THE GOVERNMENT OF MALAYSIA
THE STATE OF SARAWAK

MIRI-BINTULU

REGIONAL PLANNING STUDY

SUPPORTING REPORT

No. 6

PLANNING STANDARDS FOR SERVICES AND INFRASTRUCTURE

—1974—

HUNTING TECHNICAL
SERVICES LTD. LONDON

HOFF AND OVERGAARD
COPENHAGEN

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C O N V E R S I O N S

Linear Measures:

1 inch	=	25.4 millimetres
	=	2.54 centimetres
1 foot (12 inches)	=	0.3048 metre
1 yard (3 feet)	=	0.9144 metre
1 chain (22 yards)	=	20.117 metres
1 mile (1 760 yards)	=	1.609 kilometres

Square Measures:

1 square inch	=	6.45 square centimetres
1 square foot	=	9.29 square decimetres
1 square yard	=	0.836 square metre
1 acre (4 840 sq. yards)	=	0.405 hectare
1 square mile (640 acres)	=	259.00 hectares

Weights:

1 ounce (16 drams)	=	28.350 grammes
1 pound (16 ounces)	=	0.454 kilogram
	=	12 tahils
1 kilogram	=	1.65 katis
1 cwt (112 pounds)	=	50.8 kilograms
1 ton (20 cwt)	=	16.8 piculs

Measure of Capacity:

1 pint	=	0.568 litre
1 quart (2 pints)	=	1.137 litres
1 gallon (4 quarts) (or 1 gantang)	=	4.546 litres

Velocities:

1 cubic foot per second or 1 cusec	=	0.028 cubic metres per second or cumecs
	=	28.31 cubic decimetres per second
1 gallon per hour	=	4.54 cubic decimetres per day
1 gallon per second	=	4.54 cubic decimetres per second

Temperature:

Fahrengeight	=	$9/5\ ^{o}C + 32$
Centigrade	=	$5/9\ (^{o}F - 32)$

INTRODUCTION

0.1 GENERAL

This Report presents the standard service and utility units which have been used as a basis in planning the levels of services recommended in the Regional Plan. They have been translated to the physical requirements and investment costs of the proposed new and expanded towns, villages and other settlements detailed in the Development Packages annexured to the Main Report.

The standards were derived and have been evolved from those presently used by Government departments and State authorities and organisations; and through discussion with these bodies where such standards have not been set down.

0.2 STANDARD CRITERIA

The standards as presented are based primarily on population thresholds, that is the fixed relationship between the population of an area and the desirable level of services required by such a population. In applying the standards due weight has also been given to other local criteria such as the level of social and economic activity, the character of the transport network and the density and distribution of the population.

The present population thresholds for public services in Sarawak are shown in Table 0.1.

TABLE 0.1 PRESENT POPULATION THRESHOLDS FOR PUBLIC SERVICES

Population threshold	Education	Health	Government administrative offices	Local councils	Postal	Police
50 000		District Health Centre				
45 000	Pre-university level		District Office			
30 000						
25 000						
20 000					Class A Post Office	District Police Station
15 000	Upper secondary school		Sub-District Office	District Council		
10 000					Class B Post Office	Minor Police Station
7 500	Lower secondary school	Health sub-centre				
5 000					Class C Post Office	Police Post
1 500	Primary school	Community health centre			Class C Phase 1 Postal Agent	Village Post

0.3 STANDARD COSTS

The costs presented in this Report and applied to calculation of the Development Package investment costs, have been based on the 1972/73 price level generally obtaining throughout Sarawak.

0.4 COST ADJUSTMENT

Before implementation of the projects included in the Development Packages, it will be necessary to adjust investment costs to current price levels and local conditions.

0.5 FUTURE APPLICATION OF THE REPORT

It is considered that the Report would be of assistance in planning future integrated regional development in the State, and for this reason further information on its make-up and use is given.

The standard units and costs could not be applied mechanically. However they do purport to be usable guidelines and a starting point for future planning.

At any given time the units should express the relative importance attached by Government to the different services. Past achievements and future priorities - social, economic and political, will affect this degree of importance. The units should therefore be maintained under constant review and amended as circumstances and conditions demand.

Catchment areas for the different service levels overlap so that at all population thresholds an acceptable degree of service is available. In the service structure, the highest levels would be found in the main town of the area, and the subordinate and supporting levels in the complementary secondary towns and villages within the area. Co-ordination of the interacting service levels would be undertaken from the highest level office.

Because the various services have differing population thresholds for their standard units, a co-ordinated hierarchy of services can only be obtained if the population thresholds for some types of services are flexible and adjusted during planning. The need for this adjustment is demonstrated in Table 0.1 which shows the present population thresholds of various standard service units in Sarawak. It is shown, for example, that a District Health Centre is associated with a population of 50 000, while a District Administrative Office is associated with a population of 45 000, and District Council with 15 000 people and a District Police Station with

20 000. It would be more logical in future if the prefix 'District' for all services were to be associated with one chosen population threshold or with a physical Administrative District.

When planning the location and level of education and health facilities it is important to take into consideration the vital need for these services. All communities require them, and therefore, application of the standard units in relation to the population thresholds must be rather rigid. More rigid, for example, than for the services of post offices, police, fire protection and administration. For these types of public service the application of standard units can be determined more by convenience and/or economies of supply.

Therefore, in the Regional Plan education and health have been considered the 'leading' service facilities, and these facilities will require the highest inputs of capital and manpower. This implies that the unit sizes, the population thresholds, and the location of other services should be in future closely linked or adjusted to these services. However, this adjustment is not shown in this Report; there must be a gradual process over time of changing the unit sizes and the population thresholds for the non-leading services to conform with the input levels of the leading services.

0.6 PLANNING EXAMPLE

(a) General

Planning is a continuous and iterative process in that changes will inevitably result from the creation of new resources, the availability of new and revised information, and the presentation of new ideas and aspirations.

The first stage of planning would be to apply the basic principle of the number and standard of units justified according to population thresholds. The next stage would be the adjustment of the distribution of services based on an evaluation of the density and location of the population, and the character of the transport network so that investment costs might be reduced without affecting the service standards. Finally the services would be costed relative to existing price levels. Should the establishment costs be too high for accommodation in the development budget, further adjustments would be necessary, either by reducing standards or omitting certain units. The action to be taken would depend on the overall evaluation of the economic situation then prevailing, and of the development aims for the specific area under consideration.

Supporting Report No. 10 describes the iterative process in more detail.

(b) Example

The example given here refers to the Detailed Plan area which is illustrated on Map No. 20 in the Map Folder. The area is situated between the Niah and Suai rivers. Only the location of public services are considered in this example. For convenience and easy reference Figure 0.1 is presented here, showing the planned settlements and road network in the Detailed Plan Area of the Niah-Suai Rural Development Area (RDA). The Detailed Plan Area is envisaged to be well developed by 1980/85. It contains about 40 000 acres of land suitable for agriculture, which when developed, would accommodate about 15 000 people whose livelihood would come from agriculture. When additional people associated with the derived services and industries are included together with the people already living in the area, the total population by 1990 would be about 25 000 people. The urban settlements for this population are envisaged in the Regional Plan to consist of:-

- five villages of 1 500 to 2 000 people (in total 8 000 to 10 000 people);
- one town of about 10 000 people;
- dispersed settlements (mostly longhouses) containing a total of about 5 000 people.

In the Plan the villages have been so located that their distance from the main town is about five to seven miles. A good road network is planned to connect the villages and the town.

