

administrative staff employed at Wewak Hospital as described in the following table. In addition to the above regular hospital staff, maintenance personnel include one painter, two carpenters, two plumbers and a few other staff who are stationed at the hospital, despatched from DOW.

2: Project Plans

Health services at Wewak Hospital are provided at each unit as shown on Fig. 2-7, and the operations and administration will not be disrupted by construction. The services are to be continuously provided with current staff and organisation.

The current accommodation space is to be increased only at the special care nursery room. This special care nursery room is to be provided by modification of an existing ward. Therefore, the total floor area is not increased nor is the nursing staff. There are also some modifications planned under the project to add a small-scaled facility. Therefore, no increase in medical staff is required upon completion of the project.

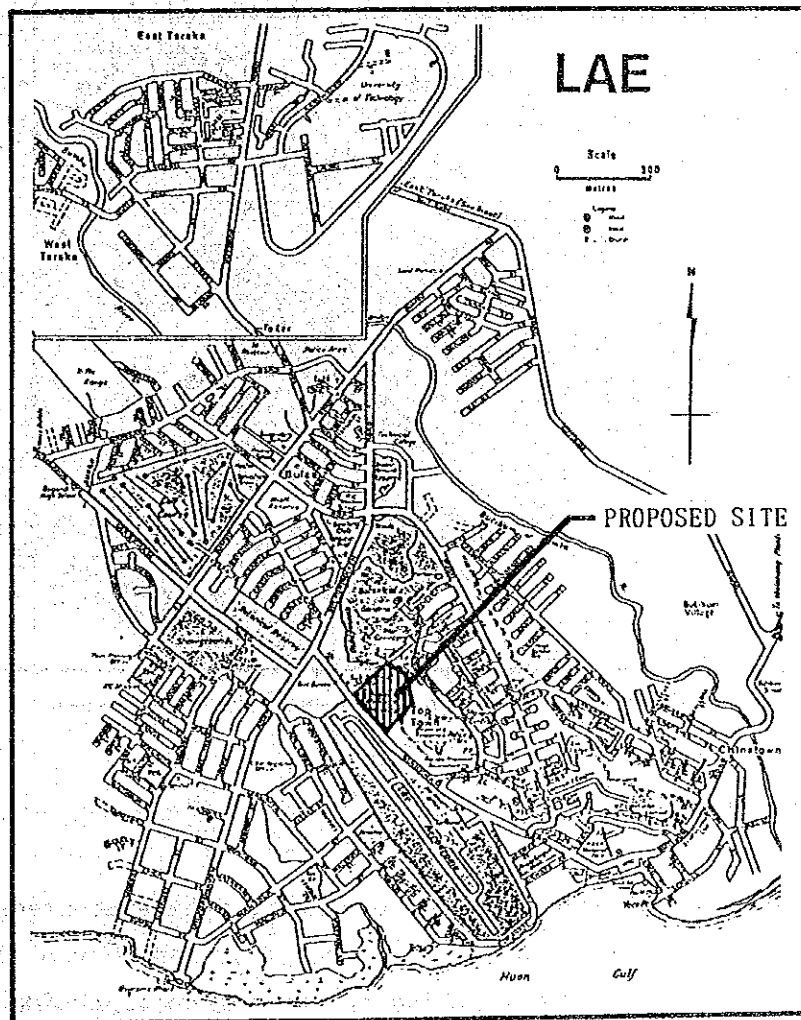
3-3-2 Locations and Conditions of Project Sites

(1) Construction Sites

1) Lae (Angau Memorial) Hospital

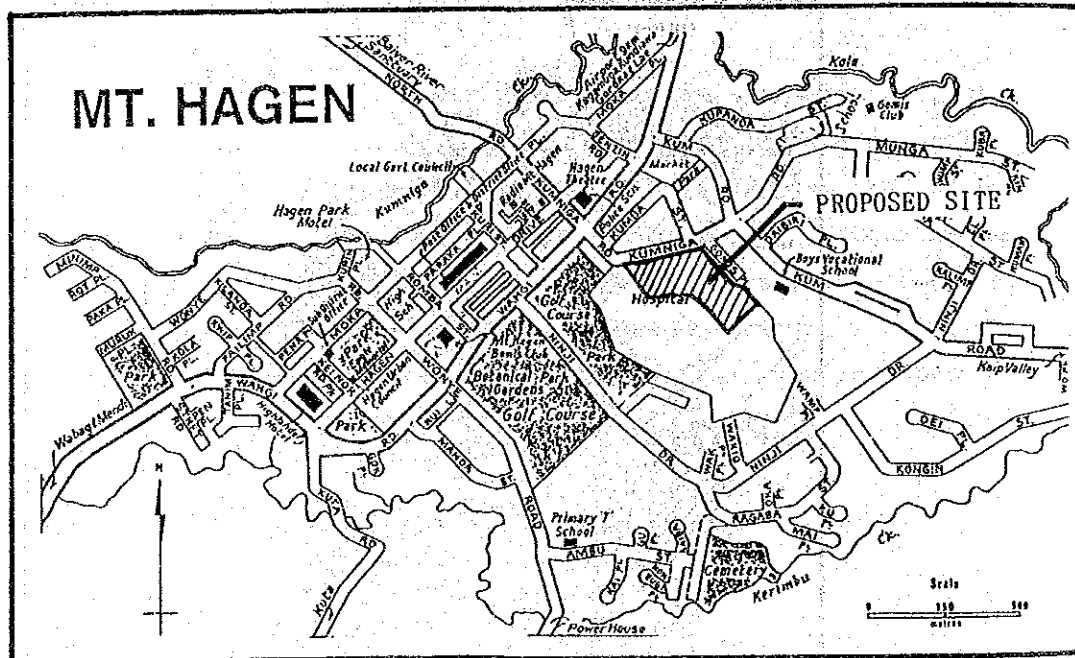
The City of Lae is a harbour city facing the Solomon Sea at the east side. Lae Hospital is situated in the centre of the city, along Markham Road, one of the main roads in the city. Across the road from the hospital is an airport, used mainly by the Defense Force. The take offs and landings of aircraft are not so frequent to generate noise and make a nuisance to adjacent areas. The site of construction is extensive, with a gross area of almost 20 hectares including the areas for the nursing

school and staff quarters. One third of the ground area of east side where the nursing school is located is on the hill approximately 15 metres above the remaining areas. The south side of the site is used for residential areas. The hospital facilities are scattered in the remaining flat areas of approximately eight hectares. The new central ward is to be constructed at the south side of the existing hospital facilities where a number of houses are presently scattered up the hill at east side.



2) Mt. Hagen Hospital

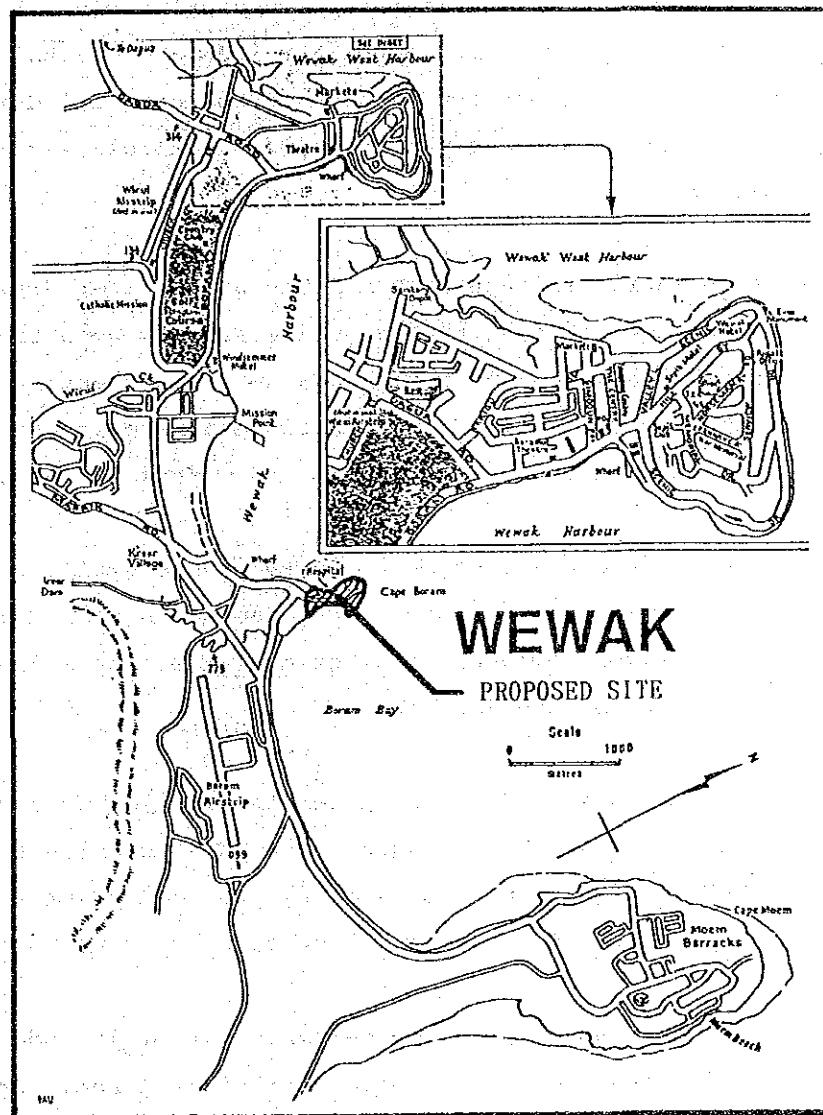
The City of Mt. Hagen is a mountainous city situated 1,700 metres above sea level. Mt. Hagen Hospital is located in the centre of the city, having a large site of approximately 20 hectares. However, the existing hospital facilities are scattered in a limited area of approximately 3 hectares. The remaining areas are steeply sloped and are not suitable for construction sites. The hospital is located at a point facing to Kumniga Road, one of the main roads, convenient for access from the centre of the city.



3) Wewak Hospital

The City of Wewak is a harbour city facing to Bismark Sea at north. Wewak hospital is situated at Cape Boram (40 to 50 metres wide and projecting to the sea in approximately 500 metres) about one kilometre apart from the airport toward the city. The site is, therefore, surrounded by the sea at its three sides. The site faces to direct wave and wind attack,

and its boundary along the beach line is severely eroded by repeated wave action.



(2) Existing Infrastructure

1) Lae (Angau Memorial) Hospital

Water Supply: Water is supplied from two connection points to the city water main. At present, however, only one pipeline of 150 mm-dia connected to the 200 mm-dia city water main Markham Road is being used. Quality of the water conforms to the

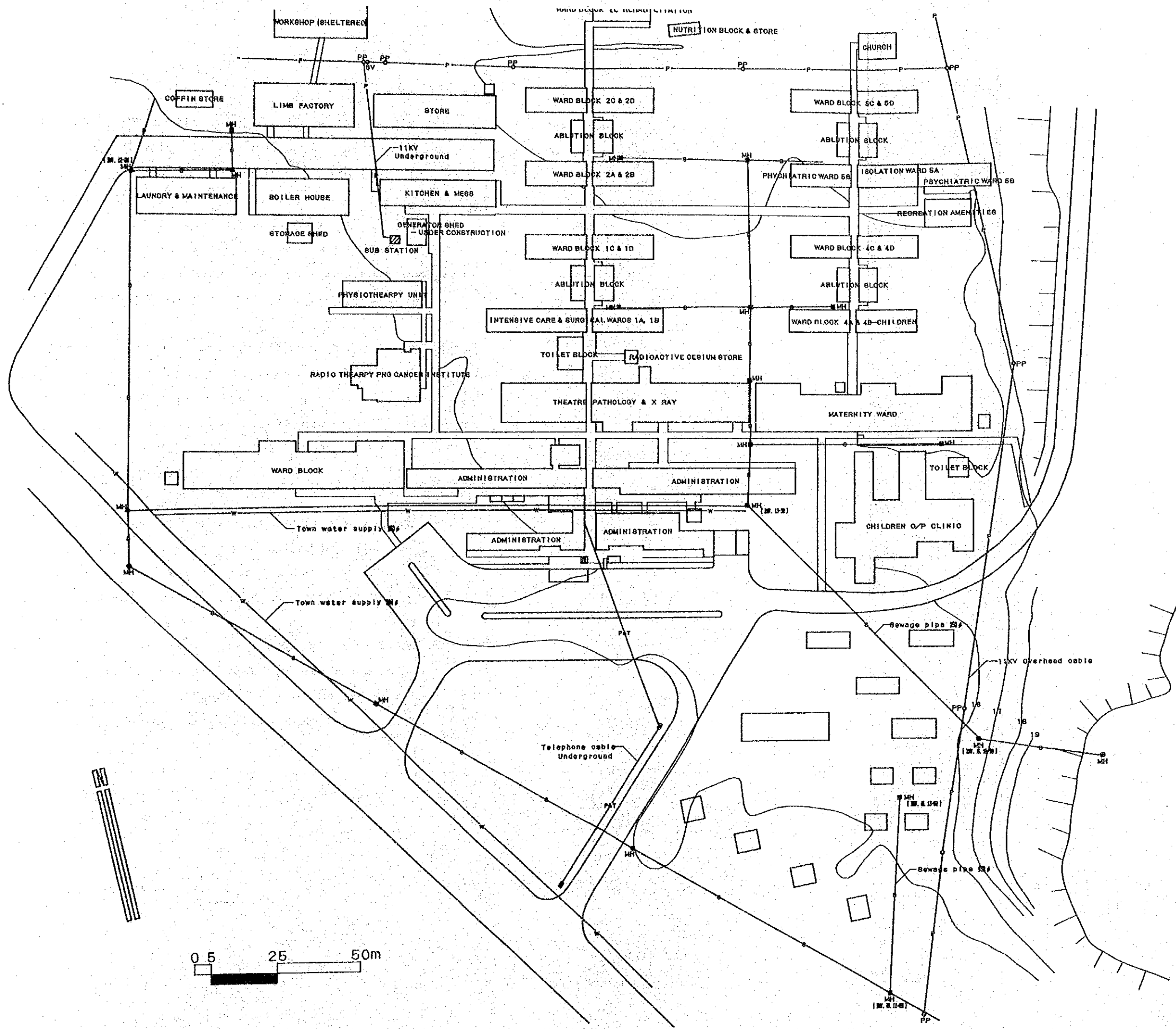
standard established by WHO for potable water, but it is too hard and not suitable for use in boilers without a water softener. Since the reservoir is situated at an elevated location, the water pressure of approximately 4.5 kg/cm² will be provided. The city water services are maintained by the Waterboard. Gross consumption of the hospital during the month of August 89 as recorded to be 27,000 kilolitres (or cubic metres).

Waste Water Drainage System: The waste water drainage system is complete throughout the entire areas around the hospital. Both waste water and sewage can be drained out to the city main without treatment. Surface water drainage is connected to the city main buried in the ground under Markham Road.

However, the existing main piping is too small, and a part of the site is often flooded about 400 mm in deep during the heavy rainy season. The waste water drainage system is also maintained by the Waterboard.

Electric Power: Electric power is supplied to the hospital transformer station through overhead high voltage cables of 11 kV. A low voltage cable line provides power to the residential area where new central ward is to be constructed.

Telephone System: Telephone cables are laid underground from Marham Road and connected to the existing PBX. Approximately 70 circuits out of the 100 circuits are presently being used. The existing communication system, therefore, can be extended.



LAE (ANGAU MEMORIAL) HOSPITAL

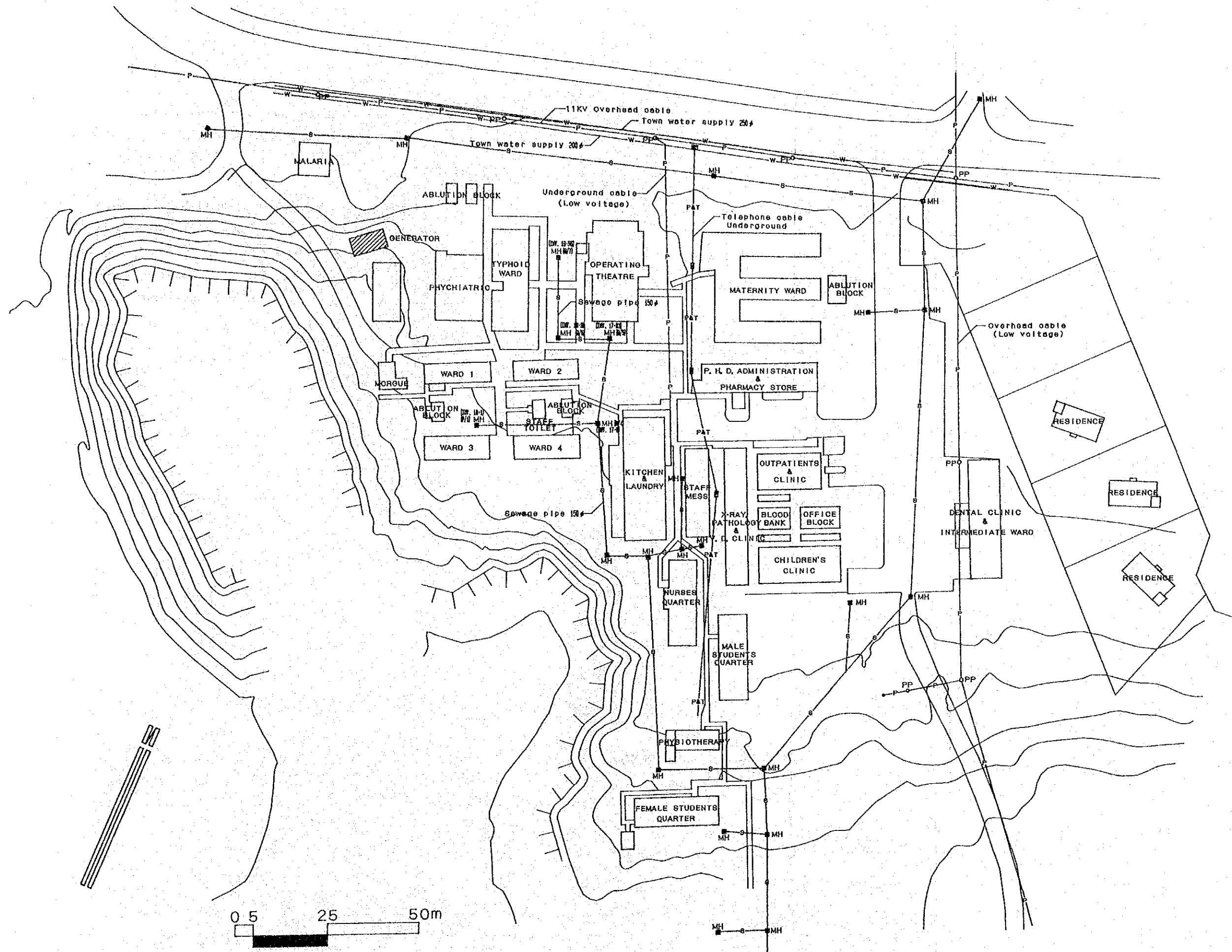
2) Mt. Hagen Hospital

Water Supply System: Two city water mains of 250 mm and 200 mm dia are buried under Kumniga Road. Water is supplied through 80 mm-dia service line connected to a 100 mm-dia branch metre which connects to the city water main. The water pressure is adequate even at the floor level of 5th floor of a building. The city water mains are maintained by the Waterboard. The gross consumption of the hospital during the month of June 89 was recorded to be 10,300 kilolitres (or cubic metres).

