A.S. "SMIT"
AUGUST 1958

C.M.S. GROOTE EYLANDT MISSION

(1) Location
This mission is to be located on the Central Western side of the island, five river miles upstream on the left bank (looking west) of the Angurugu River. Geographical co-ordinates by Mr Surveyor Seton south, Department of National Mapping give values for a station marked No. 1 in the mission area as 13° 56' 54" South, 135° 27' 36" East. The compass declination at this point on 13th August 1958 was 5° 56'. To be added to magnetic bearings to convert to true.

(2) Access
(a) Sea: Most bulk supplies to the Island are received in this way per "The Core", an L.S.T. type craft. The mission itself has a small craft named "Faith" powered by a "Simplex" two cylinder engine, this boat being used mainly in fishing activities around the coast.

It is advisable for vessels with a draught more than 8 feet to anchor some three miles off-shore in the river mouth area. Also the approach should be made from further seaward heading in Masterly, thence proceeding by smaller craft to the shore, for only at high tide can the remaining part of the journey, the tidal stretch of the river, be navigated up to the mission causeway.

It is understood that a team of native fishermen from the mission nightly adjacent to the river mouth area, either on shore or on the boat "Faith". By contacting these folk, any unexpected arrival requiring to get to the mission, can make his presence known.

(b) Air: Fortnightly schedule flights by M.A.A. deliver mail etc. to the island. The airstrip, some ½ mile from the mission, will take aircraft of D.C.3 size.

(c) Road: Internal bush track facilities exist between the mission and the following: Umbakumba Mission at Port Langdon, the old mission on Emerald River, top landing, a war time airstrip and various localities in the immediate vicinity of the mission.

Road travel on the island appears to be possible for most of the year, other than during flood periods.

(d) Wireless: Daily radio schedules are carried out with stations on W.I.D. network.

(3) About the Settlement
The mission was first established on the Emerald River some ten miles to the south of its present site, to where it was moved in 1945.

The native population is about 400, together with a white staff of about 20 (including children).

Available facilities are those of a small Australian community of similar population and environment, excepting that there are no hostelry facilities.
The natives appear, in the main, to be very well adapted to white ways, and activities noticed were: welding, driving, farming, sandblasting, sawing, whilst the children receiving schooling appeared to be quite as advanced as white children of the same age.

Roads within the mission area are generally ten feet wide, formed of consolidated earth and gravel. Roads adjacent to the main settlement are provided with a storm water channel also, together with 10 gallon drum culverts under intersections and with a rock kerb line.

Buildings are constructed from timber (post and weather boarded), the larger ones having verandas and the floor level being elevated some 5'0" above ground level. They have corrugated ("Big Six") asbestos sheet roofs on wooden trusses. The two new school buildings, however, are steel framed with a timber cladding and corrugated G.I. roofing. These too, are elevated above ground level some 5'0". Most of the smaller buildings and native quarters are on ground level, constructed of timber with G.I. Sheets. The church is timber framed and weather boarded with a corrugated asbestos roof; the floor is of sand. Most buildings are painted externally and are unfenced.

Woolly Butt trees have been retained in the mission area being lightly spaced to provide good shade to the buildings.

Most of the staff homes have small garden areas, where shrubbery and vegetables have been introduced. They seem to grow quite well, but this could be due to good husbandry.

The river near the mission flows between laterite formations and the two appear as both banks as outcrops from river alluvium. When these outcrops have not been extensive, the areas have been cleared of the dense bush and used as agricultural plots; otherwise clearing has been restricted to tracks and the way for the occasional water pipe line.

4. Soil

Soil in the agricultural plots is generally of a sandy nature, being levee bank deposits. I gather that it is deficient of some of the trace elements, and that intensive farming soon depletes its productive capacity.

5. The Anamuruk River

The settlement area is situated on the left bank of this river, being on the levee bank of the flood channel and is therefore susceptible to flooding during heavy flood periods; highest flood recorded to date was that which occurred in 1953 when flood waters lapped the boundaries and was 15' above the floor of a room adjacent to the causeway road. This would represent a rise in stage of approximately 40 feet above its dry season level.

The banks of the river in the mission area are quite well formed, average 30 feet in height with regular cross sections between the primary and secondary banks and with a good straight channel. This gives way to levee banks and shallow flood channels, being typical, in formation, of most rivers in the Territory. Some erosion is taking place along the banks, whilst the banks in general are covered with a medium mixed forest with a dense understory of bush.
In the vicinity of the mission, the river is intersected by three laterite outcrops, the downstream one being further built up in the form of a causeway, giving road access to the airstrip and to Umbakumba; whilst the upstream one, known as "top crossing," was used in its natural state as a crossing to a wartime air base. Both would make good sites for small water retention dams or bridge structures, and because of the falls over the outcrops, could be investigated further for a small hydroelectric scheme.

About 1 mile upstream the causeway, at the pump house site, a smaller laterite outcrop extends across the creek. This would also make quite a good site for a weir, also being a stable control for any stream gauging activities.

Between each of the outcrops, the river has very little fall; its banks and bed are sandy.

If stream gauging is to be considered and an automatic water level recorder installed, the most suitable site would be in the river stretch between the pump house outcrop and top crossing, for also in this stretch flood-slope-area studies could be made. Also in this locality, the secondary banks contain the highest flood.

Cross sections have been taken at all three outcrops, with spot levels giving an approximate outline of the extent of the occurrence.