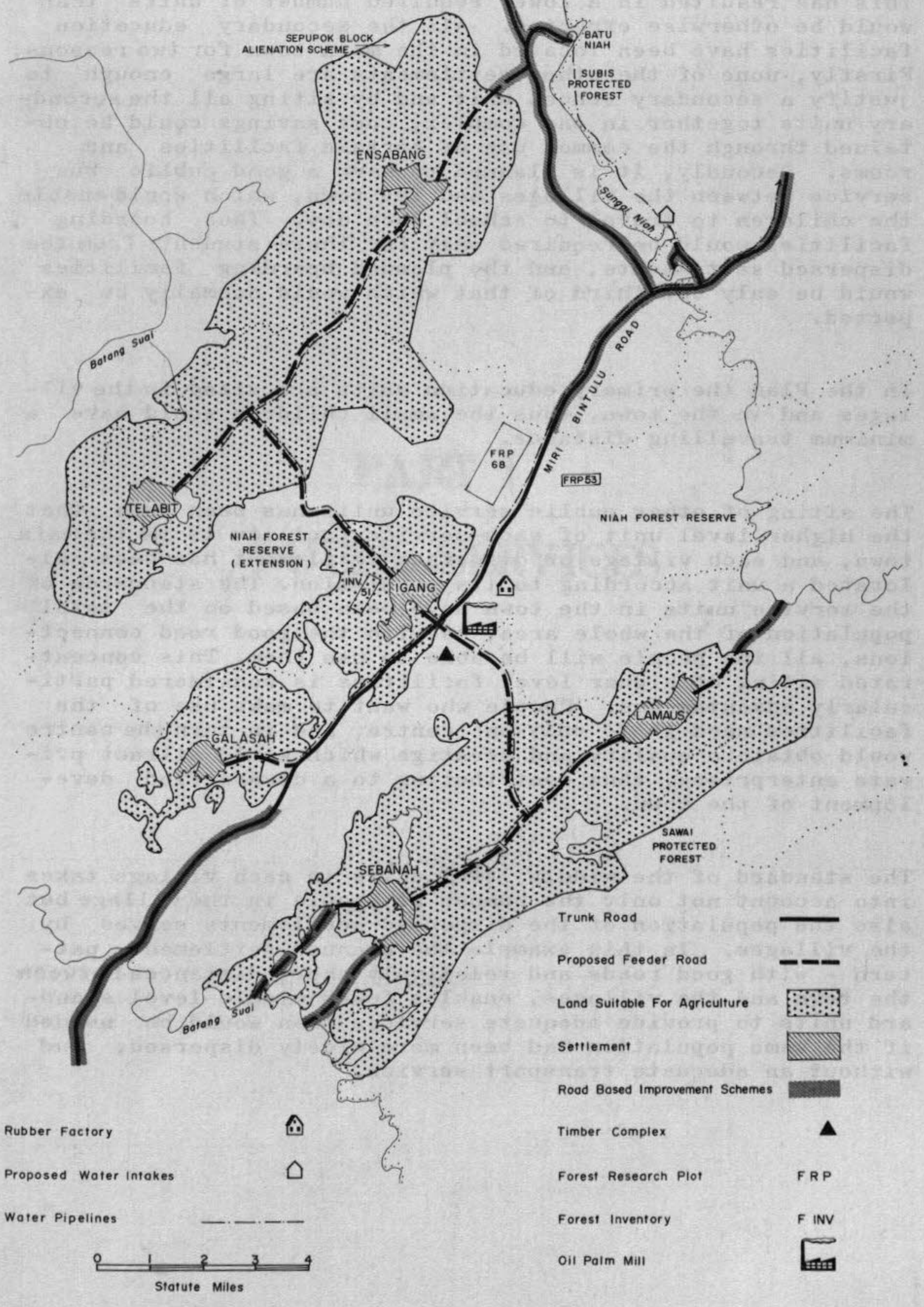
By 1990 the recommended numbers of standard units of public services would be as shown in Table 0.2. These are lower than would result from a purely mechanical application of the standards in relation to population thresholds.

TABLE 0.2 DISTRIBUTION OF PUBLIC SERVICES

Type of services	Town	Village	Dispersed settlements	Total
	Number of units			
Upper secondary school	1			1
Lower secondary school	3			3
Primary school	7	5	2	14
Health centre	1			1
Community health centre		5	2	7
Sub-District Office	1			1
District Council	1			1
Class B Post Office	1			1
Class C Phase 1		5		5
Postal agent			2	2
District Police Station	1			1
Village Police Post		5	2	7

FIGURE 0.1

NIAH–SUAI DETAILED PLAN AREA



For educational units a higher population threshold than stated for each unit has been applied; because the population will be largely agricultural and have relatively low incomes. This has resulted in a lower required number of units than would be otherwise expected. All the secondary education facilities have been located in the main town for two reasons. Firstly, none of the other settlements are large enough to justify a secondary school unit and by siting all the secondary units together in one complex, cost savings could be obtained through the common use of certain facilities and rooms. Secondly, it is planned to have a good public bus service between the villages and the town, which would enable the children to travel to school each day. Thus boarding facilities would be required only for those students from the dispersed settlements, and the planned boarding facilities would be only one-third of that which would normally be expected.

In the Plan the primary education units are sited in the villages and in the town, thus the small children would have a minimum travelling distance.

The siting of other public service units has been such that the higher level unit of each service facility is in the main town, and each village or dispersed settlement has been allocated a unit according to its population. The standards of the service units in the town have been based on the total population of the whole area, as with the good road connections, all the people will be able to use them. This concentrated siting of higher level facilities is considered particularly advantageous. People who want to make use of the facilities need go to only one centre, and in turn the centre would obtain a quality and prestige which would attract private enterprises, thus contributing to a diversified development of the town.

The standard of the middle level units in each village takes into account not only the number of people in the village but also the population of the dispersed settlements served by the villages. In this example the planned settlement pattern - with good roads and relatively short distances between the town and the villages, enables fewer middle level standard units to provide adequate services than would be needed if the same population had been more widely dispersed, and without an adequate transport service.

PART I

PUBLIC SERVICES

CHAPTER 1

EDUCATION

The present public educational system of Sarawak is shown in Figure 1.1 which indicates the different types and levels of education corresponding to specific age groups.

1.1 DERIVATION OF STANDARDS

The number of people who will attend the different levels of education will depend both on the population available in each relevant age group, on the entrance requirements and/or on the educational survival rates. The entrance requirements are constantly under review and in particular the primary six selection examination is expected to be abolished in 1974.

The calculation of the number of people in the age groups 6 to 11, 12 to 14, 15 to 16 and 17 to 18 is based on the information contained in the 1970 Census and shown in Appendix I.3. The Census figures reveal that the proportion of the total population in each age group does not vary much by geographical location, that is by Planning Unit within the Study Area. A comparison of the interpolated figures in the 1970 Census with the actual figures of the 1960 Census shows in general that there are more persons in the younger age groups per thousand people in 1970 than in 1960. Such a trend is not unexpected, but is not likely to continue when family planning comes into effect. The following standards have therefore been based on the assumption that the percentage composition of each age group will remain the same over the next decade or so.

1.1.1 Primary Level

One primary stream normally consists of six classes at 35 pupils per class in rural areas and at 45 pupils per class in urban areas. Hence the total number of pupils per stream are 210 and 270 respectively. These figures are interpreted as follows: ideally there should be a minimum of 210 pupils in a primary stream, however, given normal teaching facilities, one stream has the capacity of a maximum of 270 pupils, that is before another stream has to be created.

The following survival rates have been taken from the Mid-Term Review of the Second Malaysia Plan (Department of Education). The rates indicate the number of pupils expected to continue from one primary stage to the next.

		Per cent
Primary 1 to Primary 2		(92)
Primary 2 to Primary 3		(95)
Primary 3 to Primary 4		(95)
Primary 4 to Primary 5		(88)
Primary 5 to Primary 6		(98)

Assuming that 100 per cent of the primary one age group is starting in school, the percentages in brackets then indicate the proportion of the child population that would attend each level, for example 92 per cent of the primary two age group would attend this level. The calculations indicate that about 72 per cent of the primary six age group would attend this stage, and that an average of 85 per cent of the age group 6 to 11 will be studying in primary school. If less than 100 per cent of the primary one age group is starting in school, the figures in brackets would be correspondingly less.

A check on this average has been carried out by means of the 1970 Census. In that year it is estimated that about 17 per cent of the population was in the age group 6 to 11. The actual number of pupils in primary school in 1970 was 144 000, which corresponds to 14.7 per cent of the total population. From this it can be concluded that the attendance rate was about 86 per cent, which is the same percentage as obtained through the survival rates.