Waste Water Drainage System: The hospital started to treat the waste water in 1986. The city waste water mains are buried throughout the city, and both sewage and general drains can be drained out to the city main. Surface water is drained into the city drainage system (partially open) passing by the operating theatre and obstetric wards.

Electrical Power: Power is supplied through the overhead high voltage cables of 11 kV installed along Kumniga Road. The power is branched at the high voltage cables and supplied to the electrical equipment room through underground cables.

Telephone System: Three cable lines are led from Kumniga Road. PBX at the administration unit has spare capacity to accommodate approximately 400 additional extensions, and the system can be extended similarly to Lae Hospital.

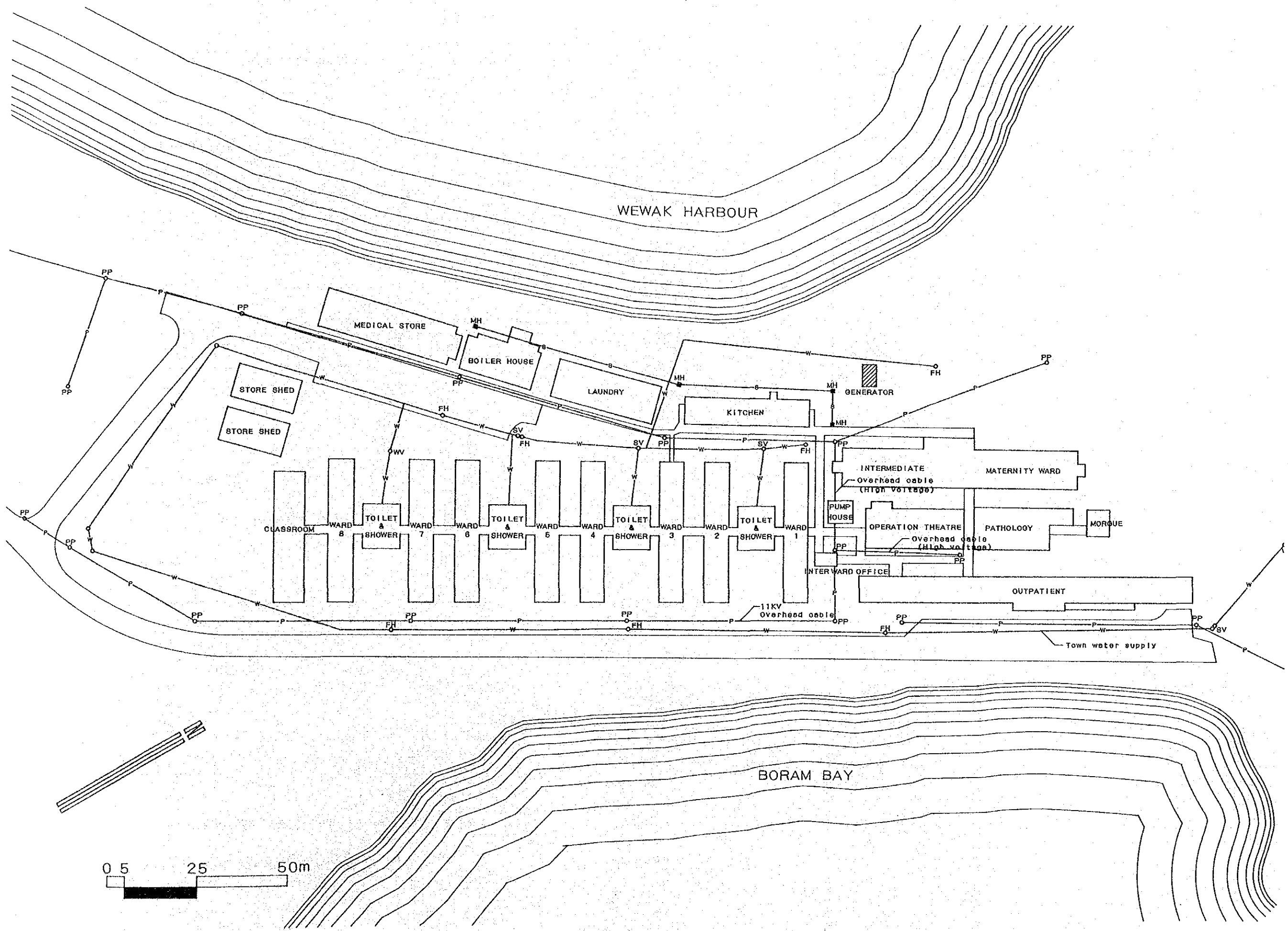


MT. HAGEN HOSPITAL

(3) Wewak Hospital

Waste Water Drainage: Waste water drainage system in the area of the hospital is complete. Both sewage and waste water are drained out to the sea without treatment.

Electrical Power: Power is fed through overhead high voltage cables of 11 kV to the transformer station. The power is stepped down to a lower voltage and is fed to the distribution panelboard. The existing transformer station can only provide 40 kVA and needs an addition to meet the increased demand.



WEWAK HOSPITAL

3-3-3 Outline of Proposed Facilities and Equipment

(1) Outline of Facilities

1) Lae (Angau Memorial) Hospital

New Central Building, consisting of the following listed departments, will be constructed as a core facility for the health care services:

New Central Building

Department	Floor Area (m ²)
Outpatient	2,102
Dispensary	377
Examination Laboratory	742
Operation	1,077
Administration/Services	497
TOTAL FLOOR AREA	4,795

Connecting Passage between the existing Obstetric Ward and Operating Theatre	10
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Total: 4,795 + 10 = 4,805 m²

Post Construction Gross Floor Area

DEPARTMENT	FLOOR AREA (m ²)	TO BE RELOCATED	TO BE REUSED AS	PLANNED FLOOR AREA (m ²)
Outpatient	1,956	638	Administration Office	2,102
Dispensary	151	152	Ward	377
Examination Laboratory	368	352	Ward	742
Operation	655	653	Delivery Room	1,077
Wards	5,838	-	-	-
Other Health Facilities	907	-	-	10
Administration	759	99	Ward and	497
Services	2,006	-	Administration Office	
TOTALS	12,640	1,894	-	4,805

Total: 12,640 + 4,805 = 17,445 m²

Post Construction Gross Floor Area: 17,445 m²/526 beds = (33.2m²/bed)

2) Mt. Hagen Hospital

A new MCH Building consisting of the following listed departments will be constructed to solve the problem of a shortage of beds. The new building will be constructed at a site where previous ward buildings (574m²) have been demolished and removed.

New MCH Building (Department)	Floor Area (m ²)
X-ray Examination Laboratory	110
Paediatric Ward	1,117
Obstetric Ward (including Delivery Room)	1,163
ICU Department	116
Administration/Services Departments	261
TOTAL FLOOR AREA	2,767

New OPD Building housing of the following departments will be provided to relieve congestion at the existing Outpatient Department.

New OPD Building (Department)	Floor Area (m ²)
Specialist Outpatient	147
Dispensary	213
Pathology Examination Laboratory	252
On-Call Staff Room	72
TOTAL FLOOR AREA	684

Total 2,767 + 684 = 3,451 m²

Post Construction Gross Floor Area (Mt. Hagen Hospital)

DEPARTMENT	FLOOR AREA (m ²)	TO BE RELOCATED	TO BE REUSED AS	PLANNED FLOOR AREA (m ²)
Outpatient	1,047	36	General Outpatient	147
Dispensary	82	82	Administration Office	213
Examination Laboratory	226	81	Laboratory	252
Operation	505	-	-	-
Wards	1,692	699 (to be removed: 574)	Ward	2,506
Other Health Facilities	118	-	-	72
Administration	455	-	-	-
Services	594	-	-	261
TOTALS	4,719	(868)	-	3,451

Post Construction Gross Floor Area: (4,719 + 3,451) - 574 = 7,596 m²/375 beds = (20.3 m²/bed)

3) Wewak Hospital

The following listed alterations and extensions will be provided to solve problems due to shortage of floor area and to upgrade the functions of the hospital.

Total Floor Area of Alterations/Extensions (Wewak Hospital)

Department	Floor Area (m ²)
Outpatient	247
Dispensary	53
Pathology Laboratory	80
Operating Theatre	41
Wards	272
TOTAL FLOOR AREA	693

Post Construction Gross Floor Area (Wewak Hospital)

DEPARTMENT	FLOOR AREA (m ²)	TO BE RELOCATED	AREA TO BE ALTERED	PLANNED FLOOR AREA (m ²)
Outpatient	268	110	247	147
Dispensary	78	34	53	19
Examination Laboratory	299	59	80	21
Operation	314	29	41	18
Wards	2,827	260	272	12
Other Health Facilities	449	-	-	-
Administration	263	-	-	-
Services	769	-	-	-
TOTAL	5,267	492	693	207

$$5,267 + 207 = 5,474\text{m}^2$$

Post Construction Gross Floor Area: 5,474 m²/358 beds= (15.3 m²/bed)

(2) Outline of Medical Equipment

1) Lae (Angau Memorial) Hospital

New Central Building

Outpatient

Emergency Outpatient

Minor operating sets,
emergency sets, and others

Specialist Outpatient	ENT unit, ophthalmology unit and others
Dispensary	Dispensing table and others
Examination Laboratories	
X-ray Examination	Radiographers, Automatic film processor and others
Pathology Examination	Testing tables and others
Operating Department	Operating sets (operating tables, shadowless lights and anaesthetic instruments etc.

2) Mt. Hagen Hospital

New MCH Building

Ward Department	Beds, obstetric (delivery-related) instruments, neonate-related instruments, paediatric instruments etc.
X-ray Examination	Radiographers and others
ICU	Heart resuscitator

New OPD Building

Dispensary	Dispensing table and others
Pathology Examination	Testing table and others

3) Wewak Hospital

Radiographers, photo-electric spectrophotometre, emergency

sets, physiotherapy equipment, equipment for special care nursery, basic medical equipment for outpatient and others

3-3-4 Maintenance and Operations

(1) Maintenance and Operation System

1) Lae (Angau Memorial) Hospital

New Central Building will be operated and maintained, after completion of the project, together with the existing hospital buildings and their affiliates.

2) Mt. Hagen Hospital

New MCH Building and OPD Building will be operated and maintained, after completion of the project, together with the existing facilities.

3) Wewak Hospital

Extended portions will be operated and maintained together with the existing facilities after completion of the project.

(2) Maintenance and Operation Plan

1) Lae (Angau Memorial) Hospital

Total floor area of the new buildings at Lae Hospital is 4,805m². The hospital has now the gross floor area of 12,640m². The gross floor area, therefore, will be 17,445m² after completion of the construction. The open space in the existing facilities such as the outpatient department will be altered in future by the Government of PNG to be reused as an administrative building, wards, and delivery rooms. The hospital has now 526 beds. The number of beds will remain unchanged, as wards are not provided in the New Central

Building. The examination laboratory is expanded with three new laboratories in addition to the existing two laboratories. Radiograph technicians will not be increased, since seven technicians are currently assigned. The operating theatres will be four by adding a new operating theatre. At present six doctors are assigned at the three existing operating theatres to provide health services. The operating theatres, therefore, can be operated with the same medical staff even with the additional theatre.

2) Mt. Hagen Hospital

The new floor area is 3,451m² in total. The gross floor area of the existing facilities is 4,719m². New gross floor area will be 7,596m² by adding the new floor area of the MCH and OPD Buildings, and by deducting the floor area of 574m² to be demolished and removed. The net increase in floor area is, therefore, 2,877m². The total number of beds is 263 prior to construction. 150 beds will be added under the project, but 38 beds will be lost due to demolition and removal. The net increase is 112 beds. Therefore, the total number of beds will be 375 after completion of the project. The existing MCH Building presently accommodates one obstetric unit (12 nursing staff) with 37 beds and two paediatric units (32 nursing staff) with 48 and 30 beds respectively. The total number of beds available at the existing MCH Building is 78. The New MCH Building will accommodate a 50-bed obstetric ward and a 100-bed paediatric ward, increasing by 13 and 22 beds respectively. The beds will be laid out in the New MCH Building in accordance with the Nightingale system. Each nursing unit (50-bed) will be controlled by 12 nursing staff as existing.

The number of beds in the whole hospital will be increased by 112 as the result of construction of new MCH Building as stated in the preceding paragraph. Assignment of wards is to be planned by the counterpart upon relocation of the existing MCH wards to the new building. Increase of nursing may have to be

considered to meet the expanded ward spaces with increased beds.

3) Wewak Hospital

The project will provide alterations of 486m² and extensions of 207m² in total floor area. The net increase is, therefore, 207m² total. The project is intended only to increase the restricted floor area. Increase of health staff, therefore, will not be considered.

(3) Increase in Maintenance and Operation Cost

Annual maintenance and repair costs are directly disbursed from the treasury of DOW. The DOH desires to secure the maintenance and repair cost preferably for 2% of the construction cost, at least 1% of the construction cost.

On the other hand, the cost of utilities such as electrical power and water is disbursed from the operation cost which is allocated to each hospital by the DOH.

Pharmaceuticals and medical equipment are procured directly by the DOH, and are supplied to each hospital. The cost of the pharmaceutical and medical equipment is not included in the operating cost.

The following table shows the recent expenditures for operating costs, pharmaceuticals and medical equipment, and maintenance and repair costs, actually paid or to be paid by various hospitals in PNG. All numerical data in subparagraphs (3) and (4) have been collected from DOH.

COMPARISON TABLE OF VARIOUS BUDGETS OF HOSPITALS

(Operating Cost, Pharmaceuticals and Medical Equipment, and Maintenance and Repair)

Hospital	Hospital Operation Cost Actual (1989) Budget (1990) Kina/month	Rate of Rise versus Previous Year (%)	Pharmaceuticals Medical Equipment Actual (1989) Budget (1990) Kina/Month	Ratio versus Operation Cost (%)	Maintenance and Repair Actual (1989) Budget (1990) Kina/month	Ratio versus Operation Cost (%)
Lae	307,450 329,200	7.1	63,700 63,750	19.4	5,870 5,000	1.5
Mt. Hagen	140,300 167,830	19.2	13,870 13,920	8.3	1,920 2,330	1.4
Wewak	150,500 141,300	-6.1	10,130 10,170	7.2	2,580 3,330	2.4
PMGH	489,790 581,570	18.7	101,130 102,100	17.60	9,630 10,000	1.7
TOTAL OF PNG HOSPITALS	1,841,900 2,130,700	15.7	353,240 355,830	16.7	33,130 34,000	1.6

The following tables show the estimated increase in maintenance and repair costs and utility cost including electrical power and water, for the facilities added by the redevelopment project.

ESTIMATED INCREASE IN MAINTENANCE AND REPAIR COST

Hospital	Maintenance/ Repair Cost Kina/month (1990)	Estimated Increase (1%) Kina/month	Rate of Increase (%)
Lae	5,000	4,425	78
Mt. Hagen	2,330	3,740	118
Wewak	3,330	320	12
TOTAL	10,660	8,285	78

Note: Maintenance and Repair cost is assumed to 1% in consideration of the tight financial conditions in PNG and less need for the new facilities immediately after completion.