It is reported that the dry season flow in the river any year is very much the same as at present. This is estimated at 20 cft/sec, although in the severe drought of 1952, flow in the main river ceased, but the springs which join the river on the right bank upstream the pump house outcrop, continued and the water supply to the mission was therefore maintained.

A water sample taken upstream the tidal influence at the causeway, gave the following result:

| Chloride (as NaCl) | 30 ppm |
| Hardness (as CaCO₃) | Nil ppm |
| Carbonate (as CaCO₃) | 30 ppm |

This would indicate a good quality water.

Below the causeway, the river is subject to tidal influence. A sample taken here gave similar results to the one above. This would only suggest that the tide was not at that time influencing that position of the river.

(6) Present Water Supply to Mission

The present water supply to the mission is by means of five hydraulic rams supplying a 3000 gallon tank, and is not nearly adequate for a community of this size, not to mention the need for water in any irrigation of the agricultural plots.

A "southern Cross" diesel engine which was in use at the pump house site is now out of commission. Some of the existing main pipe runs appeared to be in quite a reasonable condition, whilst the majority of the service pipes would need replacing.

(7) Purpose of Survey

The primary purpose of this survey was for designing a water supply to the area, both domestic and for irrigation.
The investigations covered a period of three days only. The information is therefore of a very brief nature and the plotted results will only give a general indication of the topography of the mission and approximate layout of the area in general, no attempt having been made to produce figures suitable for preparing an accurate Cadastral Plan of the area. Method used in obtaining the results was as follows:

Mr Surveyor Saton operated a Wild T II theodolite both distance and height being obtained by Tachometry, whilst Mr Watts located the natural occurrences, engineering feature, took notes and sketched along the traverses, accompanied by two natives, Nalgunanara and Gauyabidja, who cleared lines of sight and held the staff in the positions directed.

Distances and levels were obtained by Stadia readings. Each observation taken, however, is accurate. Inaccuracies will occur only in the location of engineering features in relation to the points observed, when plotted i.e. correct orientation of buildings and correct road features and dimensions.

However, this work combined with a chain and compass traverses of the area by Mr Trevor Povey (Agriculturist, Mt the Mission) should enable results and further design works to be completed to a reasonable degree of accuracy.
C.W.S. UMBAKUNGA MISSION

This mission is situated on the North Eastern part of the island at Little Lagoon in Port Longdon and is reached by

(a) Sea
(b) Overland from Groote Eylandt Mission by means of a bush track, which is passable most of the year. Its location at one stage is through a pass which appears to be the only feasible location for any road, the surrounding country being of dense bush with rugged hills and rock outcrops; and
(c) An airstrip is at present under construction near the mission.

The settlement was first started privately by a Mr Grey and was this year taken over by the C.W.S. The total native population is 175 together with a white staff of 11 (including children). The usual activities of a native mission settlement are already well under way and further hopes for more advanced schooling of the older natives is also being considered. Hopes also exist for the development of a saw miling plant and native art. Fishing is actively undertaken to supply local needs.

The settlement is on the littoral and consists of a collection of six buildings of timber and concrete.

Water supply is in the form of a well, and a small creek adjacent further supplements supplies. These sources could be perpetuated by damming if the situation warrants.

Further to the North across Little Lagoon is the site of the war time sea-plane base.

GROOTE EYLANDT GENERALLY

Timber on the island is in general much denser than on the mainland with a dense understorey of bush like growth. Small stands of Cypress Pine occur, whilst Paper Bark occurs in quite good stands also. This varies in quality and some varieties will ruin circular saws after the first few cuts. Other timber includes Bloodwood, Woolly Butts, Stringy Bark etc. All forests appear healthy.

It is hoped to develop these natural resources for local use only, with a saw mill already operating at Groote Eylandt Mission and one under construction at Umbakumba Mission.

Two other rivers besides Arguruga River are known to be spring fed and flow all the year round. These are the Emerald River, where the original mission was constructed whose approximate geographical co-ordinates for the river mouth are 14° 30' South 136° 26' East. Also the Anagula River whose approximate geographical co-ordinates for the river mouth are 14° 14' South 136° 20' East.

It is believed that the water occurrences in these rivers would be from subterranean sources from the mainland. Catchment area and dry season discharges are the bases of this assumption, together with the reported fact that fresh water can be got at a particular location out to sea (location not known by me). This occurs, I am told, in the form of bubbles on the surface of the ocean and was for a time, viewed with some form of mystification by the natives.

The island seems well endowed with animals, providing good supplies of bush Tucker.
Death adders appear to be prevalent on the island, together with other varieties of snakes.

Very few crocodiles are to be found.

Mosquitoes, although present, did not warrant the use of a net. This, of course, could change daily.

The climate of the island is inclined to be milder than on the mainland. Meteorology reports are made to Bureau of Meteorology.

Whilst sailing from Port Langdon to Groote Eylandt Mission, typical views of the coastline were sketched with true bearings to prominent features. These may be of interest to persons making sea journeys in this area in the future.

Just North of Connexion Island and extending shorewards to Groote Eylandt, a distinct jump in the sea bed was recorded on the Echo Sounder. This appeared to cause a hydraulic jump up on the surface of the sea, with a distinct difference of wave action on either side of the jump up.

With the island being a centre of population and Christian teaching, I feel the needs and development of the community could well be served in this Department’s line of studies. If Stream gauging activities be commenced on the Angurugu River and later on the Emerald and Amagula Rivers whilst at Groote Eylandt Mission, studies on Evaporation losses (for use in future irrigation developments) should be undertaken.

B. Water
Hydrographer
August 1958.