Appendix I.3.1 reveals that the average number of children falling within the age group of 6 to 11 (the primary school attendance age) is 172 per thousand, with a range from around 160 to 180. Applying the attendance rate of 85 per cent to these figures the average number of primary pupils per thousand population would be 145, with a range from about 135 to 155. Consequently, in order to realise a primary stream of 210 pupils respectively, there will be a need for a population size in rural areas ranging from 1 350 to 1 550 with an average of 1 450 and a range from 1 750 to 2 000 with an average of 1 850 in urban areas. If the attendance rate in the future should increase to 100 per cent, the average population required for one primary stream would go down to 1 200 in rural areas and to 1 550 in urban areas.

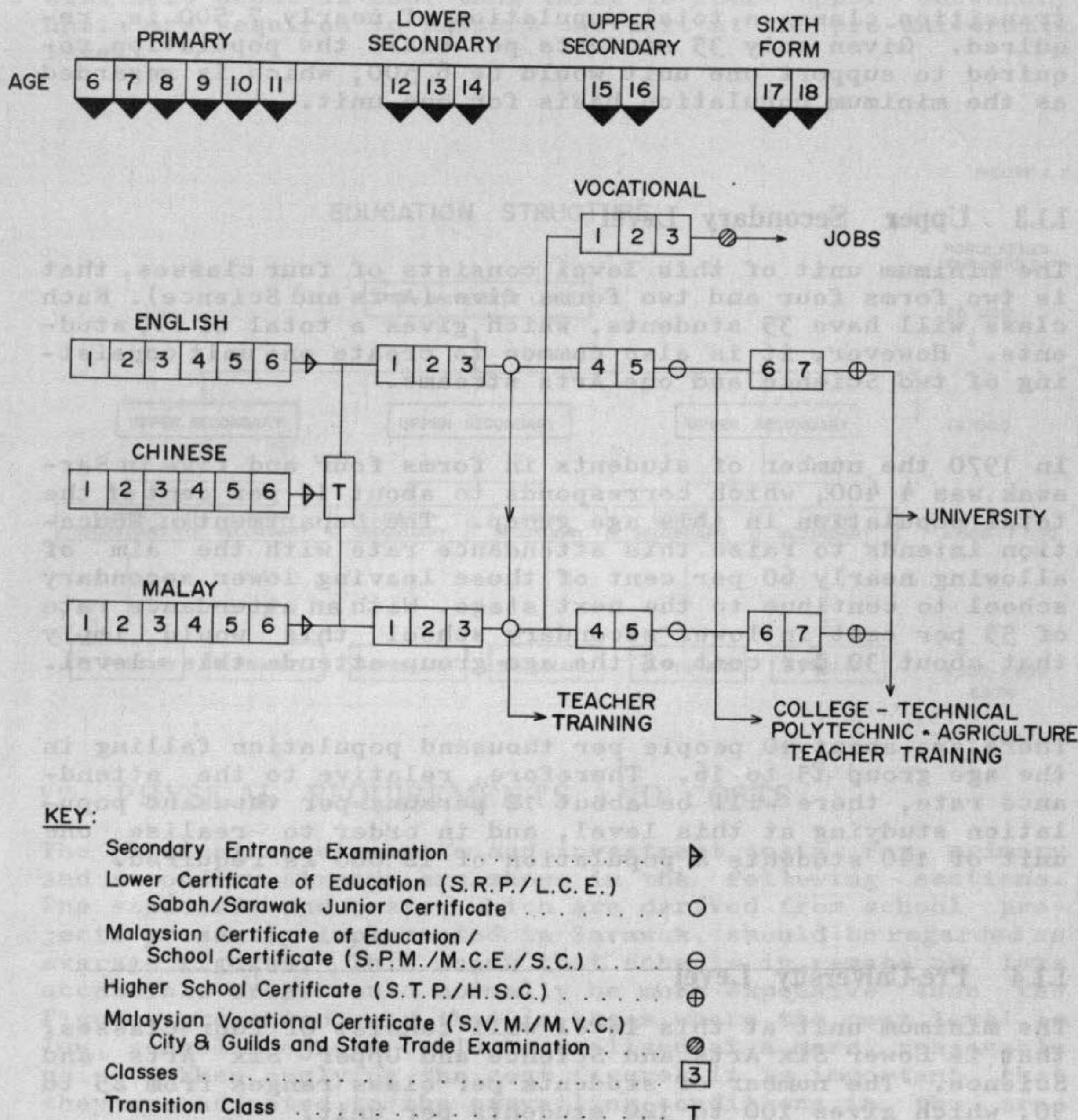
1.1.2 Lower Secondary Level

The smallest lower secondary unit normally built is one transition class and two streams, each stream consisting of three classes, forms one to three, with 40 pupils in each class. The total number of students in the unit is 280.

The present attendance rate for lower secondary schools in Sarawak is about 30 per cent of the age group 12 to 14 years. When the Common Entrance Examination is abolished in 1974,

FIGURE 1.1

PUBLIC EDUCATION PATTERN, SARAWAK 1970



the Department of Education expects that about 90 per cent of primary six pupils will continue to the lower secondary level. This high rate is further expected by the Department to fall again to 75 per cent in the late 1970's. Hence, a rate of 75 per cent will be used as a basis for the planning of new schools. With an attendance rate of 72 per cent in primary six and a continuation of 75 per cent of these people to the lower secondary level, the attendance rate for the age group 12 to 14 will be nearly 55 per cent (72 per cent by 75 per cent equals to 54 per cent). In this age group there are about 70 persons per thousand population, out of which an average of 38 persons would attend lower secondary school. Hence, to create one unit of two secondary streams and one transition class, a total population of nearly 7 500 is required. Given only 35 students per class the population required to support one unit would be 6 500, which is regarded as the minimum population basis for one unit.

1.1.3 Upper Secondary Level

The minimum unit of this level consists of four classes, that is two forms four and two forms five (Arts and Science). Each class will have 35 students, which gives a total of 140 students. However, it is also common to create one unit consisting of two Science and one Arts streams.

In 1970 the number of students in forms four and five in Sarawak was 4 400, which corresponds to about 12 per cent of the total population in this age group. The Department of Education intends to raise this attendance rate with the aim of allowing nearly 60 per cent of those leaving lower secondary school to continue to the next stage. With an attendance rate of 55 per cent in lower secondary school this would imply that about 30 per cent of the age group attends this level.

There are about 40 people per thousand population falling in the age group 15 to 16. Therefore, relative to the attendance rate, there will be about 12 persons per thousand population studying at this level, and in order to realise one unit of 140 students a population of 12 000 is required.

1.1.4 Pre-University Level

The minimum unit at this level will consist of four classes, that is Lower Six Arts and Science and Upper Six Arts and Science. The number of students per class ranges from 25 to 30, which gives 100 to 120 students per unit.