COST OF ELECTRICAL POWER AND WATER

(included in Hospital Operating Cost)

Hospital	Utilities Budget (1990) Kina/month	Estimated Rise of Utilities Kina/month	Rate of Rise (%)	Rate of Increase versus Operation Cost (%)
Lae	40,680	Elect 16,000	53.3	6.6
		Water 5,700		
		Total: 21,700		
Mt. Hagen	10,750	Elect 8,300	132.0	8.5
		Water 5,900		
		Total: 14,200		
Wewak	(1989) 26,750	Elect 500	2.0	0.3
		Water		
		Total: 500		
TOTAL	78,180	36,400	47.0	5.7

The following may be assumed based on the above information:

- Estimated increase of maintenance and repair costs is not too high, except for Wewak Hospital, but it still covers a substantial proportion of the current budget of the Department of Works.
- The cost of electrical power and water is estimated to rise steeply, except for Wewak, when compared to the appropriate expenditures for utilities within the hospital operating cost. However, the estimated increase is less than 10% of the total hospital operating cost, and the disbursement may be made from the current hospital operating cost in view of the actual rate of increase against the previous year.
- It is assumed that consumption of pharmaceuticals and medical equipment will rise at a higher rate, except for Wewak, in accordance with the advanced medical services and additional beds at Lae and Mt. Hagen. Rate of these items is not high compared to the budgeted operating cost. However, considerable

efforts may be required to keep the increase within the present budget frame.

- Cost of manpower will not increase sharply because of this redevelopment project. However, some increase may be inevitable because the existing wards will be much improved with additional beds to be provided for Mt. Hagen.

(4) Impact on Recurrent Expenditures of Various Hospitals

By taking into account of the situations described in the paragraph (3) above, calculations have been tried to find the anticipated increase of recurrent expenditures after completion of the redevelopment project for the four hospitals, (three project hospitals and PMGH), based on the following assumptions:

* Assume the following:

- Operating Costs of Hospitals

In addition to the increase of cost of utilities as described above, an increase of manpower cost and other expenditures is assumed, as a result of the addition of beds, the advanced level of medical services, and the anticipated increase in number of patients.

- Medical Equipment and Pharmaceuticals

An increase in the cost of medical equipment and pharmaceuticals is assumed, as a result of the addition of beds, the advanced level of medical services, and the anticipated increase in number of patients.

- Maintenance and Repair Costs

Increase of the maintenance and repair costs is assumed to

be approximately 1% of the total construction cost, as the facilities of 3 hospitals and PMGH are presently new.

**ANTICIPATED INCREASE OF RECURRENT EXPENDITURES
FOR FOUR HOSPITALS REDEVELOPED
(VERSUS 1990 BUDGET)**

(unit: thousand kina/year)

Hospital	Hospital Operating Cost	Pharmaceuticals & Medical Equipment	Maintenance & Repairs
	(1990 Budget) (Estimated increase)	(1990 Budget) (Estimated increase)	(1990 Budget) (Estimated increase)
PMGH	6,978 x 0.15 = 1,047	1,225 x 0.30 = 368	120 18,200 x 0.01 = 182
Lae	3,950 x 0.1 = 395	765 x 0.50 = 382	60 5,310 x 0.01 = 53
Mt. Hagent	2,013 x 0.4 = 895	167 x 1.00 = 167	28 4,490 x 0.01 = 45
Wewak	1,696 = 0	122 = 0	40 = 0
Totals	14,639 2,247	2,279 917	248 280
Total Budget of All Hospitals (a) (after completion of Project)	25,568 + 2,247 = 27,815	4,269 + 917 = 5,186	408 + 280 = 688
Total DOH Budget (b) (Actual: 1987) (Estimated: 1990)	76,805 87,305		
(a)/(b) (1990) (After Completion)	29.3% 31.8%	4.9 5.9	0.47 0.8
TOTAL			(34.67) 38.5

The guidelines of the Second National Health Plan stipulate that the total budget for all hospitals shall not exceed the limitation of 45% of the total budget of the Department of Health. In accordance with the above table, the aggregate sum of the maintenance and repairs controlled by DOW and of the medical equipment and pharmaceuticals directly controlled by DOH, is limited to approximately 38.5% of the total budget of DOH. It is assumed that the budgets of all relevant hospitals will stay

within the limitations as stipulated in the guidelines.

As discussed in the preceding paragraphs, it has been clearly evidenced that the total budget of hospital operating costs, pharmaceuticals, medical equipment, and maintenance and repairs, will not exceed the 45% limitation of the total budget of the Department of Health. However, it has also been revealed that future expenditures will rise at a considerably higher rate. To cope with the increasing costs, it may be necessary to take appropriate measures based on the health service philosophy regardless of the present budgetary restrictions for the three items of expenditure.

CHAPTER 4
BASIC DESIGN

CHAPTER 4 BASIC DESIGN

4-1 BASIC DESIGN POLICY

This project intends to confirm the problems in three existing provincial hospitals at Lae, Mt. Hagen and Wewak, to resolve the problems, to improve the hospital functions, and to strengthen their health services by redeveloping the existing facilities. The following has been considered as basic design policy in preparing the appropriate basic designs as described herein.

(1) Common Basic Policy

- 1) To prepare the redevelopment plans in line with the future plan of each hospital.
- 2) To provide adequate functions so each hospital can operate as a central hospital for its area. For Lae Hospital to provide a 500-bed facility suitable as a national hospital, for Mt. Hagen Hospital to provide a 400-bed facility suitable as a base hospital, and for Wewak to provide a 300-bed facility suitable as a provincial hospital.
- 3) To provide facilities adequate for long-term usage, and flexible facilities to allow for future changes of internal functions.
- 4) To carefully coordinate the functional relationship between the New Central Building and the existing facilities.
- 5) To minimise interference of daily operations (health services) at the hospitals during the construction.
- 6) To plan the maximum use of local construction materials and construction methods, and to try to minimise maintenance requirements of the new facilities.

7) To have designs appropriate for local environmental conditions and social environment (functions of the hospital and relevant regulations and laws).

8) To reuse medical equipment which is used in existing facilities to be redeveloped.

(2) Basic Policy for Each Hospital

1) Lae (Angau Memorial) Hospital

- Major portions of the existing facility may be converted to some other use with internal modifications. Therefore, demolition and removal of the existing medical facilities will be minimised.
- Provision of lifts is not considered feasible since there is no building with lifts and no maintenance is available. Therefore the project buildings will be 2-storied to preclude the requirement for elevators.

2) Mt. Hagen Hospital

- The greatest problem this hospital faces at present is the lack of beds (only 263 at present) versus number of outpatients (190,000 annually). Meanwhile, the site of construction is very limited due to configuration of the sloped ground. Therefore, new maternity and children (MCH) building will be constructed on the site where demolition and removal of present wards has the least affect on beds.
- Design will be planned in consideration of effective and practical use of the sloping terrain.

3) Wewak Hospital

- To plan to upgrade the health services by adding to and altering the existing facilities.
- Since three sides of the site faces to the sea, design will take into account the salty environment.

4-2 STUDY AND EXAMINATION ON DESIGN CRITERION

4-2-1 Design Conditions for Facilities

(1) Lae (Angau Memorial) Hospital

1) Construction Site

New Central Building is deemed as a facility requiring a main entrance of the hospital, and easy approach to the entrance from the main public road is required. Also, the health services and their connections with the existing facilities (such as wards) should not be interrupted by construction work. In consideration of the above, it is considered optimum to locate the construction site at the south side of the existing children outpatient building (all existing residential buildings in this area will be demolished by the Government of PNG prior to commencement of construction).

2) Required Functions

The functions listed for each department below are required under the project:

New Central Building

Ground Floor:	Outpatient Department (includes Emergency and Minor Operating Theatre) Radiographic Department Dispensary Department Administration Department (Partial) Others, including mechanical equipment room and other affiliate facilities such as toilets, store, stairways, and corridors
1st Floor:	Operating Department (including central supply)

Pathology Examination Department

Specialist Outpatient Department

On-Call Staff Room

Others, including affiliate facilities such
toilets, store, stairways, and corridors

Connection Corridor between Obstetric Wards and Operating

Theatre

The interior corridors of the two buildings were connected by the corridor.

3) Master Plan

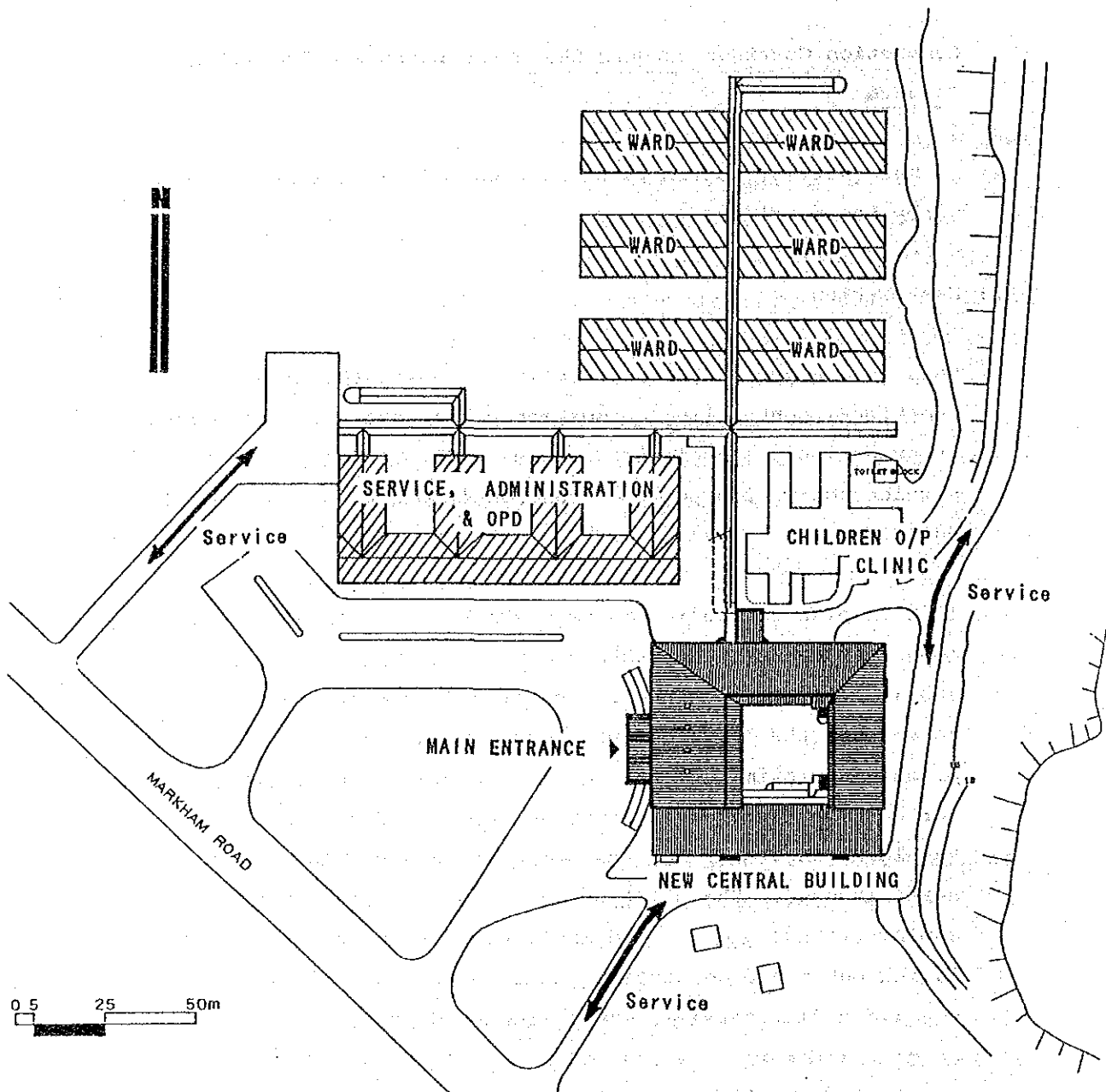
This redevelopment will result in upgrading the diagnostic functions, controlling congestion within the hospital building by extension of the limited spaces, and expediting the health service activities, by the construction of a new outpatient building.



If this plan is considered as a Phase I project within the long-term master plan, an oncoming project, as a Phase II, should consider the integrating of all separate wards and try to shorten the length of passages within the hospital. A line passage approximately 220 metres long is normally required now for catering services by nursing staff. This long passage should be shortened and the present heavy workload of nursing staff reduced. Phase III project should upgrade the administrative and service activities by centralising and laying out these departments at a convenient location where equal and fair services may be rendered to all outpatient and ward departments. Lae (Angau Memorial) Hospital, as a base hospital with 500 beds, will then become a hospital to provide smooth and efficient health services in near future.

Meanwhile, temporary transfer of patients during construction may be easily performed if the existing facilities and open

areas are effectively used, and patients are treated on an adequate rotation schedule.

The future conception plan is merely a proposal to be considered.



-  — Phase-2 Wards (526 beds)
-  — Phase-3 Service, Administration & OPD

4) Natural Conditions

Natural conditions at Lae are as stated below:

Latitude: 6'43" S

Average Temperature: 28.3°C (near constant round-the-year)

Max temp: 36.5°C (Feb)

Min temp: 19.6°C (Dec)

Average Humidity: 89%

Gross Annual Rainfall: 3,925 mm

Max rainfall: 440 mm/month (Oct)

Min rainfall: 123 mm/month (Dec)

Wind Direction: Northwest and southeast

Seismic Zone: 2

Various measures for shading, rain water shielding, and natural ventilation have been considered and incorporated into designs based on the natural conditions as cited above, and design of air conditioning system has been prepared in accordance with the reference values as set forth for standard interior conditions.

5) Study for Scale of Facilities

Outpatient Department

Waiting Hall: Average number of outpatients per annum is 191,551 persons (daily average of 525) from the records of last five years. Approximately 120 to 150 persons, including helper to the patients, are assumed to wait in the hall at the peak of the day. Therefore, the design will provide for a 150-seated waiting hall. Meanwhile, an extra space for screening patients by three sisters is provided in the hall.

Sub-Waiting Hall: Gross floor area of the existing sub-waiting hall is 50m². However, the area includes 20m² for passage, and some of outpatients may be required to wait unseated when seats are occupied in the existing sub-waiting area. Therefore, design provides for 30 waiting seats for patients and their attendants.

Consultation Rooms: Design provides for five consultation rooms annexed with treatment rooms for medication and injection by five doctors. A one way passage system will be used in the consultation rooms based on the local practice.

Specialist Outpatient Department: Design will provide five consultation rooms (five doctors assigned for surgery, internal medicine, ophthalmology and ENT) based on the current health services. Daily average number of outpatients is approximately 80 persons based on records for the last five years (annual average of 16,015). A separate room will be provided for the ophthalmology and ENT, because these clinics require special equipment. Three rooms are allocated for the busiest surgery (two doctors) and internal medicine (one doctor) considering their reciprocal use, in expectation of future increase of surgeons. The existing STD Department, with a floor area of 38m², crowded all the time with seven health staff and outpatients of 50 to 100 per day, needs more floor space. Also, the clinic is used by both male and female patients, and the passage line is complicated. Design provides for separate rooms for male and female outpatients.

Emergency Outpatient Department: This department is busiest between evening and midnight. A minor operating theatre for emergency operations and an observation room with five beds will be provided for diagnosis and post-operation observation of outpatients. In addition to the above two rooms, a resuscitation room for patients in a critical situation and a nurse station will be provided to monitor the above rooms.

Dispensary Department

Waiting Hall: Average number of prescriptions handled in the dispensary per year reached 126,785 and daily average of 350 for the last four years. If average waiting time of 30 minutes is assumed for each patient, approximately 22 patients wait for dispensing at every hour in the hall. Design provides for waiting hall of 40-seats on the assumption that 30 to 40 patients are waiting for dispensing at peak hours of the day.

Bulk Storage: Present storage capacity is adequate for only a three or four weeks supply of medicine. The design provides for a bulk storage of approximately 100m² in floor area to store at least a 60-day supply of bulks and to secure sufficient working space for a staff of five. The store will be annexed with a cold storage of minimum necessary storage capacity.

Dispensary: Existing dispensary has a floor area of 57m², and also function as a bulk storage. Since a new bulk storage will be provided at a new location, it will become easier to handle 350 prescriptions a day in the new dispensary of size similar to existing.

Office: Design provides for a new room of equivalent size as existing (10m²) to the chief pharmacist. Also a meeting room will be provided to accommodate a staff of about 12.

Examination Department

[Radiographic Examination]

X-ray Room: Average number of examinations for the last five years numbered 27,800 per year, but last year recorded 31,000, the maximum in the past years. Daily average is equal to 125. On the assumption that 10 minutes are required for each examination, the total time required reaches 20 hours. If

time for changing clothes and the past growth rate are taken into consideration, at least three X-ray units are required for 8-hour daily operation (3 x 8 = 24 hours). Design will provide for affiliate rooms required for operation of the equipment.

Waiting Hall: Approximately 125 cases are handled daily, and 20% of the total cases are assumed to be handled at the peak time, then 25 to 30 patients could wait in the hall. Therefore, a 30-seat waiting hall will be provided.

[Pathology Examination]

Laboratory: Based on the current systems, four units of biochemistry, haematology, bacteriology and serology will be provided. Two or three staff are assigned at each unit. Average floor areas range from approximately 16 to 20m²/unit.

Waiting Hall: Average recorded number of examinations handled for the last five years numbered 55,000 per year (200 per day). Normally one third of outpatients, 60 patients, are examined per day. Assume 20% of the cases are handled at the peak, then 10 to 12 seats are required. A bleeding room will be provided, annexed to the waiting hall.

Cold Storage: The design provides for a central cold storage (+4°C to 8°C) to store medicine and blood samples.

Washing Room: A washing room will be provided to improve working efficiency.

Office: An office of similar size to existing will be provided for the chief. Also, a staff meeting room will be provided, annexed to the office for use by 10 staff members.