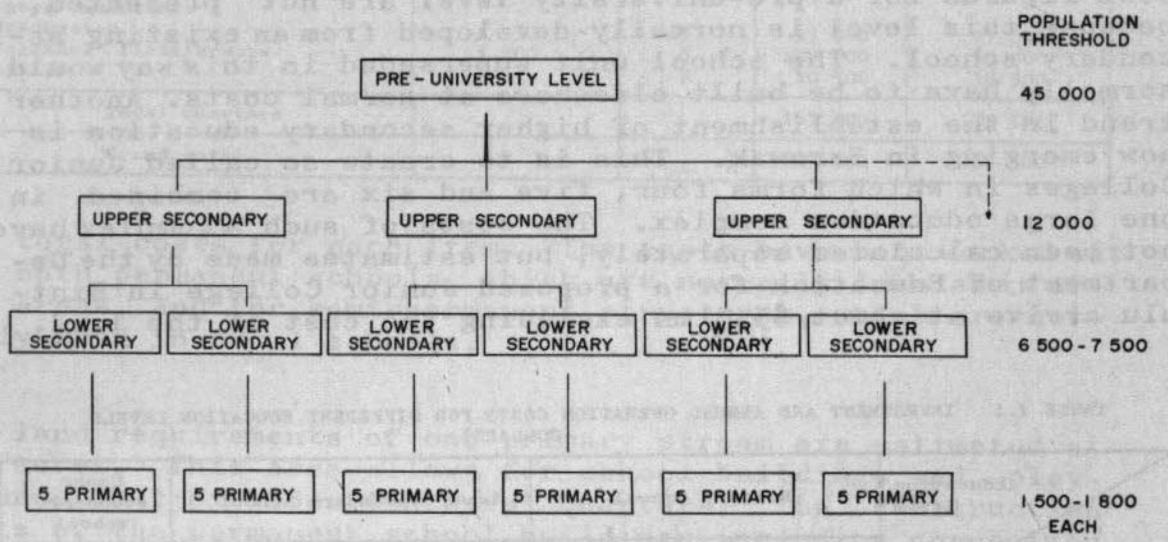
Selection from the upper secondary level to this stage is expected by the Department of Education to be 20 to 22 per cent. An attendance rate of 22 per cent in this age group would then be about six per cent or 2.2 persons per thousand population. Hence, in order to obtain one unit of 100 students there is a need for a population of about 45 000.

1.1.5 The Education Structure

Figure 1.2 shows the education structure based on the foregoing standards. This hierarchy indicates for example that the pre-university level will require a population of about 45 000 to support one unit, while one upper secondary unit will need about 12 000, thus three to four upper secondary units are required to support one unit at the pre-university level.

FIGURE 1.2

EDUCATION STRUCTURE



1.2 PHYSICAL REQUIREMENTS AND COSTS

The physical requirements and investment costs for primary and secondary streams are shown in the following sections. The standards and costs, which are derived from school projects presently implemented in Sarawak, should be regarded as average figures. This means that schools in remote or less accessible areas would normally be more expensive than the figures presented, and that in areas where the cost level is low, school projects could be realised at a more reasonable price. When applying the cost figures it is important that they are adjusted to the prevailing conditions in the area where the school projects will be implemented.

As a basis for the calculations one stream has been found an appropriate unit for primary schools and two streams for the secondary level, but this should not be considered a rigid requirement.

The physical requirements have been estimated separately for each education level. In most cases in Sarawak it is found opportune to combine two successive levels as one physical unit, for example lower and upper secondary school. The reason is that an upper secondary unit is normally established on the basis of a sufficient number of graduates from existing lower secondary schools in an area, and then built as an extension to one of the existing schools. The cost figures for the upper secondary unit are based on these assumptions. Thus, the sports grounds, the dining/kitchen rooms for the boarders and certain other facilities would serve both levels.

Cost figures for a pre-university level are not presented, because this level is normally developed from an existing secondary school. The school unit superseded in this way would normally have to be built elsewhere at normal costs. Another trend in the establishment of higher secondary education is now emerging in Sarawak. This is to create so called Junior Colleges in which forms four, five and six are combined in one large education complex. The costs of such a complex have not been calculated separately, but estimates made by the Department of Education for a proposed Junior College in Bintulu arrive at about $5.3 mn excluding the cost of the land.

TABLE 1.1 INVESTMENT AND ANNUAL OPERATION COSTS FOR DIFFERENT EDUCATION LEVELS (DOLLARS)

Facility / Education level	Primary school		Lower secondary school		Upper secondary school
	Total permanent structures	Total semi-permanent structures	Total permanent structures	Total semi-permanent structures	Total permanent structures
Investment costs					
School buildings	262 000	160 000	577 000	424 000	250 000
Teachers' quarters	165 000	128 000	218 000	172 000	172 000
Boarding	-	-	270 000	180 000	140 000
Total investment	427 000	288 000	1 065 000	776 000	562 000
Operation costs					
Teaching	31 000 to 40 000 (1)		70 000		55 000
Boarding	-		15 000		17 000

Note (1) Depending on the number of students in the school.

Table 1.1 shows the investment and annual operation costs, excluding the cost of land, for different educational levels.

1.2.1 Primary School

The physical requirements for a primary stream, shown in Table 1.2 have been divided into two groups, namely the classrooms and facilities directly connected with teaching, and the teachers' quarters. Table 1.2 gives the floor space for each facility required, the number of units per stream, and

TABLE 1.2 ONE PRIMARY STREAM - PHYSICAL REQUIREMENTS AND INVESTMENT COSTS

Facility	Size per unit in square feet	Units per stream	Cost in dollars	
			Permanent structures	Semi-permanent structures
Classroom	600 to 750	6	90 000	60 000
Office	600 to 750	1	15 000	10 000
Library facilities	600 to 750	1	15 000	10 000
Assembly hall	3 000	1	50 000	30 000
Toilet	1 200	1	25 000	12 000
Connection of electricity and water			15 000	-
Drainage, leveling, piling, etc.			12 000	12 000
Furniture and equipment			12 000	12 000
Fencing			8 000	-
Contingencies (10 per cent)			20 000	14 000
Total school			262 000	160 000
Teachers' quarters:				
Headmaster	1 350	1	35 000	27 000
Teachers' flats/houses	1 200	6	120 000	90 000
Furniture		7	10 500	10 500
Total quarters			165 500	127 500
Grand total			427 500	287 500

the total costs for each item. The costs have been worked out for both permanent schools, which are normally located in urban areas, and for semi-permanent structures, which are normally used in rural schools.

The land requirements of one primary stream are estimated at 1.5 acres. This area allows for school buildings and playgrounds, but excludes teachers' quarters. The construction costs of the permanent school buildings including connection to the main water and electricity supply systems and the provision of furniture amount to $262 000, which approximates to $40 000 per classroom or $880 per pupils place. The cost of a rural school without water, electricity and fencing is estimated at $160 000 or about $27 000 per classroom.

The provision of teachers' quarters costs about $165 000 in urban areas and $127 000 in rural areas. The high cost of quarters compared to the costs of the school itself indicates that where outside accommodation is available at reasonable rental, school quarters should not be provided.

The operating costs of primary schools are estimated to be $150 per pupil annually. This cost does not include boarding.

1.2.2 Lower Secondary School

The facilities needed and the corresponding investment costs of two junior secondary streams are shown in Table 1.3. A unit of two streams plus a transition class, that is 280 pupils, has been chosen for this education level as this appears to be the smallest unit normally built.

TABLE 1.3 TWO LOWER SECONDARY STREAMS - PHYSICAL REQUIREMENTS AND INVESTMENT COSTS (DOLLARS)

Facility	Size per unit in square feet	Units per stream	Costs	
			Permanent structures	Semi-permanent structures
Classroom	750	6	90 000	60 000
Office	750	1	15 000	10 000
Staff room	750	1	15 000	10 000
Library and reading room	2 500	1	60 000	40 000
Assembly hall	3 000	1	50 000	50 000
Woodwork shop	1 250	1	30 000	20 000
Science laboratory	1 250	1	30 000	20 000
Home science room	1 250	1	30 000	20 000
Canteen	1 250	1	30 000	20 000
Storage space	500	1	10 000	10 000
Books			10 000	10 000
Science equipment			30 000	30 000
Office equipment			5 000	5 000
Toilet	1 200	1	25 000	12 000
Bicycle shelter			5 000	-
Connection of electricity and water			15 000	15 000
Drainage, leveling, piling etc.			12 000	12 000
Internal roads and passage ways			20 000	20 000
Sports grounds:				
Basketball/volley ball			10 000	10 000
Football/hockey/athletics			15 000	15 000
Fencing			20 000	-
Contingencies (10 per cent)			50 000	35 000
Total school			577 000	424 000
Teachers' quarters:				
Headmaster	1 350	1	35 000	27 000
Teachers' flats/houses	1 200	6	120 000	90 000
Domestic staff quarters	1 000	4	48 000	40 000
Furniture		11	15 000	15 000
Total quarters			218 000	172 000
Boarding:				
Hostel for boys (100 beds)	7 000		140 000	120 000
Hostel for girls (60 beds)	4 000		80 000	60 000
Dining hall/kitchen	2 500		50 000	
Equipment for kitchen/dining hall				
Total boarding			270 000	180 000
Grand total			1 065 000	776 000

The costs of a lower secondary unit have been worked out for permanent and semi-permanent buildings. The investment costs for these two building types, excluding teachers' quarters and boarding facilities, amount to $577 000 and $424 000 respectively. Including quarters and boarding a permanent lower secondary unit would cost $1 065 000 and a semi-permanent $776 000. For a semi-permanent school no costs have been indicated for dining hall/kitchen as they will be combined with the assembly hall and therefore included in its costs. The gross area needed for school buildings and sports grounds is estimated at 6.5 acres.