Operating Department

Operating Theatre: Average number of operating theatres

performed for the last five years recorded 3,650 per year, or 10 per day (could be more during weekdays). Existing three operating theatres are fully used. The vehicle age is oncoming in the country, and the number of operating theatres may rise sharply due traffic accidents. Therefore, four new operating theatres will be provided in the New Central Building ready for increased demand assumed in the near future.

Central Supply Room: Existing central supply comprises steriliser room of 52m², store of 14m², and building machine room of 30m². However, the passage lines of these three rooms are crossing and interfere with smooth and efficient operations. Design clarifies the passage lines of washing and sterilising work and provides for separate passage lines to prevent equipment and supplies from spreading infection due to mixing passage of polluted and sterilised equipment and supplies.

Recovery Room: Design provides for recovery room in consideration of number of operating theatres (10 cases per day) performed in four operating theatres, and to be used by patients as a waiting space.

Office: Design provides three independent rooms for doctors, sisters, and anaesthetic specialists. Also, an affiliate room is annexed for meeting by 15 staff members.

Other Medical Facilities

On-Call Staff Room: The on-call staff room is defined as overnight accommodations provided for the emergency department. Four separate rooms (for emergency staff, radiographer, doctors, and anaesthetic specialists), toilet, shower, and dining room for joint use will be provided.

Administration Department

Accounts Room: Independent office room for chief and general room for five staff members will be provided.

Public Relations Office: General office for three social workers will be provided.

Medical Records Room: Approximately 30m² of the existing medical records room in total floor areas of 54m² is occupied by medical records. Some records are stored in the office. Design provides an independent record room and general office for the chief and four staff members.

Office: Office rooms will be designed in accordance with the standards of the Government of PNG.

STANDARD FLOOR AREAS FOR ADMINISTRATION OFFICES IN PNG

Room	Required Floor Areas
Medical Superintendent	15 m ²
Superintendent's Staff	15 m ² including waiting hall
Hospital Secretary	15 m ²
Staff for Hospital Secretary	10 m ² including waiting hall
Doctor	15 m ²
Matron	15 m ²
Deputy Matron	8 m ²
Department Chief	12 m ²
Office	6 m ² per person
Conference Room	2 - 3 m ² per person
Library	2 m ² per person

Connection Corridor:

A new corridor is to be provided between the obstetric ward and the operating theatres immediately after completion of the New Central Building, so that the existing operating theatres can be used for delivery rooms. This will relieve the shortage of the delivery rooms.

6) Design Conditions of Utilities

Water Supply: The water pressure and flow of the existing city water main are considered sufficient to supply water for the new facilities. New water piping is directly branched out from the existing main pipe of 100 mm in diameter.

Hot Water Supply: Existing boiler will be used to supply hot water.

Waste Water Drainage: Branch connection will be made to the existing city sewage pipelines.

Steam Supply: Existing boiler will be used to supply steam.

Airconditioning System: The following values will be used for designing:

Outside design dry-bulb temperature:	36.5°C
Outside design wet-bulb temperature:	33.4°C
Inside design dry-bulb temperature:	25.0°C

Ventilation System: Natural or forced air ventilation will be provided for offices, stores, and toilets on as-required basis or at air changes of three to 10 times per hour.

Transformer Station: An additional transformer station will be provided to relieve the current shortage of power and in consideration of future increase in demand load at the new building.

Lighting System: Standard fluorescent luminaries will be provided at lighting intensity from 100 to 1,000 lux.

Telephone System: Existing telephone system will be extended to cover the new facilities.

Generating System: An additional generator will be provided to backup the existing generator.

(2) Mt. Hagen Hospital

1) Construction Site

The site of Mt. Hagen Hospital is on sloped ground, and the areas suitable for construction are limited. Most of the areas are covered with existing buildings. Therefore, some existing buildings must be demolished in order to construct the new buildings. The hospital is severely handicapped by a shortage of beds. It is desirable to demolish and remove existing wards which are located at the northwest corner and are equipped with fewer beds (38 beds for 2 wards) than others, and to obtain the most area for construction for the new MCH Building. On the other hand, it is considered optimum to construct the new outpatient (OPD) building in the open area at south side of the existing OPD in consideration of relationship between new and existing buildings.

2) Required Functions

The functions listed for each department below are required under the project:

New MCH Building

Semi-Underground Floor: Mechanical room

Ground Floor:

Paediatric Ward

Radiography

ICU

Others (including toilets, store, stairways, and corridors)

1st Floor:

Obstetric Ward

Special Care Nursery

Delivery

Others (including toilets, store, stairways, and corridors)

New OPD Building

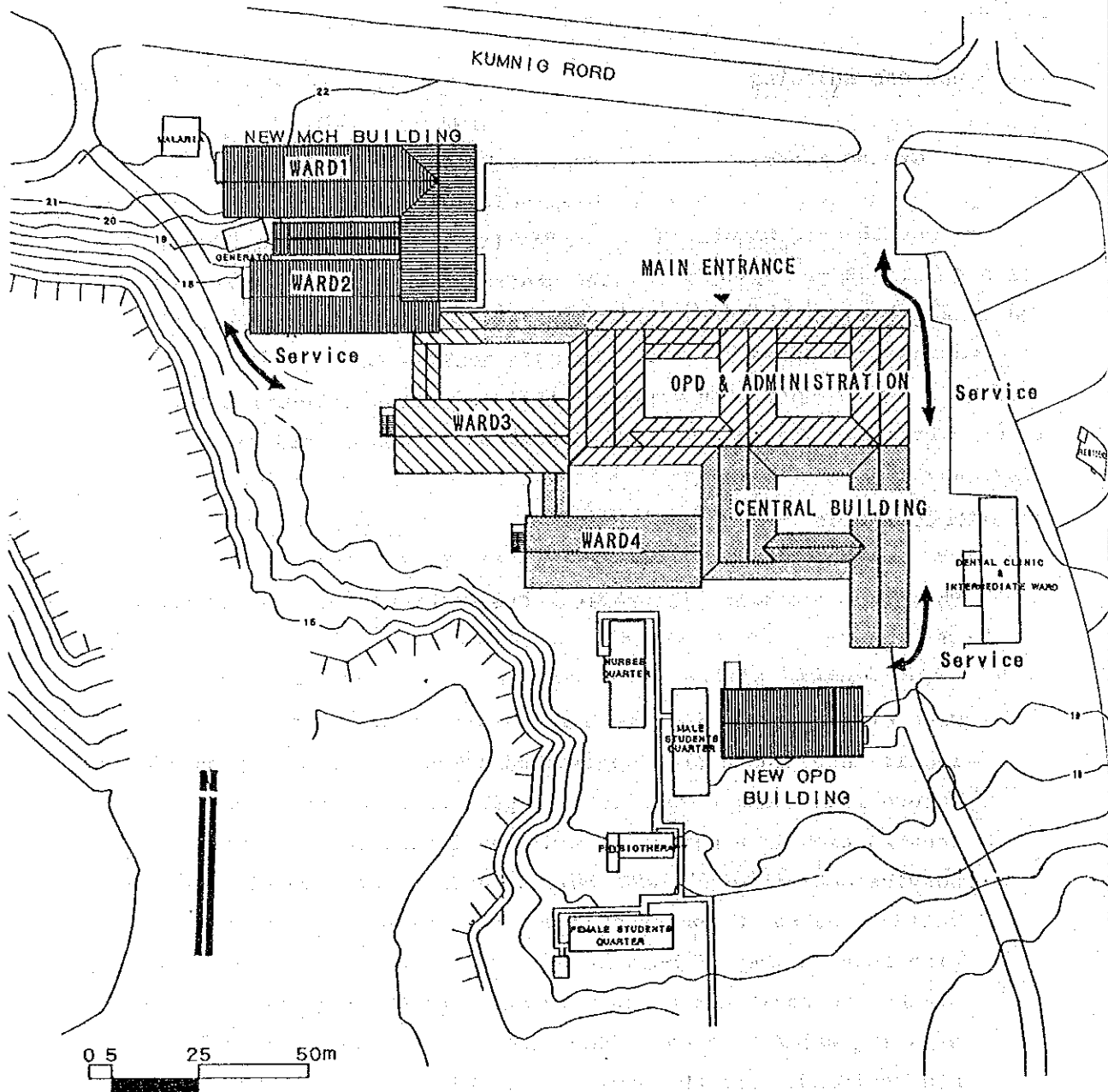
Ground Floor:	Special Outpatient Department Dispensary Department Others (including toilets, store, stairways, and corridors)
1st Floor:	Pathology Examination Department On-Call Staff Room Others (including toilets, store, stairways, and corridors)




3) Master Plan

This redevelopment will relieve the major problems of shortage of beds.

Most of the ground in this hospital is covered with various facilities. Therefore, special care must be paid in planning future redevelopment projects to perform demolition and construction in a manner to minimise interference to the health service activities. Under this redevelopment project, new MCH Building is to be constructed at the site of existing wards, with least number of beds to be demolished. Next project is planned to construct a new ward building at the site some of existing wards have been demolished at the south side of NEW MCH Building. The third project is planned to construct a new building to house outpatient wards and a part of the administration building at the site existing administration building has been demolished. The fourth project is to construct a new building to house the outpatient department and the remaining part of the administration department, and additional wards to construct a 400-bed proper hospital.

Upon completion of the series of projects, the existing MCH building is to be demolished to provide an open space for use by the whole hospital.



-  — Phase-2 WARD3 Ward, Service
-  — Phase-3 OPD & ADMINISTRATION OPD, X-Ray, Administration
-  — Phase-4 WARD4 Ward, Service
- CENTRAL BUILDING** Examination, Central Supply
Operation Theatre, ICU
Administration

※Total Beds-400 Beds

The above future conception plan is merely a proposal to be considered.

4) Natural Conditions

Natural conditions at Mt. Hagen are as stated below:

Latitude: 5'52" S

Average Temperature: 18.3°C (near constant round-the-year)

Max temp: 31.1°C (Jan)

Min temp: 1.7°C (Sep)

Average Humidity: 77%

Gross Annual Rainfall: 2,586 mm

Max rainfall: 285 mm/month (Mar)

Min rainfall: 119 mm/month (Sep)

Wind Direction: South throughout the year

Seismic Zone: 3

Various measures for shading, rain water shielding, and natural ventilation have been considered and incorporated

into designs based on the natural conditions as cited above.

Where air conditioning is required, the system is designed

in accordance with the reference values as set forth for

standard interior conditions.

5) Study for Scale of Facilities

[New MCH Building]

Radiographic Examination

X-ray Room: Average number of examinations for the last three

years recorded 5,567 per year, but the last year recorded 6,436, showing a rapid growth rate of about 15% when compared to the record of the previous year. Daily average is equal to 26. On the assumption that 10 minutes are required for each examination, then total time required is 4.3 hours. At present the hospital is equipped with one fixed type and one portable type X-Ray unit, and this equipment seemed adequate to cover the current demand. The Government's request covers one additional fixed type X-ray unit to be used specially for the obstetric ward and for the operating theatre next to the new MCH Building.

Waiting Hall: A waiting hall with about 10-seats will be provided for X-ray room. Waiting hall is laid out to accommodate the passage to the operating theatre which will include stretchers.

Inpatient Wards

[Obstetric]

Ward Beds: Average recorded number of deliveries handled by this hospital was 2,170 per year (daily average of 6 deliveries) for the last three years. Normal delivery requires a 7-day hospitalisation, therefore, approximately 42 beds are necessary when simply calculated based on the above data (6 deliveries x 7 days = 42). In consideration of the rise of deliveries and abnormal deliveries requiring a longer stay in hospital, 50 beds, equivalent to a single nursing unit, will be provided.

Special Care Nursery Room: Average recorded number of premature infant deliveries was 210 per year for the last three years, but the record of the last year (1988) steeply rose to 260 (0.71 per day) at growth rate of 21% compared to the record of the previous year. On the assumption that an average of seven days are required for hospitalisation, five cots (0.71/day

x 7 days) are additionally required when simply calculated based on the above records. In consideration of premature infants delivered off hospital (265 infants per year) and long-term hospitalised infants, five more cots will be provided. To provide for infected infants three cots will be separately provided.

Delivery Rooms: Normal deliveries were recorded at the average rate of 5.5 per day (1987 per year), and abnormal deliveries numbered 0.58 per day (213 per year). In consideration of time required during process of labour, delivery and resuscitation, and adding extra demand factor at peak, a total of nine beds, eight for normal and one for abnormal deliveries, will be provided.

Affiliated Rooms: Based on the current system, an independent room will be provided for doctors and sisters. At present 12 staff are assigned to the hospital, but employment of 18 additional staff employees (in charge of deliveries and special care nursery) is expected to be approved. A new staff room, nurse station, and store will be provided for smooth operations of health services.

[Paediatric]

Ward Beds: Average number of child-outpatients was recorded as 98,500 per year (270 per day) for last three years. Average ratio of outpatients versus ward beds in Japan (number of outpatients/number of beds) is normally from 2.0 to 3.0. Estimated number of beds becomes 108 beds on assumption of the ratio is 2.5. In consideration of 78 existing beds available in the hospital, 100 beds per two nursing units will be provided.

Affiliated Rooms: Based on the current system, an independent room will be provided for doctors and sisters. In addition, treatment rooms and its affiliate will be provided. At present

12 staff are assigned in the hospital, but the request for employment of 24 additional employees has been applied to the central government for approval. The hospital plans to start three shift services with 36 staff. A meeting room will be provided for use by 12 staff members at one time.

Intensive Care Unit (ICU)

Ward Beds: At present three ICU beds are equipped in the existing ward to be demolished. These beds are not being used presently because of absence of doctors who are studying at Port Moresby General Hospital. The doctor is scheduled to return during the next year, and request for the employment of 18 additional nurses and eight nurse aides was submitted to the central government for approval. The request will possibly be approved, since the Government acknowledges this hospital, as a base hospital, is short of personnel and equipment. Four ICU beds (one additional bed to existing three) will be provided (one bed is to be allocated to the separation room). Layout will be designed taking into account the relationship of the existing operating theatres.

[New OPD Building]

Outpatient Department

Specialist Clinic: At present two doctors are assigned to this clinic. Two more officers may be employed in near future. Three consultation rooms will be provided based on an appointment system to be adopted.

Dispensary Department

Waiting Hall: Existing waiting hall (7m²) is located at the entrance on the ground floor of the existing administration building. Floor areas are not sufficient and its function is very poor. During our survey, approximately 100 to 150

prescriptions were being handled a day. Assuming 20% of the total prescriptions are handled at the peak of the day, a 20- to 30-seated waiting hall will be provided.

Bulk Storage: Existing bulk storage has floor areas of 42m². The store is partitioned into small rooms, and is inconvenient and unpleasant for use. New bulk storage will be provided with sufficient floor area to store a six weeks supply of medicine.

Dispensary: Existing dispensary has a floor area of 33m². It was reported that working efficiency is not lowered because of the restricted space. Size of the dispensary will be similar to the existing in its floor areas (30 to 40m²), but a cold store will be annexed to save floor areas.

Pathology Department

Laboratory: Based on the current system, four units of biochemistry, haematology, bacteriology and serology will be provided. Two or three staff are assigned at each unit.

Waiting Hall: Average number of examinations handled for the last three years was recorded as 16,600 per month (45 per day). Assuming that 20% of the cases are handled at the peak, then nine seats are required.

Cold Store: The design provides for a central cold store (+4°C to 8°C) to store bulks and blood specimens.

Washing Room: A washing room will be provided to promote working efficiency.

Office: An independent room will be provided for the chief. Also, a meeting room will be annexed to the office for use by eight to 10 staff members.

Other Medical Facilities

On-Call Staff Room: The on-call staff room is defined as an overnight accommodation for the emergency staff etc. Three separate rooms (emergency staff, radiographer, doctors, and anaesthesia specialists), toilet, shower, and dining room will be provided for joint use.

6) Design Conditions of Utilities

Water Supply: The water pressure and flow of the existing city water main are considered sufficient to supply water for the new facilities. New water piping is directly branched out from the existing city main of 200 or 250 mm in diameter.

Hot Water Supply: Existing boilers are too small to supply hot water to the new facilities. A new hot water heater is to be provided.

Waste Water Drainage: Branch connection will be made to the existing city sewage pipeline.

Medical Gases: Centralised system will be provided in consideration of ease of management and application.

Air Conditioning System: The following design values are set for heating conditions:

Outside design dry-bulb temperature: 13.0°C

Outside design wet-bulb temperature: 11.8°C

Inside design dry-bulb temperature: 22.0°C

Ventilation System: Natural or forced air ventilation will be provided for offices, stores, and toilets at air changes of three to 10 times per hour.

Receiving Power Transformer Station: New transformer station will be provided for the New Central Building independently from the existing system.

Lighting System: Standard fluorescent luminaries will be provided for a lighting intensity between 100 and 1,000 lux.

Automatic Fire Alarm System: The system will conform to applicable Australian standards.

Telephone System: Existing telephone system will be extended to cover the new facilities.

Generating System: An additional generator will be provided in the new building to cope with new load.

(3) **Wewak Hospital**

1) **Construction Site:** Within the site of Wewak Hospital.

2) **Portions to be Modified:** The following additions or modification will be provided.

Outpatients, dispensary, pathology examination, operating theatre, special care nursery, physiotherapy, and psychiatric ward.

3) **Master Plan**

There will be no future construction plan at Wewak Hospital, since the aforementioned functions are updated.