In Sarawak about 30 per cent of the students in Government Aided and Government secondary schools are boarders. It is the aim of the Government to step up the secondary school building programme, which would imply a higher boarding rate. It is expected that the percentage of boarders will increase by two per cent annually to about 45 per cent in 1980 (Second Malaysia Plan - Mid-Term Review - Education Department). For

Government schools alone this would imply a boarding percentage of about 60, which corresponds to about 160 boarders per unit. The cost of a permanent hostel to accommodate this number is estimated at about $270 000 or $1 700 per boarder.

The annual running costs of lower secondary education excluding boarding and teachers' quarters are calculated at $250 per pupil. The basis for the calculation are the salaries paid ($400 to $600 per month for teachers), maintenance, and the supply costs of water and electricity. The annual recurrent costs per boarder have been worked out similarly to be $100 excluding food.

1.2.3 Upper Secondary School

As mentioned in paragraph 1.2.2 an upper secondary unit is normally developed as an extension of a lower secondary school. The physical requirements and investment costs shown in Table 1.4 are calculated on the basis of this assumption. The cost figures reflect the building of a permanent school, which excluding quarters and boarding facilities would amount to $250 000. Including quarters and boarding the total costs are about $560 000. The additional land requirement for two streams of this level, excluding teachers' quarters, totals about 3.5 acres.

TABLE 1.4 TWO UPPER SECONDARY STREAMS - PHYSICAL REQUIREMENTS AND INVESTMENT COSTS

Facility	Size per unit in square feet	Units per stream	Costs (dollars)
Classroom	750	4	60 000
Assembly hall extension	800	1	25 000
Science laboratory	1 250	2	60 000
Science equipment			60 000
Connection of electricity and water			7 500
Furniture			6 000
Drainage, leveling, piling etc.			8 000
Contingencies (10 per cent)			23 500
Total school			250 000
Teachers' houses	1 350	4	140 000
Domestic staff quarters	1 000	2	24 000
Furniture		6	8 000
Total quarters			172 000
Boarding: Hostel (100 beds)	7 000	1	140 000
Total boarding			140 000
Grand total			562 000

The annual operating cost of the teaching facilities has been estimated at $400 per student, or a total of $55 000 per year. The recurrent boarding costs, excluding food, amount to $17 000 per year, which corresponds to $170 per boarder.

1.3 STAFF REQUIREMENTS

The staff requirements for different educational levels and number of streams are shown in Table 1.5.

TABLE 1.5 STAFF REQUIREMENTS

Educational level and stream		Teaching staff			Teaching/ boarding		Boarding staff			Staff total
		Principal	Teachers	Laboratory attendant	Clerk	Groundsman	Matron	Cook	Servants	
Primary school	1 stream	1	6			1				8
	2 streams	1	12		1	1				15
Junior secondary school	1 stream	1	3			1	1	1	1	8
	2 streams	1	8	1	1	1	1	2	1	16
Upper secondary school	1 stream	1	3			1	1	1	1	8
	2 streams	1	6	1	1	1	1	1	1	13

<u>Lower Secondary School</u>: one extra teacher for each additional stream;

<u>Upper Secondary School</u>: two constants and one teacher extra for each 100 pupils in schools accommodating over 300 pupils.

The Department of Education also applies the following quota in the estimates of staff requirements for secondary schools:

Lower Secondary School - 1.43 teachers per class;
Upper Secondary School - 1.6 teachers per class.

CHAPTER 2

HEALTH

2.1 THE ADMINISTRATIVE ORGANISATION OF THE MEDICAL SERVICE

Prior to 1971 a network of Dispensaries, Sub-dispensaries, Maternity Child Health Clinics and Rural Health Supervisors' posts were established to meet the need of the rural population. These units worked almost independently of each other, which was clearly felt to be a disadvantage. Therefore during the Second Malaysia Plan a system of Main Health Centres and Health Sub-centres based on a Malaysian concept was introduced in Sarawak with the objective of integrating the curative and preventive services.

The Ministry of Health (1972) has stated that the number of beds to population should be of a ratio of two beds per thousand population. On this criterion, the patient care service for this region by 1975 should have 742 beds as compared to what will probably be the actual figure - 496 or 1.3 beds per thousand population.

In the concept of regionalisation of patient care services, the State of Sarawak would have a Regional Hospital, and a State Hospital which will be supported by a Divisional Hospital in each divisional headquarters and District Health Centres in all Administrative Districts. It is envisaged that the Sarawak General Hospital at Kuching or a new hospital in connection with the university area in Bintulu will be the Regional Hospital, and places like Sibu and Miri will have Divisional Hospitals.

The standards applied for estimating the future supply of medical services are based on the New Economic Policy in the Second Malaysia Plan and a recent review of the Rural Health Service as a preparation for the Third Malaysia Plan (Medical Department, 27th December, 1973).

The review of the structure of the Medical and Health Service was made with a view to improve the health delivery system envisaged for the Second Malaysia Plan as a preparation for the Third Malaysia Plan. It was decided that further modification was necessary in view of the following factors:-

(a) the many widely scattered small population groups in the State;

(b) the difficult means of communication;

(c) the changing role of the district hospital which should incorporate not only curative but preventive service as well;

(d) the need to satisfy the "demand", but also the health need of the population;

(e) the difficulty in locating appropriate health facility requirements as a result of movement of population due to development in the various areas of the State.

Thus the objective in the Third Malaysia Plan would be to build as many Community Health Centres as possible to provide for as near total coverage as possible.

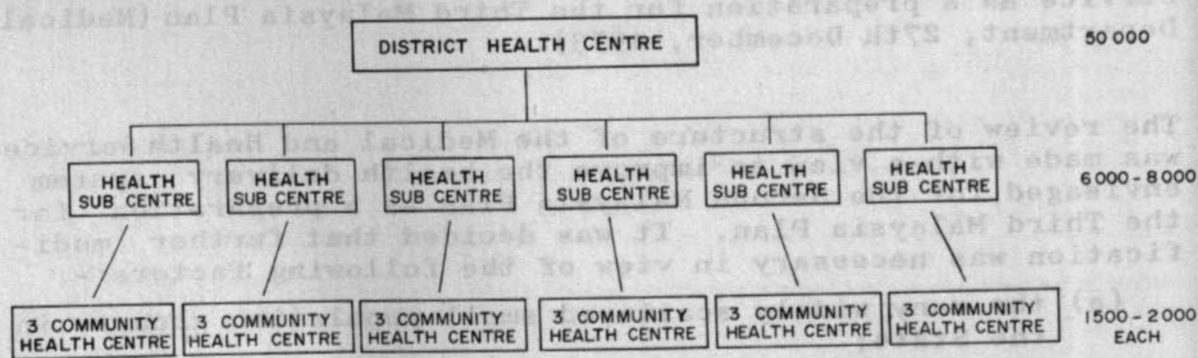
The original concept of Rural Health Service has now been modified from the original three tier system to a two tier system with the elimination of the Main Health Centre which will now be incorporated into the District Hospital later to be called a District Health Centre. The present Health Sub-centre will remain, but will now serve a population of 6 000 to 8 000 instead of the original 5 000 and the Community Health Centres will serve a population of 1 500 to 2 000. Depending on the population growth and its location, the Community Health Centres will gradually be upgraded to Health Sub-centres. This strategy will provide for a more flexible approach in planning.