4) **Natural Conditions**

Natural conditions at Wewak are as stated below:

Latitude: 3°35" S

Average Temperature: 28.3°C (near constant round-the-year)

Max temp: 33.3°C (Jan)

Min temp: 22.7°C (Sep)

Average Humidity: 82%

Gross Annual Rainfall: 2,457 mm

Max rainfall: 407 mm/month (Aug)

Min rainfall: 78 mm/month (Jan)

Wind Direction: Northwest and southeast

Seismic Zone: 2

Various measures for shading, rain water shielding, and natural ventilation have been considered and incorporated into designs based on the natural conditions as cited above. Where air conditioning system is required, the system is designed in accordance with the reference values as set forth for standard interior conditions.

5) Study for Scope of Facilities

Outpatient Department

Consultation Room: Average number of outpatients was recorded to be 75,500 per year (200 per day) for last five years. Two consultation rooms will be provided to handle 200 outpatients (five rooms for 525 patients at Lae Hospital). There is only a single exit in the existing consultation room and has resulted in crowding in the room. To improve the passage flow of patients, the existing room is to be extended by five metres westward. A one way passage system will be adopted from the consultation room to dispensary through the treatment room. Small rooms are annexed to the treatment room for injection, medication and observation.

Emergency: At present, the existing emergency has waiting hall of 18m² and treatment room of 14m². A part of the emergency waiting room is to be converted to an outpatients waiting hall, because the room is relatively larger. The existing emergency will be extended by five metres to westward (floor areas are extended to 24m²), provided with additional space for four beds.

Corridor: A new corridor will be provided from the outpatient department to the dispensary and operating theatre to prevent the adverse flow of patient passage.

Dispensary Department

Dispensary: Total floor area of the existing dispensary is 35m². Average number of prescriptions handled at the dispensary was recorded to be 14,800 per year (40 per day). The existing dispensary is not provided with separate store and therefore the room is crowded. The room is to be extended three metres westward, and new store space provided there.

Pathology Examination Department

Laboratory: Based on the current system, three units of biochemistry, haematology, and bacteriology will be provided. The room is to be extended by three metres to westward to house all equipment.

Operating Department

Affiliate: The recovery room is too small, and the patients are crowded outside the room. The southside of the affiliate will be extended and the interior space is increased with change room and enlarged recovery room.

Wards

Special Care Nursery: Average number of premature infants was recorded to be 0.75 per day (274 per year) for last four years. On assumption that average seven days are required for admission, six cots (0.75/day x 7 days) are required when simply calculated based on the above records. The hospital receives some premature infants delivered off the hospital. Inpatients and outpatients are separated to prevent spread of infection.

Physiotherapy: It was noted that the room had no ceiling and the window glass was broken. The interiors are to be upgraded, and a part of the room is to be extended as requested. The present floor is elevated by 60 to 85 centimetres above ground, and needs a sloped approach for handicapped patients.

Psychiatric Ward: It was also noted that the rooms had no ceiling and windows damaged. The interiors are to be upgraded as requested. The kitchen sink and refrigerator placed now in the recreation room are to be relocated into the administration office to prevent them from misconducts by innocent and mischievous patients.

6) Design Conditions of Utilities

Water Supply and Waste Water Drainage: Both pipelines will be extended.

Air Conditioning System: The dispensary will be air conditioned on the following conditions:

Outside design dry-bulb temperature: 33.3°C

Outside design wet-bulb temperature: 30.0°C

Inside design dry-bulb temperature: 25.0°C

Electrical System: Existing electrical wiring will be extended and electrical poles are to be relocated. A new transformer station is to be provided and distribution board is to be modified to feed power to new air conditioning system.

Telephone System: Existing PBX will be modified to meet the new requirements.

4-2-2 Selection of Equipment

- 1) Selection of Equipment to Upgrade Decrepit Functions and to Remedy Shortage: This project is not only to redevelop the existing facilities, but is also to select and recommend adequate equipment so that all medical service activities smoothly function at specified level and the current working efficiency of the doctors, nursing officer, and other medical staff is upgraded after the redevelopment.
- 2) Equipment to Suit Local Health Services: Equipment will be selected from durable and maintenance free products of good quality, best suitable for the current health services in PNG, to ensure proper, efficient and long-term usage, in consideration of scope of services, number of patients, disease patterns, availability of medical staff, current levels and systems of health services.
- 3) Maintenance-Free and Component-Replaceable Equipment: Most of medical equipment are being imported via Australia at present. This project positively selects and recommends the most reasonable products regardless of location, importing them from the third countries when deemed best and not limiting procurements to products made in Japan. Meanwhile, the Department of Health and the Department of Works currently import various products from Japan, and import consumables and parts directly from Japan or via Malaysia.

4-3 BASIC PLAN

4-3-1 Site and Layout Plan

(1) Lae (Angau Memorial) Hospital

New Central Building

The following points will be taken into consideration for layout of the New Central Building:

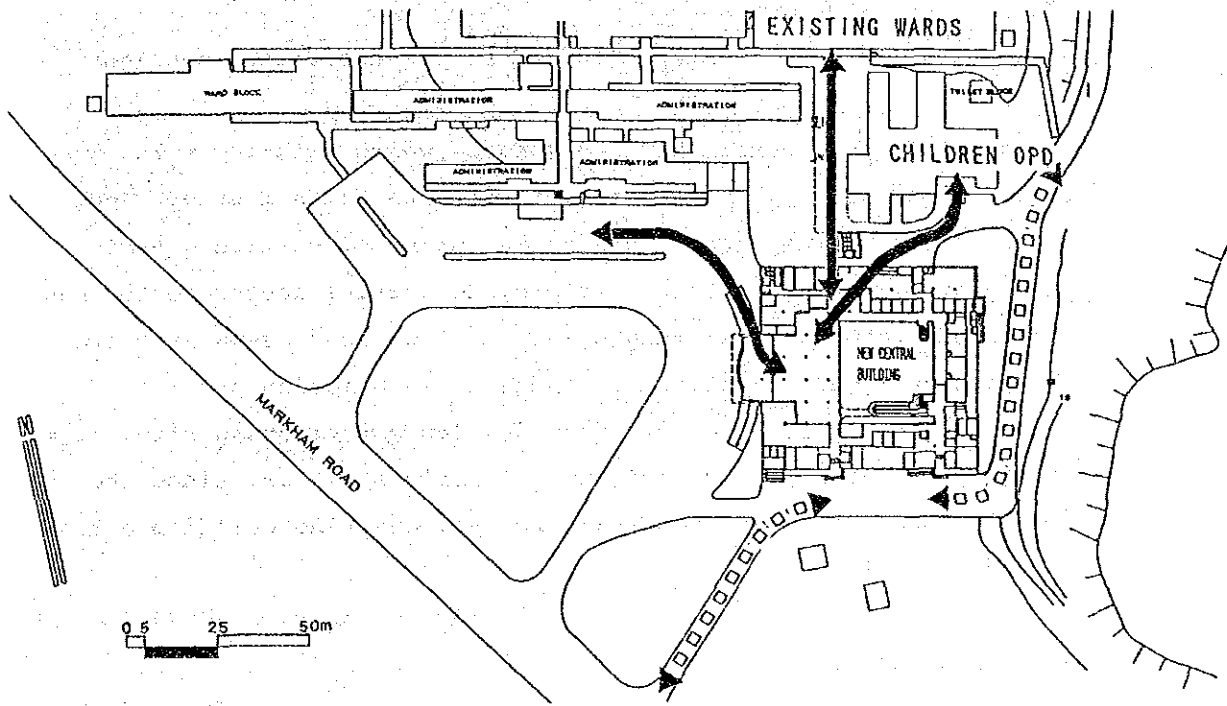
- To lay out the New Central Building in view of prospective layout of the entire hospital.
- Not to interrupt the present health service activities.
- To plan smooth and easy communication between the existing children outpatient building and new common units such as the dispensary to be installed in the New Central Building.
- To separate two approaches for the patients and for hospital services.
- To ensure natural ventilation and to prevent direct sunlight.

To satisfy the foregoing conditions, the New Central Building will be laid out close to the existing children outpatient building and consolidate the two buildings in a manner to secure a functional layout. The project will shut off the existing service road to the nursing school on the south side of existing children outpatient building to eliminate crossing passage lines, and will provide a new service road from the main road for access to the New Central Building and the nursing school. Child-outpatients are presently passing through the service road leading the nursing school which is to be shut off. This passage line may interfere the new passage line between the New Central Building and the existing wards.

Therefore, the passage line leading to the existing children outpatient building will be detoured as much as possible through the waiting hall in the New Central Building to avoid the crossing.

Corridor between Obstetric Wards and Operating Theatre

Existing corridors of two buildings will be connected with new corridors.



← PATIENT
 ← □ □ □ SERVICE

(2) Mt. Hagen Hospital

New MCH Building

The following points will be taken into consideration for layout of the new MCH Building:

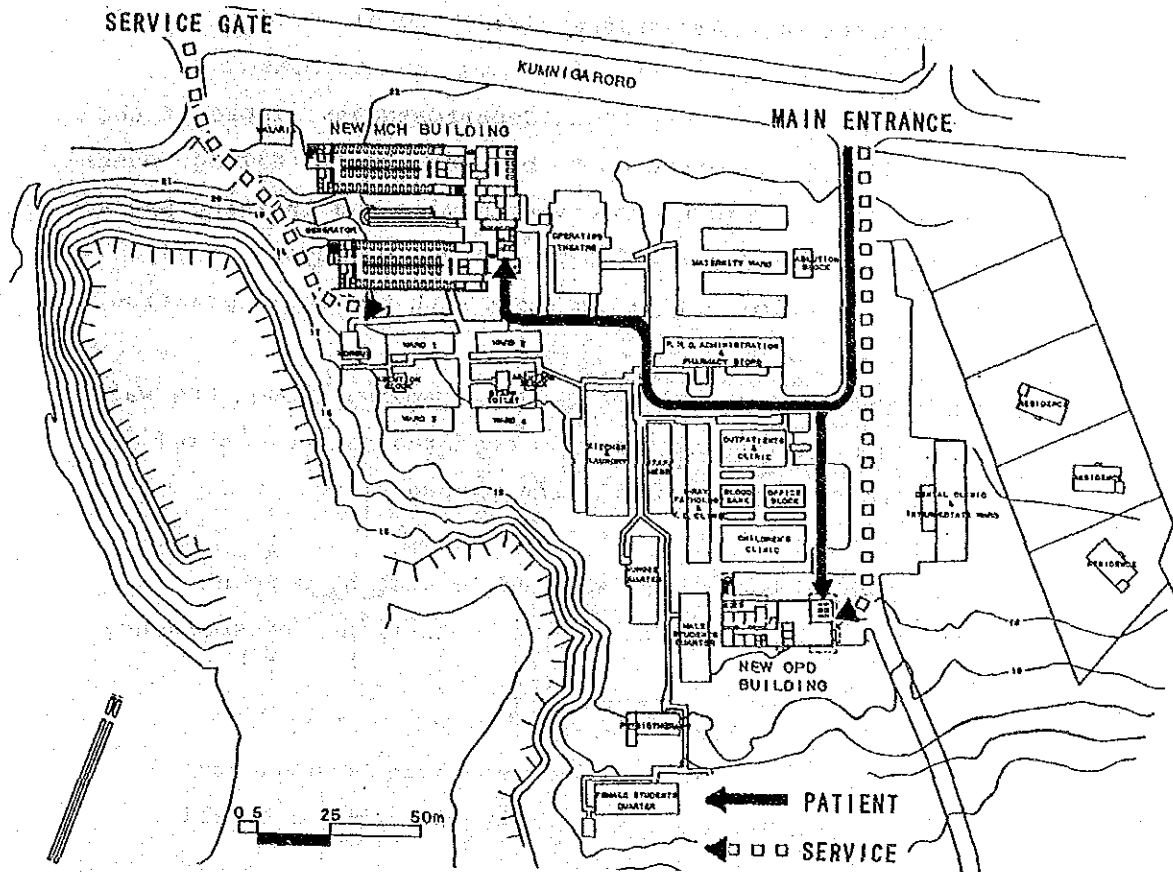
- The New MCH Building will be sited in accordance with the master plan for the entire hospital.
- Interference with the present medical services will be minimised.
- Separate approaches for the patients and for hospital services.
- Use the sloped ground conditions effectively.
- To ensure natural ventilation and to prevent direct sunlight.

The site of construction will be located where existing wards need to be demolished. The west side of the site faces a steep slope two to three metres high. This siting plans to utilise a semi-underground mechanical room. To provide service access to the new mechanical room, the existing by-way will be used, separated from the passage line for patients. There is an existing power generating facility at a corner of the new construction site. The design provides for this facility to remain as it is, since the facility provides power necessary for the existing building during the construction.

New OPD Building

A new OPD Building will be laid out in the open area at the south side of the existing OPD building.

(3) Wewak Hospital



4-3-2 Architectural Design

(1) Floor Plan

The floor plan has been prepared taking into consideration the functional requirements for each room, passage pattern of patients, personnel and goods, and operational requirements of the medical services in PNG. This floor plan has been shown on the basic design drawings.

1) Lae (Angau Memorial) Hospital

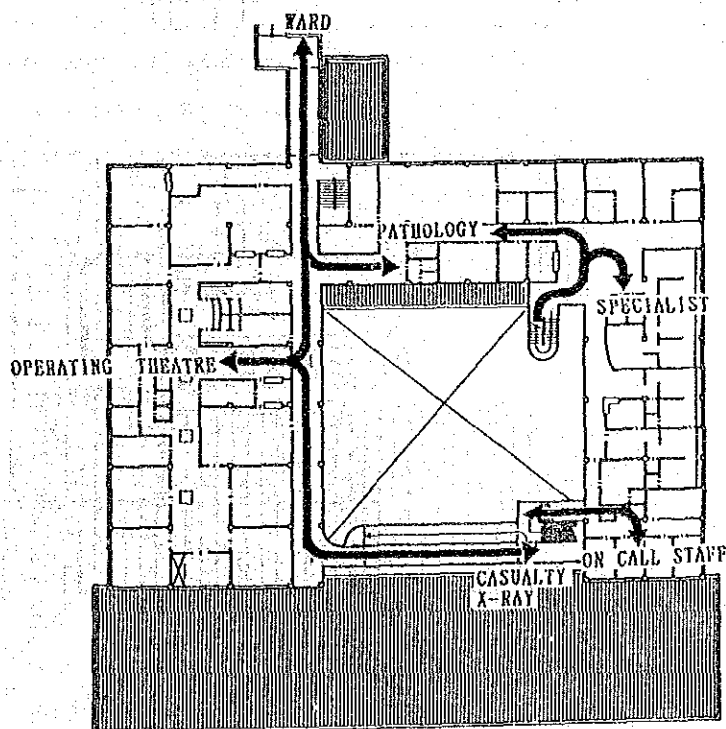
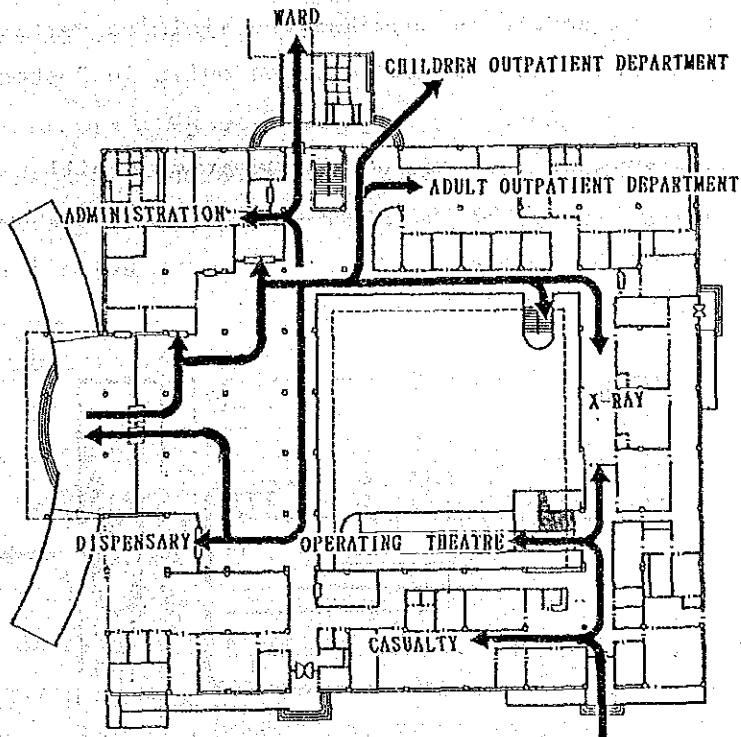
New Central Building

The New Central Building will be a two-storied building to

minimise vertical movement of the patients and to avoid the maintenance problems of the lifts.

- Since the general outpatient department, as a core of the new building, is expected to be crowded with a large number of patients, it is necessary to minimise the crossing passage at the centre of the building. A one way system will be set up in the building in accordance with the local practice.
- Child-outpatients will be guided to pass through the waiting hall and take all necessary procedures in the Central Building to avoid crossing the passage line.
- Radiographic Department will be located at a point convenient for both the general outpatient and emergency departments.
- A courtyard will be provided to obtain both natural ventilation and lighting equally distributed to all departments in the building.
- Admission office and other departments to serve outpatients will be provided at locations close to the existing wards.
- Dispensary Department will be located at a point most convenient for both outpatients and delivery services.
- Pathology Department will be provided at a point most convenient for both inpatients and outpatients. All test specimens of inpatients are collected by nurses at the inpatient wards. However, an approach way for the inpatients will be considered as much as possible.
- Operating theatre is required to be at a location accessible to both the emergency department and the inpatient wards. In addition to the above requirements, cleanliness is a requirement for this unit to prevent it from contamination.