It is planned that by the year 2000 each administrative district will have a District Health Centre supported by five to six Health Sub-centres and 15 to 18 Community Health Centres.

Diagrammatically the administrative organisation of the Rural Health Services will be as shown in Figure 2.1.

FIGURE 2.1

ADMINISTRATIVE ORGANISATION OF THE RURAL HEALTH SERVICE



2.2 PHYSICAL REQUIREMENTS AND COSTS

Table 2.1 gives the overall cost structure of the Rural Health Service.

TABLE 2.1 INVESTMENT AND ANNUAL OPERATION COSTS FOR DIFFERENT HEALTH UNITS[1] (DOLLARS)

Item \ Health unit	District Health Centre	Health Sub-centre	Community Health Centre
Investment costs			
Clinic buildings[2]	1 722 500	90 000	90 000
Equipment	649 500	44 000	22 000
Quarters	1 278 000	123 000	25 000
Total investment	3 650 000	257 000	137 000
Operation costs			
Emoluments	829 000	69 000	23 000
Services and supply	120 000	8 000	6 000
Maintenance[3]	45 000	4 000	1 000
Total operation	994 000	81 000	30 000

Notes: (1) Excluding cost of land.
(2) Includes contingencies.
(3) Maintenance of clinic building and quarters.

The detailed physical requirements and investment costs for a District Health Centre, a Health Sub-centre and a Community Health Centre are given in the following sub-sections.

The standards and cost estimates are based on health projects which are or will be implemented during the later part of Second Malaysia Plan.

2.2.1 District Health Centre

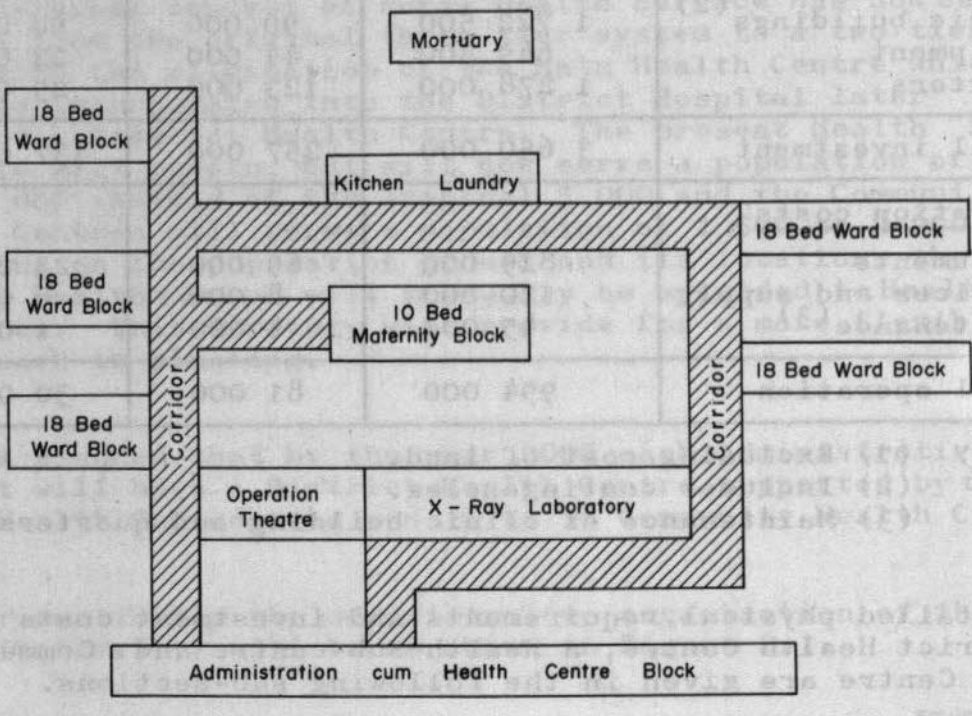
This will be the highest level of care in the structure of the Rural Health Service. The District Health Centre will occupy an area of about 30 acres.

The District Health Centre will provide both curative outpatient and in-patient care and preventive care.

It is planned that every administrative district will have a District Health Centre by year 2000. Based on the present rate of growth each administrative district excluding those situated in the Divisional Headquarters, will have a population of 50 000. This population is taken as a model for the purpose of illustration below. In such a district the District Health Centre would combine the District Health office and a Health Centre, with 100 beds for in-patients. The design of the District Health Centre is illustrated in Figure 2.2.

FIGURE 2.2

OUTLINE PLAN OF A DISTRICT HEALTH CENTRE



The staff at the District Health Centre will be headed by a District Medical Officer of Health. The detailed staff requirements are given in Sub-section 2.2.4.

The annual recurrent costs of the unit are estimated at $994 000.

2.2.2 Health Sub-Centre

A Health Sub-centre will have a dual role - one of both supervision and service. It will serve a population of 6 000 to

TABLE 2.2 DISTRICT HEALTH CENTRE - PHYSICAL REQUIREMENTS AND INVESTMENT COSTS

Facility	Floor space (square feet)	Costs $	Remarks
Land	30 acres	variable	
Administrative block cum health centre	8 084	161 000	
Operation theatre, X-ray and laboratory	4 850	120 000	
Ward block (18 beds)	14 000	280 000	At 2 800 square feet per block
Maternity ward block		50 000	
Kitchen and laundry block	2 460	44 000	
Mortuary	1 792	32 000	
Garage and workshop	2 232	31 000	
Substation building	896	12 500	
Covered way	8 280	50 000	
Boat shed		12 000	
Air-conditioning		55 000	
Electricity		190 000	Includes installation and main supply
Water supply		50 000	
Drainage		20 000	
Roads and paths		120 000	
Special foundations		200 000	
Sewage system		20 000	
Site work		40 000	
Fencing		40 000	
Furniture		100 000	
Contingencies		95 000	
Hospital building	42 594	1 722 500	
Equipment		541 000	Includes standby generator and refrigeration for mortuary
Vehicles, boats and engines		108 500	
District centre equipment		649 500	
Class II quarters	2 800 per unit	400 000	Ten units
Sisters flats		160 000	Eight units
Junior service flats		190 000	Ten units
Nurse/assistant nurse/midwife hostel		330 000	For 16 nurses and 32 assistant nurses/ midwives
Two room barracks		60 000	Six units
One room barrack		48 000	Eight units
Furniture		90 000	
Total quarters		1 278 000	
Grand total		3 650 000	

8 000 people; 1 500 to 2 000 people from within the service area of the Health Sub-centre itself, and 4 500 to 6 000 in the supervisory area. The Health Sub-centre will be a Community Health Centre with an additional function of providing technical supervision over the staff of the three Community Health Centres. Thus, whenever possible the Health Sub-centre should be located centrally in relation to the other three Community Health Centres. The Centre will require up to 15 acres of land.

The Health Sub-centres supervisory role is reflected in its staffing pattern, which is given in sub-section 2.2.4

The physical requirements and investment costs of a Health Sub-centre are shown in Table 2.3.

TABLE 2.3 HEALTH SUB-CENTRES - PHYSICAL REQUIREMENTS AND INVESTMENT COSTS

Facility	Costs $	Remarks
Land	15 000	15 acres
Clinic building	80 000	Includes site preparation, turfing and drainage
Boat shed cum store	10 000	
Equipment	15 000	
Vehicle, boat and engine	29 100	
Total	134 100	
Class III quarters	24 000	1 unit includes furniture
Class IV quarters	54 000	4 units include furniture
2 room barracks	30 000	3 units include furniture
1 room barracks	15 000	3 units include furniture
Total quarters	123 000	
Grand total	272 100	

The annual recurrent cost of the unit is estimated at $81 000.

2.2.3 Community Health Centre

The Community Health Centre will cater for a population of between 1 500 to 2 000 living within an area of approximately 150 square miles. It will have a static and a mobile unit which will make regular visits and provide services to the schools and neighbouring kampongs and longhouses.