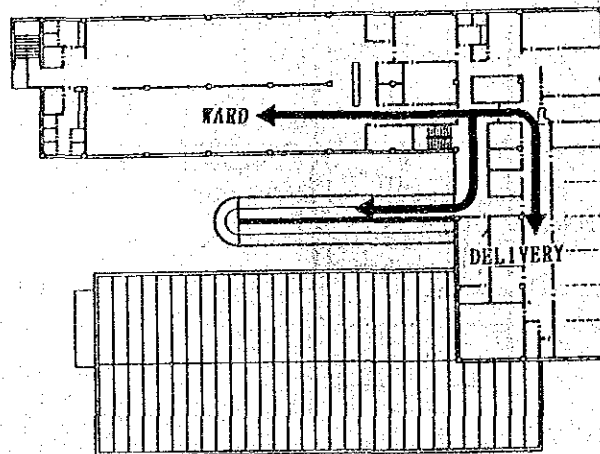
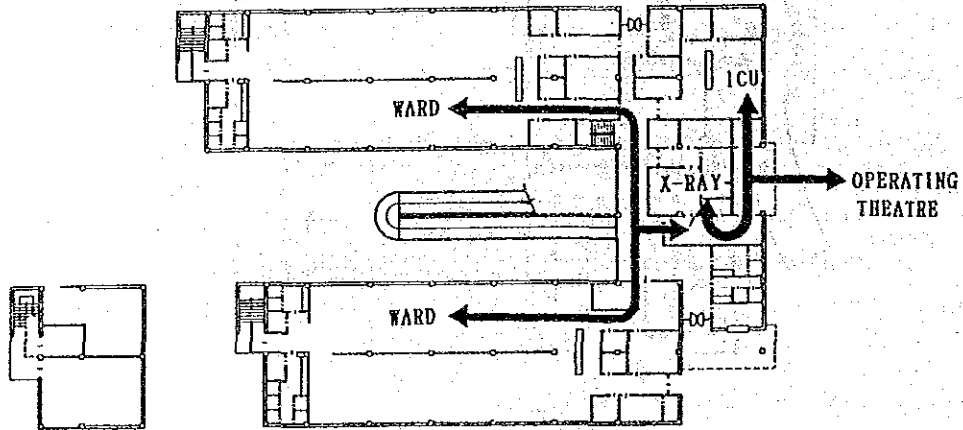
Therefore, the operating theatre is to be provided at a location remote from the public area. The central supply, annexed to the operating theatre, will be provided at a location convenient for both outpatient department and inpatient wards.



2) Mt. Hagen Hospital

New MCH Building

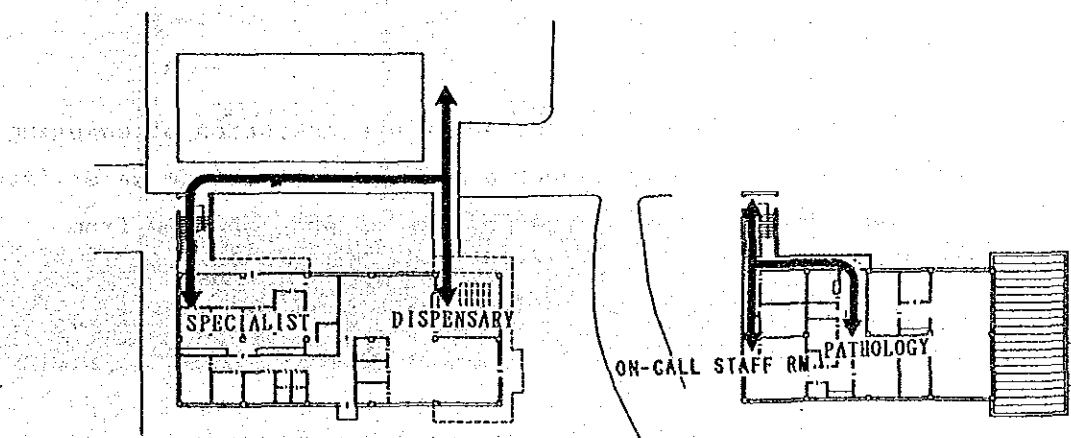
- Since maintenance services of lifts are not locally available, and it is necessary to minimise vertical movement of patients, new facility will be built in 2-storied.
- Radiography Department and ICU Department will be built at a convenient location for providing services to the existing operating theatres.



- Paediatric Ward will be placed at the ground floor so that children can play at outside the building. One nursing unit is composed of 50 beds, the beds will be laid out in accordance with Nightingale system which is practically adopted in PNG. This is the system to make it possible to attend on the most patients with the least nursing staff.
- Obstetric ward will be provided on the 1st floor of the new building, annexed with delivery rooms and special care nursery in the aim to provide passage lines for these facilities.

New OPD Building

- Special Outpatient Department will be laid out on the ground floor in consideration of relevance with the existing outpatient building.
- Dispensary Department will be placed at a location convenient to act as point of contact with patients or the servicing units for delivery of bulks.
- Pathology Department and On-Call Staff Room will be laid out on the first floor.



3) Wewak Hospital

- One-way passage system will be adopted in the ward by directing all patients coming out from the consultation and treatment rooms to the Dispensary along the one-way passage line.
- The departments of Outpatient, Dispensary, Pathology, Operating Theatre, and Special Care Nursery will be expanded by relocating the exterior walls.

(2) Elevational and Sectional Plans

1) Elevational Plan

New buildings will be constructed with sloped roofs of similar style well matched to the existing buildings not to impair harmony of the whole hospital. The exterior walls of the existing buildings will be finished with wood materials. In this project, materials of the exterior walls will be selected from the materials which require less maintenance and are generally used in PNG. Meanwhile, new exterior walls at Wewak Hospital are a part of the expansion project, they will be constructed of wood as same as the existing building in consideration of salty environment along the shore lines.

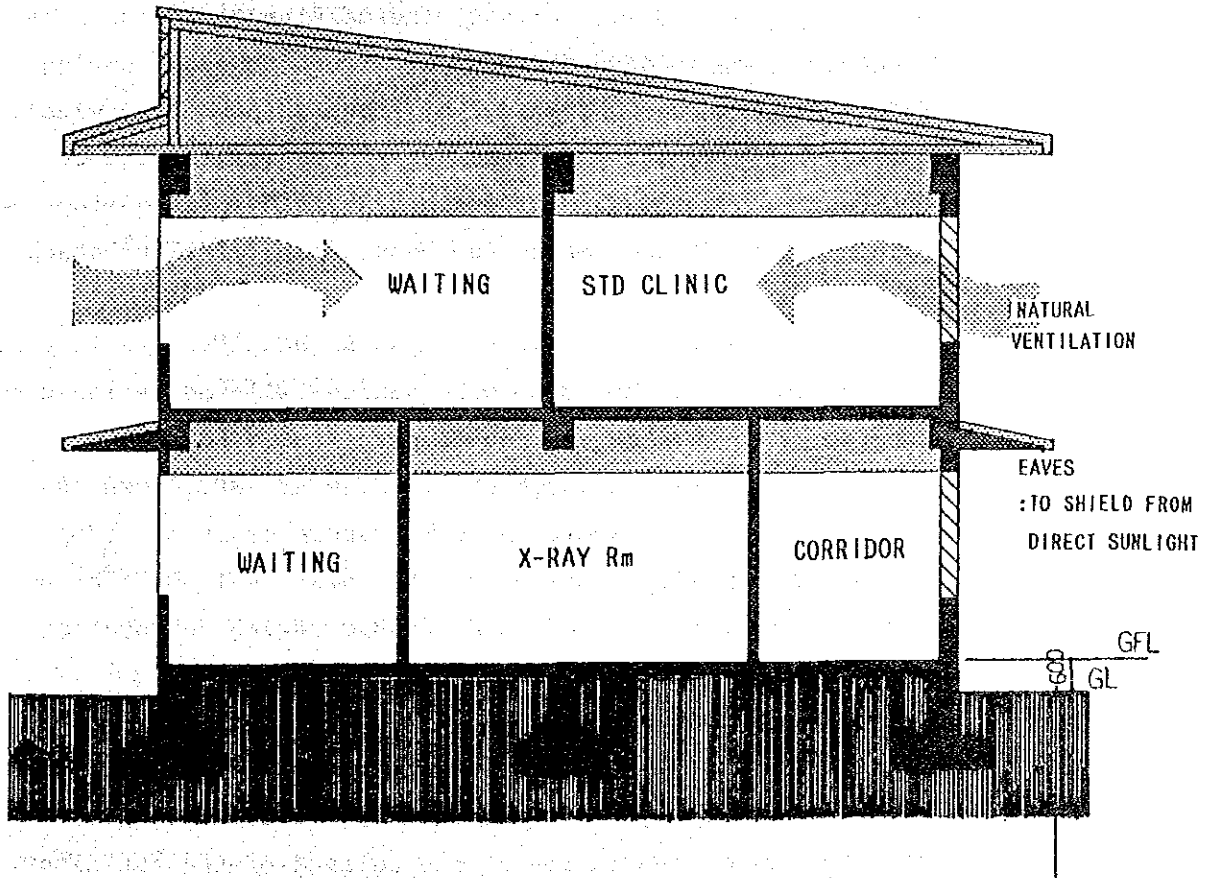
2) Sectional Plan

Sectional plans have been set up in the intention of ensuring natural ventilation, preventive measures of surface water into the facilities, measures against high tides, shading from direct sunlight, and thermal insulation for roofs.

Floor Height (Ground Floor Level)

- Lae (Angau Memorial) Hospital
Ground level plus 600 mm (same level as existing to withstand high tide)
- Mt. Hagen Hospital
Ground level plus 150 mm (same level as existing)
- Wewak Hospital
Ground level plus 850 mm (same level as existing to withstand high tide)

EAVES : TO PREVENT RAINWATER
FROM GETTING INTO ROOMS



GROUND FLOOR LEVEL IS SET 600MM ABOVE THE GROUND LEVEL
TO PROTECT THE BUILDING FROM OVERFLOWING RAINWATER

Ceiling Height (Ground and 1st Floors)

- Lae (Angau Memorial) Hospital
4 metres common for both the ground and 1st floors (to secure natural ventilation)
- Mt. Hagen Hospital
4 metres common for both the ground and 1st floors (to secure natural ventilation)
- Wewak Hospital
Remain as existing

Eaves: The site is located in the areas close to the equator where the angle of incidence is almost vertical. Therefore, the building will be shaded from direct sunlight of the day-time with deep eaves of 1.8 metres. Thermal insulation will be much upgraded, against the heat of direct sunlight during the morning and early evening, by reducing number of window openings at east and west side walls. The eaves will be designed to prevent the buildings from rainy blow during the driving rain and in a manner to secure natural ventilation.

Openings: Lae (Angau Memorial) Hospital and Wewak Hospital are located in the tropical rainy zone. The windows will be designed to the type with louvres as much as practicable to secure natural ventilation through them. However, Mt. Hagen is located on the hill where the temperature drops to 1.7°C. The buildings will be designed with lower walls similar to the existing style to reduce heat load during the heating season.

Roofs: Roofs will be designed to sloped roof with attic similarly to the existing style. The roofs will be insulated to improve thermal insulation of the ceiling of the 1st floor.

4-3-3 Structural Design

(1) Outline of Structural Designs

1) Lae (Angau Memorial) Hospital

The project of this hospital contains construction of a New Central Building which is composed of Outpatient Department, Examination Department, Dispensary Department, Operating Theatre Department, and Administration Department. Number of stories of the new building will be planned as follows:

New Central Building: two storied

2) Mt. Hagen Hospital

The project of this hospital contains construction of two buildings of MCH and OPD. The former contains departments of Obstetric, Paediatric, Special Care Nursery, ICU, and Radiography. The latter contains the departments of Pathology, Special Outpatient, Dispensary, and On-Call Staff Room. Number of stories of the new buildings will be planned as follows:

New MCH Building: Two storied with semi-basement

New OPD Building: Two storied

3) Wewak Hospital

The project of this hospital contains additions and interior modifications of various buildings such as Outpatient Department, Dispensary Department, Operating Theatre, Special Care Nursery Room, Physiotherapy and Psychiatric Wards. All these buildings are single storied.

(2) Type of Structures

1) Type of Foundations

The existing soil conditions of construction sites at Lae Hospital and Mt. Hagen Hospital are as stated below from the soil survey data furnished by the Department of Works (DOW), PNG.

Lae (Angau Memorial) Hospital

The subsurface of construction site for New Central Building is composed of poorly unconsolidated silty sand layer from 1.0 to 1.7 metres below the topsoil and of sandy gravel layer under the silty sand layer. Ground water level is between 1.5 and 2.0 metres below the ground surface. The unconsolidated silty sand layer is not adequate to support foundations. Therefore, the bearing layer for the project building will be constructed of sandy gravels placed in the ground 1.0 to 1.7 metres below the surface. Foundations of spread type are recommended.

The site is located at a point of poor drainage where surface water quite often floods during the heavy rain. Therefore, it is necessary to raise the ground floor level by 60 cm above the ground surface, and to support the ground floor with stubs. Foundations for the connecting corridor will be designed to be supported on independent footings similarly to the existing.

Mt. Hagen Hospital

The subsurface of the proposed construction site for new MCH Building is composed of reddish brown silty clay 0.1 to 0.3 metres below the ground surface. Optimum design of foundations should be the spread foundation supported on silty clay layer approximately 1.5 metres directly under the surface in line of the scale of the new building.

The subsurface of the site for new OPD Building is also composed of reddish silty clay 1.0 to 1.9 metres below the surface. The type of foundations, therefore, should be same as the foundations for the MCH Building.

Wewak Hospital

The project is to provide single storied extensions for the existing buildings. Independent footings as same as existing will be constructed in the ground excavated to a depth as necessary.

2) Type of Framing

Structural designs will be planned in consideration of functions, services, and locality of each hospital together with workability and economy.

Walls will be constructed of reinforced concrete blocks in principle. However, the walls between frames may also be constructed of seismic resistant reinforced concrete to support a partial load of horizontal force. Roof trusses will be fabricated of local wood materials by applying local construction method. The trusses will be designed to bear the self load and wind load to be applied on the roof.

Lae (Angau Memorial) Hospital

Structures of New Central Building will be fabricated in two basic modules of 6.0 m x 6.0 m and 6.0 m x 9.0 m. Floor height is to be designed 4.0 metres high for the both floors. The main structure will be rigid frame reinforced concrete shearing walls to meet the services of the building. Also, expansion joints will be provided by taking into account of its style and various problems due to seismic behaviour, concentration of stresses, and uneven settlement to act on the structure.

Connecting corridor will be planned separately to well much the existing buildings, but it will be constructed of wood in single storied raised floor.

Mt. Hagen Hospital

Structures of New MCH Building will be fabricated in two basic modules of 6.0 m x 6.5 m and 6.5 m x 6.5 m. Floor height is to be designed 4.0 metres high for the both floors. Basement will be provided by using practically the sloped ground. The main structure will be rigid frame reinforced concrete shearing walls to meet the services of the building. Expansion joints will also be provided for the new MCH Building due to similar reasons for the New Central Building at Lae (Angau Memorial) Hospital.

New OPD Building will be constructed of structure of a module of 6.0 m x 6.5 m with floor height of 4.0 metres high for both ground and 1st floors. The main structure of the building will be rigid frame reinforced concrete in consideration of its function and services.

Wewak Hospital

The project buildings will be horizontally extended with similar framing to the existing structure. Demolition of the existing walls must be carefully planned to ensure proper tie-in between additive portions and the existing buildings. The ground floor will be raised to match the existing floor level by either of reinforced concrete or of wood to suite the actual services of the buildings.

(3) Structural Materials

- 1) Cement: Normal Portland cement in compliance with AS 1315 and JIS R 5210.
- 2) Concrete: Normal concrete, Grade 20, 28-day compressive strength of 20 MPa = 200 kg/cm², in compliance with PNG Standard 1002-1982.

3) Reinforcement

Plain bars: AS 1302, Grade 230R, and JIS G 3312, SR 24

Deformed bars: AS 1302, Grade 410Y, and JIS G 3112, SD 35

Steel shapes: AS 1204, Grade 250, and JIS G 3101, SS 41

(4) Structural Design Standards

National structural design standards applicable in PNG were established in 1982 as listed below. The designs will be planned principally in accordance with these standards.

PNG Design Standards

MP1-1982	Design Manual
1000-1982	The International System of Units and Its Application
1001-1982, Part 1 & 2	General Design Requirements, and Live Loads
1001-1982, Part 3	Wind Loads
1001-1982, Part 4	Earthquake Loadings
1002-1982	Code of Practice for Reinforced Concrete Structures
1003-1982	Steel Structures
1004-1982	Reinforced Masonry Structures

(5) Loads and External Forces

1) Dead Load: Weight and other necessary data of structural and finish materials are calculated based on actual practice in

architectural designs.

- 2) Live Load: The following values will be used in planning in accordance with the requirements of Appendix B, Section 3, Part 2 of the PNG Design Standard 1001-1982, and in consideration of actual services of buildings and type of rooms:

Roof	0.25 KPa	25 kg/m ²
Patient Room	2.0	200
Treatment Room	3.0	300
Office	3.0	300
Laboratory	3.0	300
Classroom	3.0	300
Store	5.0	500
Conference Room	3.0	300

Reduction Live Load: Live load to be applied in calculations of columns, girders, and foundations may be reduced at the following rate when the values are below 5 KPa (500 kg/m²):

$$R = 0.86A$$

whereas, R : rate of reduction (%)

A : floor area (m²) supported by structural components (columns, girders, and foundations)

provided, $R \geq 50\%$, and $100 \times (D + L) / (4.33L) \%$

whereas, D : dead load (kg/m²)

L : design live load

- 3) Seismic Force

PNG is situated within the Pan Pacific seismic zone, and the land of the country is classified into four zones based on the

frequencies of earthquake recorded. Lae and Wewak are classified into Zone 2, and Mt. Hagen is classified into Zone 3.

Seismic design must be incorporated into the structural designs. Values of seismic force are based on the requirements of Part 4, PNG Design Standard 1001-1982. Total horizontal seismic base shear is calculated with the following equation:

$$V = C \cdot I \cdot K \cdot W_t$$

whereas, C : basic seismic coefficient (0.2 for Zone 2 and 0.16 for Zone 3)

I : importance factor (1.5 for hospital)

K : structural type factor (1.0 for reinforced concrete rigid frame structure)

W_t : total of the vertical loads above the level of lateral restraint

where, $0 < L < 1.5$ KPa, $W_t = D$

where, $1.5 \text{ KPa} \leq L < 5.0 \text{ KPa}$,
 $W_t = D + (L/3)$

where, $L \geq 5.0 \text{ KPa}$,
 $W_t = D + (2L/3)$

As the results of the foregoing calculations, base shear (V) to be incorporated into designs of the project hospitals will be as follows:

Lae (Angau Memorial) Hospital:

$$\begin{aligned} V &= C \cdot I \cdot K \cdot W_t \\ &= 0.2 \times 1.5 \times 1.0 \times W_t \\ &= 0.3 W_t \end{aligned}$$

Mt. Hagen Hospital:

$$\begin{aligned} V &= 0.16 \times 1.5 \times 1.0 \times W_t \\ &= 0.24 W_t \end{aligned}$$

4) Wind Load

Wind load is based on the requirements of Part 3 of PNG Design Standard 1001-1982. Design wind pressure is calculated as follows:

$$P = C \cdot q$$

whereas, C : wind pressure coefficient

$$q : 0.6 V_z^2 \times 10^{-3}$$

$$\text{Lae Hospital:} \quad V_z = 0.93 \times 24 = 22.3 \text{ m/sec}$$

$$\text{Mt. Hagen Hospital:} \quad V_z = 0.65 \times 28 = 18.2 \text{ m/sec}$$

$$\text{Wewak Hospital:} \quad V_z = 0.93 \times 28 = 26.0 \text{ m/sec}$$

Therefore,

Lae Hospital:

$$P = C \times 0.6 \times 22.3 \times 22.3 \times 10^{-3} = (0.3 \cdot C) \text{ KPa}$$

Mt. Hagen Hospital:

$$P = C \times 0.6 \times 18.2 \times 18.2 \times 10^{-3} = (0.2 \cdot C) \text{ KPa}$$

Wewak Hospital:

$$P = C \times 0.6 \times 26.0 \times 26.0 \times 10^{-3} = (0.4 \cdot C) \text{ KPa}$$

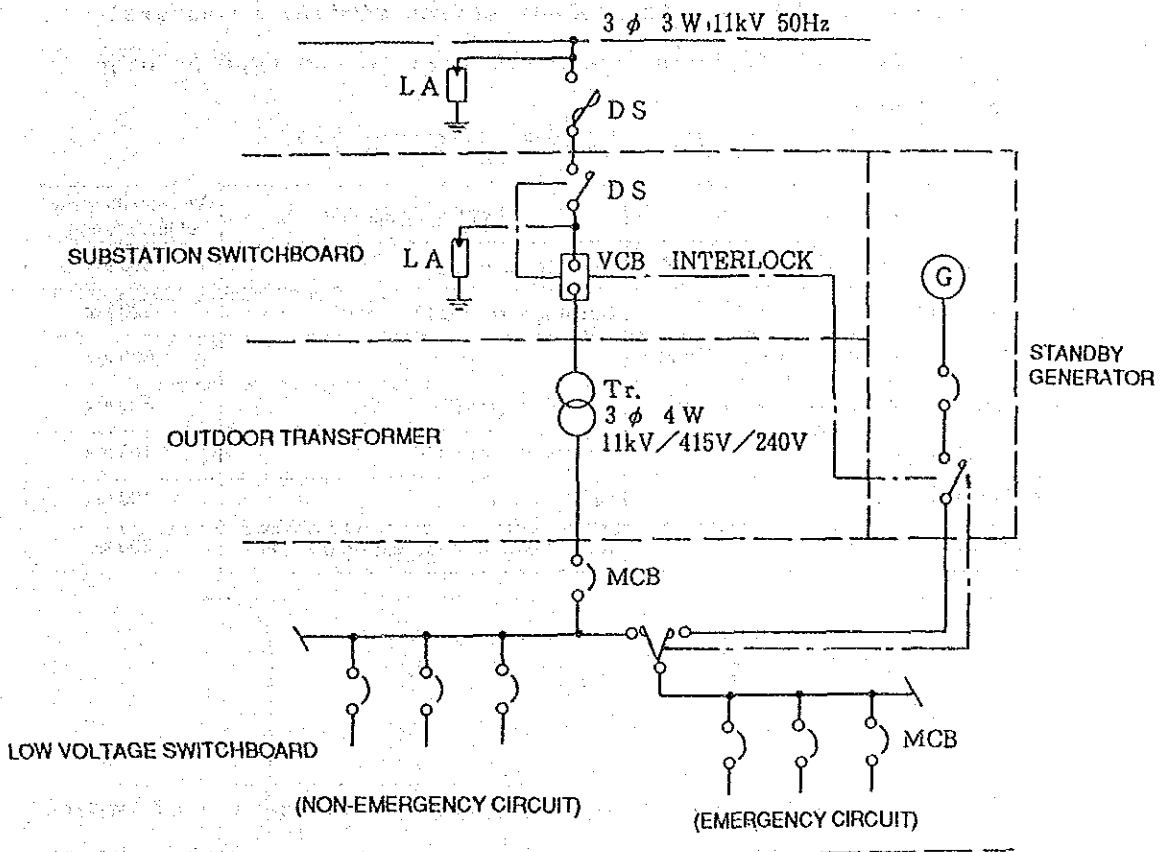
4-3-4 Building Equipment Plan

(1) Lae (Angau Memorial) Hospital

1) Electrical System

Power Supply

Power is received at the substation (400 kVA) through underground cables via overhead wiring of 3-phase 3-wire 11 kV 50 Hz, along the east side of the construction site for the New Central Building.



SUBSTATION SYSTEM DIAGRAM

Emergency Generating System

In order to maintain functional operations of the hospital during accidental power cutoff, an emergency generator will be provided to supply power to medical equipment, security lights, fire prevention system and electric motors of various mechanical systems. The capacity of the generator is 300 kVA.

Lighting System

Lighting system will be planned in a manner to provide sufficient intensity of illumination for work in the administration offices and public areas to assure easy cleaning and replacement of lights, not to provide the glare of illumination to patients in the ward, and to provide for the examination laboratories colour effect similar to natural lighting. The lighting equipment will be the type of high efficiency.

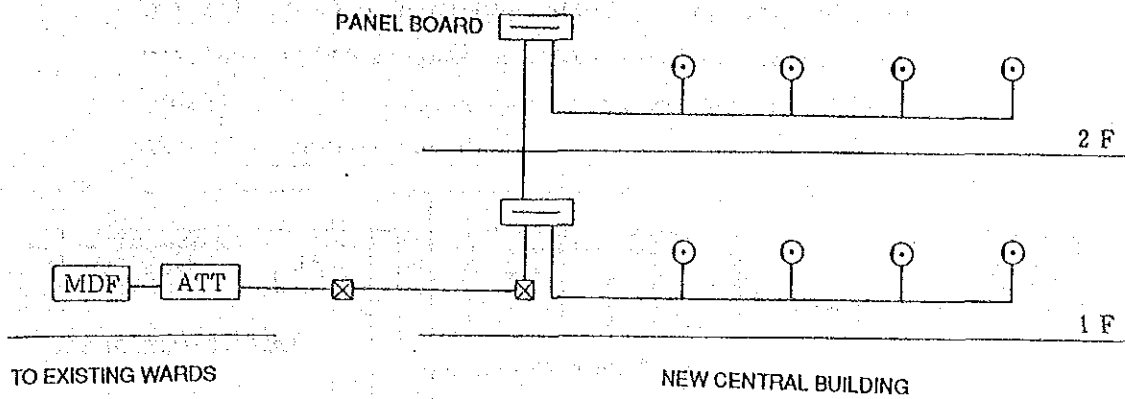
Room	Lighting Equipment	Average Intensity of Illumination
Outpatient Consultation and Treatment Rooms	Recessed open FL	300 lux
Examination Department	Recessed covered FL	500 lux
Operating Theatre and Minor Operating Theatre	- ditto -	1,000 lux
Administration Department, Staff Office & NS	Recessed open FL	300 lux
Resuscitation Room	Recessed covered FL	100 lux
Store, Toilet and others	Ceiling mount FL	100 lux
X-ray Examination Room	Natural color incandecent lamp and FL	300 lux

Outlets

Outlets will be provided as necessary for operation of medical equipment, laboratory equipment, or office equipment. Outlets for medical and laboratory equipment will be selected from grounded or explosion-proof type to suit the location of installation. An automatic voltage regulator will be provided against voltage fluctuations.

Telephone System

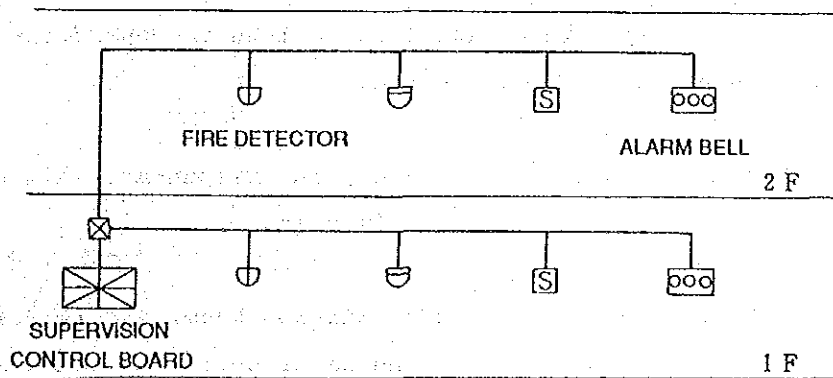
The existing internal telephone wiring will be extended to new areas.



TELEPHONE SYSTEM DIAGRAM

Fire Alarm System

System will be designed in accordance with the requirements of applicable Australian standards. The control board will be installed in the Administration Department and fire detectors will be installed at location deemed necessary.



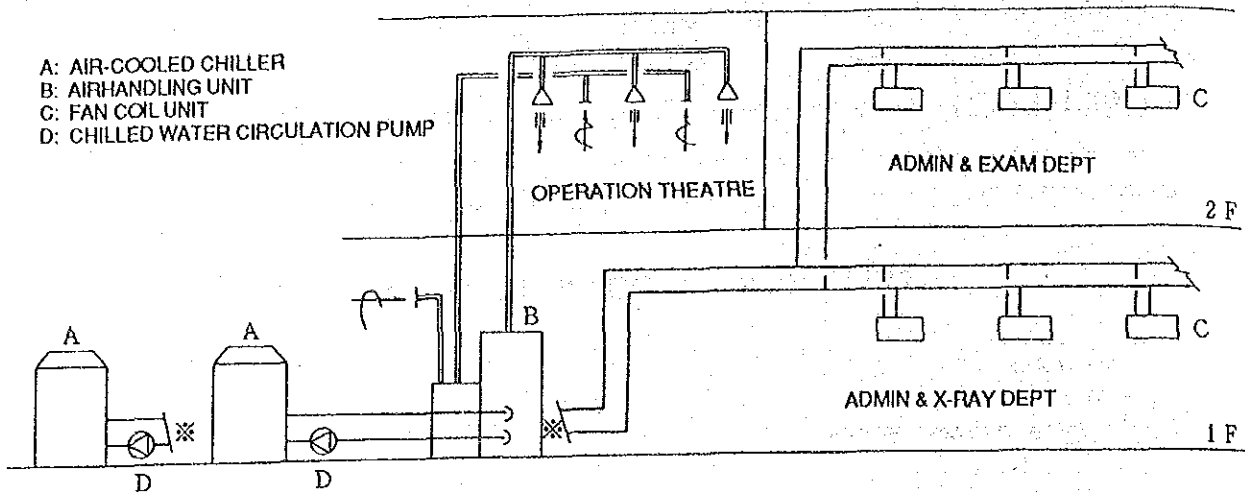
FIRE ALARM SYSTEM DIAGRAM

2) Airconditioning System

Design Temperature and Humidity

Inside and outside cooling conditions will be as follows:

Outside design dry-bulb temperature: 36.5°C
 Outside design wet-bulb temperature: 33.4°C
 Inside design dry-bulb temperature: 25.0°C



AIRCONDITIONING SYSTEM DIAGRAM

Cooling System

The system will be designed as follows in consideration of ease of operations and maintenance.

For Administration, X-ray Room, and Dispensary: Air cooled chilling water unit + fan coil units

For Operating Theatre, Resuscitation Room, and relative sections: Air cooled chilling water unit + ducted air handling unit

Ventilation System

Rooms will be naturally ventilated in principle. Where forced air ventilation is required, exhaust fans will be provided to change air at the following frequencies:

Toilet: 10 air changes per hour

Bulk Store: 5 air changes per hour
Other rooms: 3 to 5 changes per hour

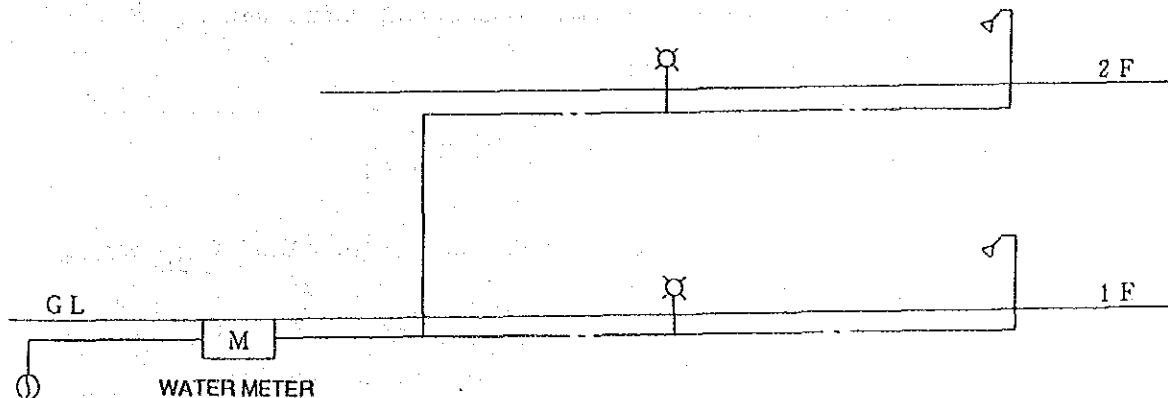
Automatic Control System

In order to simplify the procedures of operations and maintenance, each unit will be designed to control individually.

3) Water Supply and Drainage Systems

Water Supply System

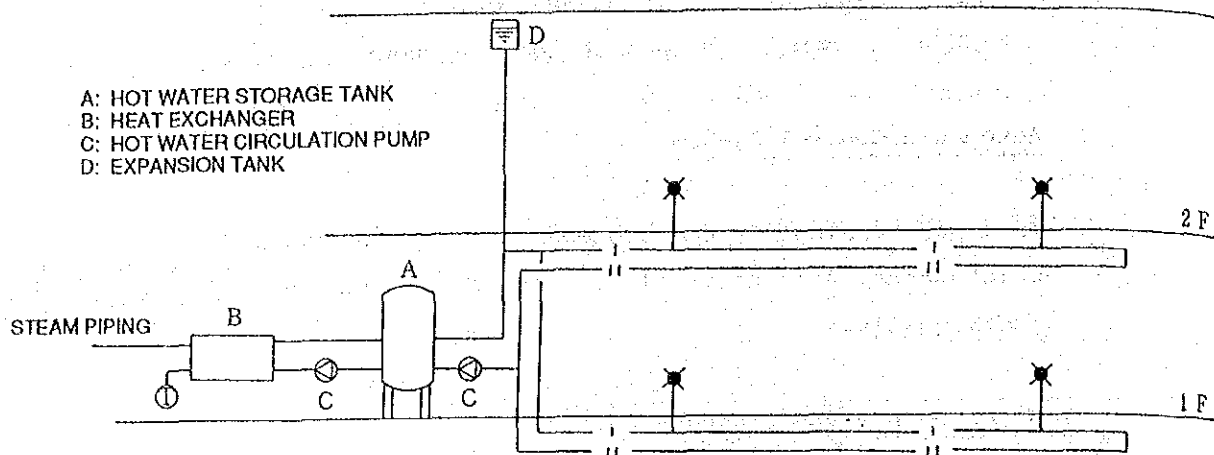
Water is supplied to the New Central Building from new water piping connected to the existing main of 100 mm in diameter. New piping will be directly connected to the existing main because the water pressure and flow are sufficient and to reduce maintenance problems in future.



WATER SUPPLY SYSTEM DIAGRAM

Hot Water Supply System

The capacity of the existing steam boiler is sufficient to provide steam to the new building. Steam will be supplied through new header and piping to the hot water storage tank to be installed in the New Central Building. Hot water will be distributed from the storage tank to appropriate locations.