It will occupy an area of two to five acres.

Organisationally the Community Health Centre comes under the supervision of the District Health Centre as part of the Health Sub-centre. However, the immediate technical supervision of the Community Health Centre should be undertaken by the Health Sub-centre.

As shown in Table 2.4 the total investment cost for this unit amounts to $142 000. The annual recurrent costs are $30 000.

TABLE 2.4 COMMUNITY HEALTH CENTRE - PHYSICAL REQUIREMENTS AND INVESTMENT COSTS

Facility	Costs $	Remarks
Land	5 000	2 to 5 acres
Clinic building	80 000	Includes site preparation, turfing and drainage
Boat shed cum store	10 000	
Equipment	10 000	
Vehicle, boat and engine	12 000	
Total	112 000	
1 room barrack	25 000	Includes furniture
Total quarters	25 000	
Total costs	142 000	

2.3 STAFF REQUIREMENTS

The staff requirements for different medical units are shown in Table 2.5.

TABLE 2.5 STAFF REQUIREMENTS

Medical unit	Professional classification*				
	Professional	Sub-professional	Clerical and technical	Manual	Total
District Health Centre	10	11	118	100	239
Health Sub-centre	-	1	11	6	18
Community Health Centre	-	-	5	5	10

Note * Classification according to Sarawak Government, (1971).

A detailed breakdown of the staff requirements is given in Appendix I.4.

CHAPTER 3

PUBLIC ADMINISTRATIVE OFFICES

In this group of public offices two different types of authorities have been included, namely Federal and State Government Offices not included in previous sections, and Local Authorities. The first group, includes the local departmental representatives of both the Federal and State Governments. The local authority, is an elected body that administers communal affairs such as refuse disposal, street cleaning and lighting, mosquito control and recreational areas. In order to finance these activities the Council raises revenues.

Outside the State capital there are three different levels of Government representation, namely the Divisional Offices, the District Offices and the Sub-District Offices. The size of these offices and the number of departments represented at each level varies a great deal, mainly because of the different sizes and populations of each Division, District and Sub-District.

Because of the great difference in size between Divisional Offices it has been found difficult and, to some extent, purposeless to establish any standards for this level. Consequently, the standards treated here are at the District and Sub-District level. The population also varies greatly among the Districts, for example from about 17 000 in Lawas to about 215 000 in Kuching. However, most of the Districts have populations of around 45 000 people, and this figure has been chosen as an average for this level. The minimum population for a Sub-District has been found to lie between 15 000 and 20 000 people. The latter population threshold seems also to be the minimum before a Local Council is established.

3.1 GOVERNMENT ADMINISTRATIVE OFFICES

It has been the practice in the past to concentrate all Government administration in one building block. Reasons for this deliberate concentration, include security and the ease with which members of the public and the Government officers themselves can go from one department to the other. An additional advantage for concentrating departments in one coherent building compound is the saving in land, building costs and the costs of provision of essential public utilities. However, the building of such compounds could pose certain difficulties with regard to future extensions of the offices.

The following descriptions therefore assume that whenever State or Federal Government departments can be grouped together they will be housed in one complex for the State offices and one for the Federal offices, unless specific departments are required to be separately accommodated.

Traditional practice has been to group the following depart-emnts together - the Court room, Administrative Office, Treasury, Registration of Births and Deaths, the Post Office, Co-operative Department, Labour Office, Forest Department, Department of Agriculture and the Immigration Office.

With the formation of Malaysia things have changed slightly with regard to control of departments, and this arrangement affects the grouping of departments that were formerly found in association with the District Administrative Officer's Department. Departments that were formerly under State Government control but are now Federal-controlled are Education, Immigration, the Co-operative Department, Labour and Information.

3.1.1 Physical Requirements and Costs

The investment and operation costs for District and Sub-District Offices are shown in Table 3.1. The State building complex houses the DO's office, the Courts, the National Registration of Births and Deaths, Probate Office, the Treasury, the Department of Agriculture and the Forest Department of which the first four offices are located within the District Office.

TABLE 3.1 DISTRICT AND SUB-DISTRICT OFFICES - INVESTMENT AND ANNUAL OPERATION COSTS

Administrative level / Cost item	District				Sub-District	
	State Offices		Federal offices			
	Size in square feet	Costs $	Size in square feet	Costs $	Size in square feet	Costs $
Investment costs						
Buildings:						
District/Sub-District Office	4 160	64 000			1 720	22 000
Agriculture	2 220	28 000			760	10 000
Forestry	645	8 500			660	8 500
Treasury	690	9 000			360	5 000
Education			1 005	16 000		
Immigration			600	9 500		
Co-operative			720	11 500		
Labour			660	10 500		
Information			2 445	39 000		
Toilet, lobbies, etc.	1 500	24 000	1 300	20 000	400	5 000
Ancillary facilities:						
Water supply		6 000		4 000		2 000
Electricity		5 000		4 000		10 000
Air-conditioning		10 000		50 000		-
Car park		3 500		2 500		-
Roads		4 000		3 500		-
Flag pole		500		500		500
Furniture		10 000		5 000		2 000
Equipment and vehicles		110 000		85 000		15 000
Contingencies		10 000		10 000		10 000
Quarters	39 500	770 000			18 700	334 000
Total investment	48 715	1 062 500	6 730	271 000	22 600	424 000
Operation costs						
Emoluments		280 000		300 000		80 000
Office stationery		15 000		10 000		4 000
Transport		70 000		15 000		15 000
Water and electricity		15 000		30 000		2 000
Maintenance of building		20 000		2 000		8 000
Total operations	-	400 000	-	357 000	-	109 000

Based on a net floor space of about 9 000 square feet of State Government Offices and nearly 7 000 square feet for Federal Offices the total land requirements are estimated at a minimum of one acre for each building complex. The corresponding land requirements of a Sub-District Office total about half an acre. However, the minimum area allocated to such an office should not be less than an acre in order to allow for future expansion. In general these area requirements should be regarded as minima.

The total investment cost for State Government offices at the District level is estimated at $1 060 000, which includes $770 000 for Government quarters. It is assumed that four Class I/II, nine Class III and 13 Class IV quarters are to be built. The investment costs for the Federal complex amount to $270 000. It is assumed that no quarters are supplied to the Federal Officers.

A complete Sub-District office is estimated to cost $420 000, of which quarters comprise the major part, namely $330 000. At the Sub-District level two Class III and 12 Class IV quarters are to be built.

The annual operation cost for the State Government Offices at the District level is estimated at $400 000 and that for the Federal Offices at $357 000, while the recurrent expenditure for State Government offices at the Sub-District level is about $110 000.

3.1.2 Staff Requirements

The staff requirements for the two levels are shown in Table 3.2.

TABLE 3.2 DISTRICT AND SUB-DISTRICT STAFF REQUIREMENTS

Professional classification (1)	District		Sub-District
	State Offices	Federal Offices	
Professional	5	4	
Sub-professional	11	10	2
Clerical and technical	28	24	15
Manual	6	7	2
Total	50	45	19

Note (1) Classified according to Sarawak Government (1971).

3.2 LOCAL AUTHORITIES

It is important for each large town or district to have a form of Local Authority to administer some of the important public services. Such an authority is known in Sarawak as the District Council, and in the case of Kuching, Municipal Status will be conferred.

The District Council is an elected body, which has a secretariat to administer the daily work. The size and functions of such a secretariat will depend on the population size and degree of urbanisation in the District.

The minimum population threshold for a District Council ranges from about 15 000 to 20 000 people. The investment and operation costs presented in Table 3.3 correspond to the minimum size of a District Council. A Council for a larger District would have additional facilities such as a fire brigade and a public works section. The costs and physical requirements for a fire brigade are treated separately.