HOT WATER SUPPLY SYSTEM DIAGRAM

Drainage and Venting Systems

Interior: Separate system for sewage and waste water.

Exterior: Combined system for sewage and waste water. Surface water is separately drained off.

Steam Supply System

Steam to the high pressured steriliser is supplied from the existing steam boiler.

Toilet Accessories

Closets of both western and Asian styles, urinals, lavatories, and showers will be provided.

Medical Gas Supply System

Centralised supply systems for oxygen, nitrous oxide, and compressed air will be provided as follows:

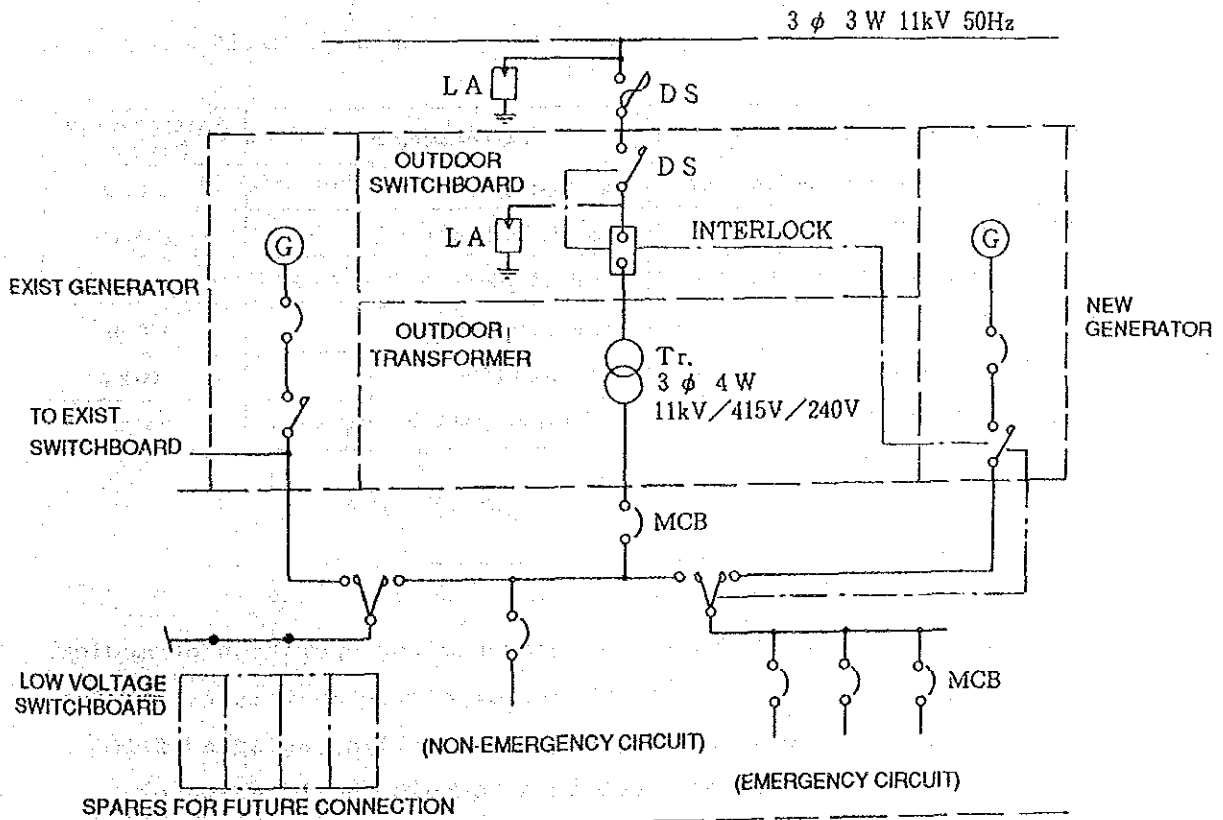
Room	Oxygen	Nitrous Oxide	Suction Pressure	Compressed Air
Operating Theatre and Minor Operating Theatre	○	○	○	○
Recovery and Resuscitation Rooms	○		○	○

(2) Mt. Hagen Hospital

1) Electrical System

Power Supply

Power is received at the substation (400 kVA) through underground cables via overhead wiring of 3-phase 3-wire 11 kV 50 Hz, laid along the road on north side of the construction site of new MCH Building.



SUBSTATION SYSTEM DIAGRAM

Emergency Generating System

In order to maintain functional operations of the hospital during accidental power cutoff, an emergency generator will be provided to supply power to medical equipment, security lights, fire prevention system and electric motors of various mechanical systems. The capacity of the generator is 150 kVA.

Lighting System

Lighting system will be planned in a manner to provide sufficient intensity of illumination for work in the administration offices and public areas to assure easy cleaning and replacement of lights, not to provide the glare of illumination to patients in the ward, and to provide for the examination laboratories colour effect similar to natural lighting. The lighting equipment will be the type of high efficiency.

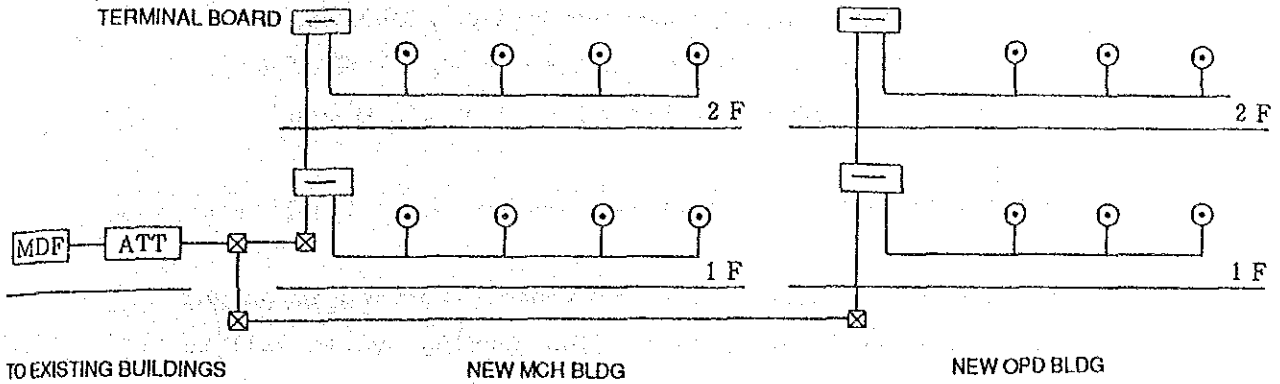
Room	Lighting Equipment	Average Intensity of Illumination
Outpatient Consultation and Treatment Rooms	Recessed open FL	300 lux
Labour and Delivery Room	Recessed covered FL	500 lux
Administration Department, Staff Office & NS	Recessed open FL	300 lux
Ward and ICU	Recessed covered FL	100 lux
Store, Toilet and others	Ceiling mount FL	100 lux
X-ray Examination Room	Natural color incandecent lamp or FL	300 lux

Outlets

Outlets will be provided as necessary for operation of medical equipment, laboratory equipment, or office equipment. Outlets for medical and laboratory equipment will be selected from grounded or explosion-proof type to suit the location of installation. An automatic voltage regulator will be provided against voltage fluctuations.

Telephone System

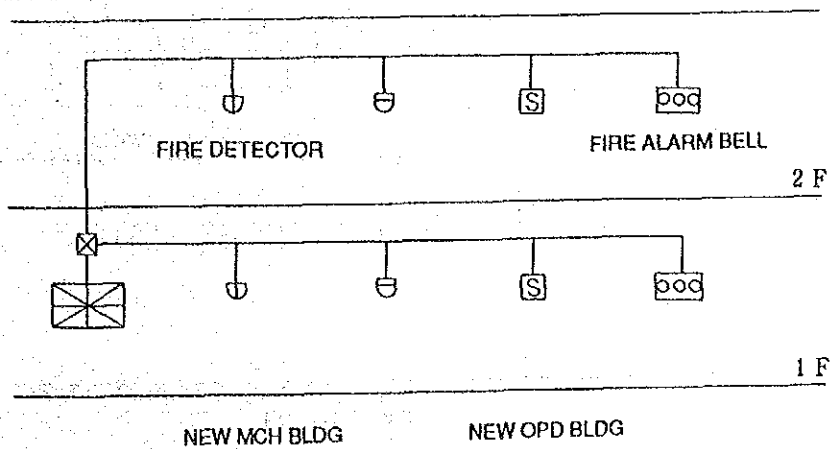
The existing internal telephone wiring will be extended to new areas.



TELEPHONE SYSTEM DIAGRAM

Fire Alarm System

System will be designed in accordance with the requirements of applicable Australian standards. The control board will be installed in the Administration Department and fire detectors will be installed at location deemed necessary.



FIRE ALARM SYSTEM DIAGRAM

2) Airconditioning System

Design Temperature and Humidity

Inside and outside heating conditions will be as follows:

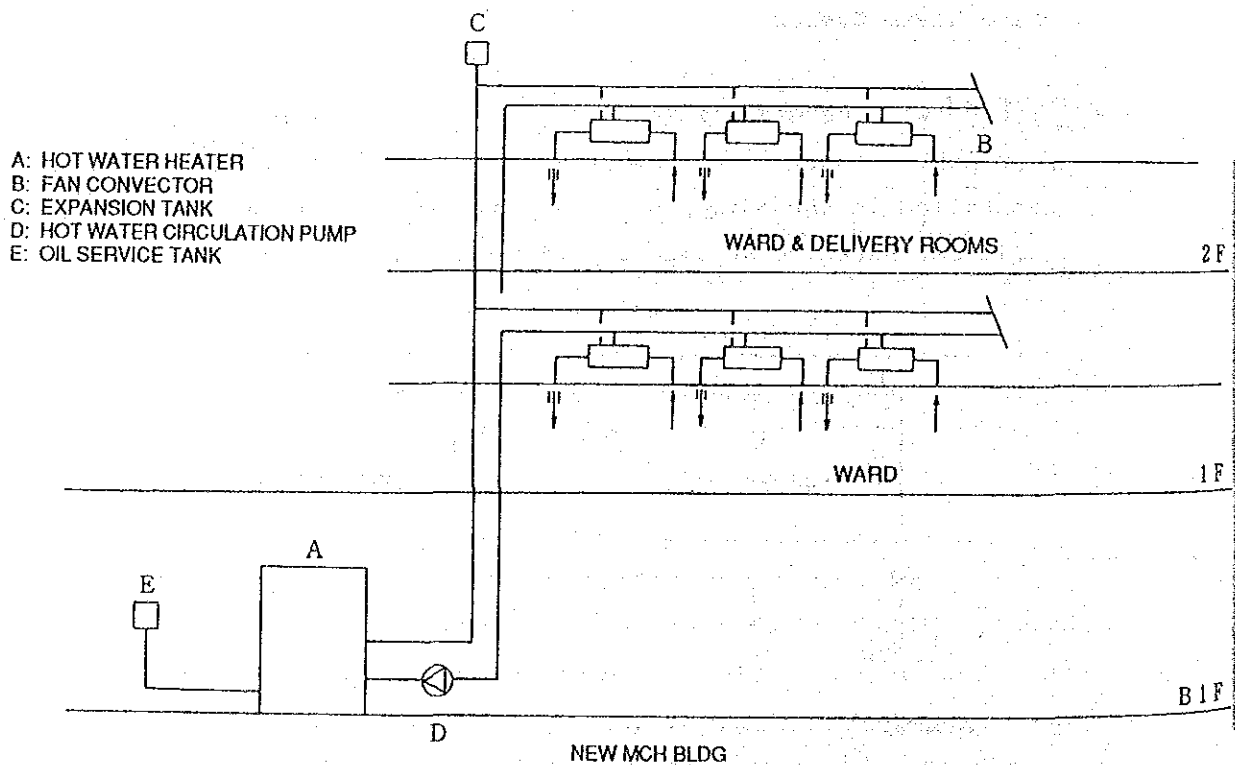
Outside design dry-bulb temperature: 13.0°C

Outside design wet-bulb temperature: 11.8°C

Inside design dry-bulb temperature: 22.0°C

Heating System

Heating system only will be provided. Cooling is gained through natural ventilation. The heating system will be designed to distribute hot water heat to all wards, ICU Room, normal and abnormal delivery rooms, and neonate and special care nursery through fan convectors.



HEATING SYSTEM DIAGRAM

Ventilation System

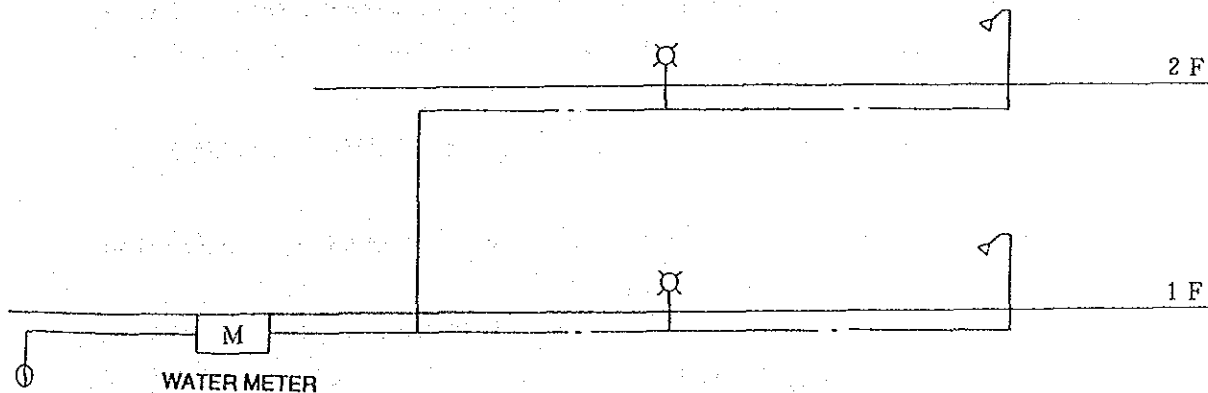
Rooms are naturally ventilated in principle. Where forced air ventilation is required, exhaust fans will be provided to change air at the following frequencies:

- Toilet and pantry: 10 air change per hour
- Bulk stores: 5 air change per hour
- Other rooms: 3 to 5 air changes per hour

3) Water Supply and Drainage System

Water Supply System

Water is supplied to the new MCH Building through new water piping connected to the existing public water main of 200 mm in diameter buried in Kummniga Road. New piping will be directly connected to the main because the water pressure and flow are currently sufficient to feed the new building.

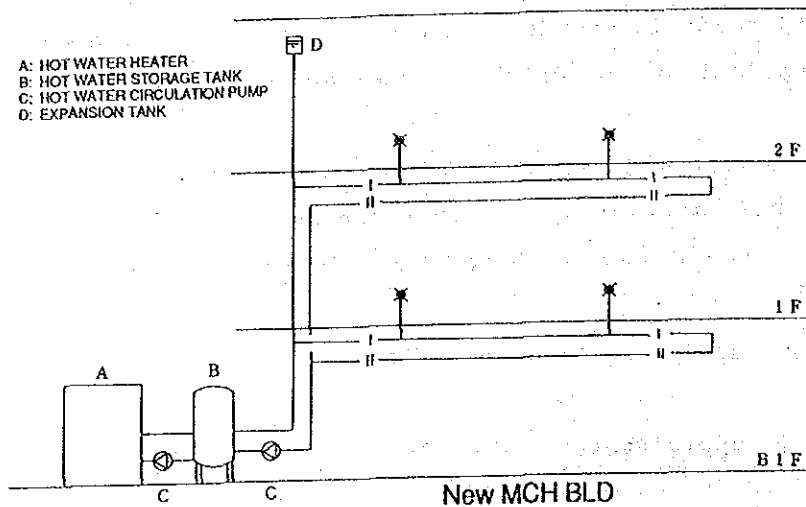


WATER SUPPLY SYSTEM DIAGRAM

Hot Water Supply System

New oil-fired hot water heater with storage tank will be provided to distribute hot water to appropriate locations in

the New MCH Building. Solar system will be provided to distribute hot water to appropriate locations in the New OPD Building.



HOT WATER SUPPLY SYSTEM DIAGRAM

Drainage and Venting Systems

Interior: Separate system for sewage and waste water.
 Exterior: Combined system for sewage and waste water. Surface water is separately drained off.

Toilet Accessories

Closets of both western and Asian styles, urinals, lavatories, and showers will be provided.

Medical Gas Supply System

Centralised supply systems for oxygen, nitrous oxide, and compressed air will be provided as follows:

Room	Oxygen	Suction Pressure	Compressed Air	Remarks
Obstetric Ward, Abnormal and Delivery Room, Treatment	○	○		
Paediatric Ward, ICU, Special Care Nursery, Neonate	○	○	○	

(3) Wewak Hospital

1) Electrical System

Lighting System

New lighting system similar to the existing system will be provided to the extended areas. Also, existing lighting equipment will be removed and reinstalled where interior modifications are performed.

Outlets

New outlets will be provided as necessary to the extended areas. Also, the existing outlets will be removed and reinstalled where interior modifications are performed.

Telephone System

The existing temporary PBX will be replaced with new PBX.

2) Airconditioning System

Design Temperature and Humidity

Inside and outside cooling conditions will be as follows:

Outside design dry-bulb temperature:	33.3°C
Outside design wet-bulb temperature:	30.5°C
Inside design dry-bulb temperature:	25.0°C

Cooling System

Multitask air-cooled package will be provided. Fan coil units of ceiling recessed cassette type will be provided to save space of installation.