TABLE 3.3 DISTRICT COUNCIL - INVESTMENT AND ANNUAL OPERATION COSTS

Item	Size in square feet	Costs $
Investment costs		
Buildings:		
Office	1 425	)
Store rooms and lobbies	650	) 55 000
Council chamber	1 050	)
Ancillary facilities:		
Air-conditioning		5 500
Electricity installations		4 000
Water connections		2 000
Parking		5 000
Road access and open space		2 000
Contingencies		5 000
Equipment and transport		73 000
Total investment		151 500
Operation costs		
Emoluments and councillors fees		55 000
Supply and services		15 000
Maintenance of buildings		1 000
Total operation	-	71 000

3.2.1 Physical Requirements and Costs

The physical requirements and costs of a District Council are shown in Table 3.3. The minimum land requirements for the office are 0.5 acre. The total investment costs, excluding land, amount to $150 000, and the annual operational costs to $70 000.

3.2.2 Staff Requirements

The staff requirements are shown in Table 3.4.

TABLE 3.4 DISTRICT COUNCIL STAFF REQUIREMENTS

Group	Number of people
Sub-professional	2
Clerical and technical	5
Manual	10
Total	17

CHAPTER 4

POSTAL SERVICES

In the Mid-Term Review of the Second Malaysia Plan the following introduction is given for the postal services:-

> "Postal services will be expanded by constructing new post offices and introducing mobile and floating post offices. The programme provides for the construction of new post offices to replace inadequate ones, the building of branch offices in the larger towns and the introduction of mobile and floating postal facilities to serve people in the rural areas. The original programme for the construction of new post offices in Miri, Binatang, Kapit and Simunjan and for the expansion of the General Post Office in Kuching has now been revised to include provision for the establishment of additional post offices in Kenyalang Park, Lutong, Mukah and Lubok Antu as well as for the setting-up of more mobile and floating postal facilities."

4.1 THE PRESENT SITUATION

The post offices in Sarawak are classified into three main categories, Classes A, B and C. The volume of business, size of population and literacy rates appear to have been significant factors in determining the number and category of post offices in each Administrative Division in Sarawak. Of the six Class A post offices in Sarawak at present, one is located in each of First and Second Divisions, and two in each of Third and Fourth Divisions. Table 4.1 indicates the distribution of post offices by class and Administrative Division. The 48 post offices served a total population of 975 000. Owing to the uneven distribution of population it would be unrealistic to derive an average population threshold for, say, a Class A post office by dividing the total population by the number of Class A post offices, which in the present situation would give a standard of one Class A post office to 162 500 people. This would imply that the population sizes of the Second, Fourth and Fifth Divisions are still not large enough to support a Class A post office. This, however, is not the case. Again if the total population is divided by the number of post offices the ratio is one to about 20 000 which is a minimum population threshold adopted by the Department of Postal Services as sufficient to support a Class A post office. A scrutiny of the postal business chart for the different classes of post offices indicates that there are not only wide variations between the classes but also among those of the same category.

TABLE 4.1 DISTRIBUTION OF POST OFFICES BY CLASS AND DIVISION

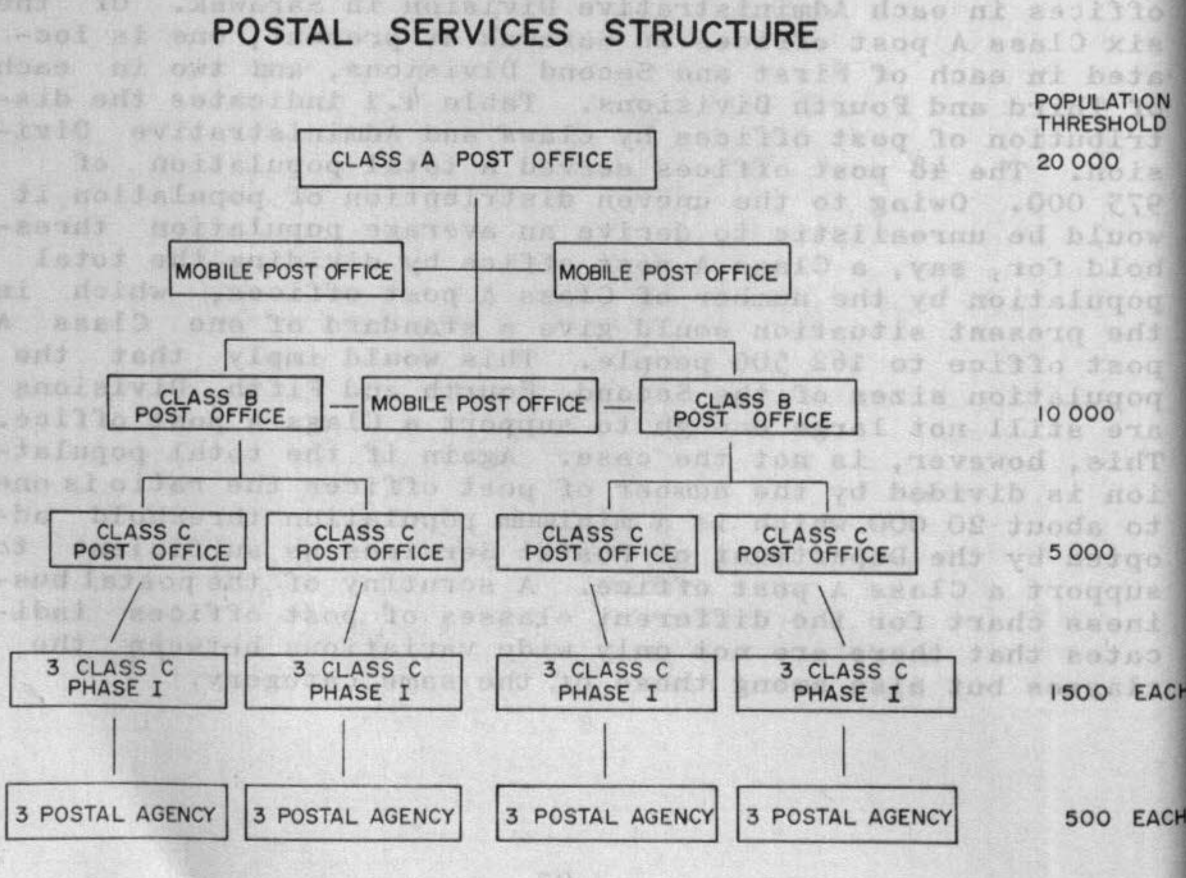
Population 1970	Administrative Division	Class A	Class B	Class C	Total
347 000	First	1	7	1	9
137 000	Second	1	3	9	13
319 000	Third	2	8	3	13
135 000	Fourth	2	3	4	9
37 000	Fifth	-	2	2	4
975 000	Total	6	23	19	48

4.2 DERIVATION OF STANDARDS

The Department of Postal Services' population threshold for a Class A post office is between 20 000 and 30 000. This range coincides with thresholds for other services like Police, Medical Service and Education.

A structure of postal establishments is proposed consequent to the existence of smaller centres and settlements that will have populations falling short of the threshold required for a Class A post office. This service structure is made up of a series of five types of unit, each differentiated by its specific functions and population thresholds. These units, are shown in Figure 4.1.

FIGURE 4.1



The structure proposes the creation of Postal Districts, each covering a population of around 20 000 people, and within which the five levels of postal units would be established.

The system implies that units in the lower echelon are not able to provide all the services that those in the next higher rank are able to provide. This is obvious for the following reasons:-

- the population of Sarawak is widely scattered in centres of many different sizes and consequently the establishment of Post Offices of the same class cannot be justified everywhere on economic, staffing and establishment grounds;
- a structure of postal units gives flexibility; thus the smallest unit, the Postal Agency will be located in the less accessible kampong and longhouse areas where population is not only scattered but also small.

4.3 PHYSICAL REQUIREMENTS AND COSTS

The investment and operation costs for each postal unit are given in Table 4.2. No cost estimates have been obtained for mobile postal services. In the Mid-Term Review of Second Malaysia Plan about $200 000 have been set aside for such services, compared to about $3.8 mn for the total postal service. The total investment cost for a mobile post office would be about $15 000 and its annual operation cost $6 000.

Only $100 in investment costs for postal agencies have been indicated, as these will be located in existing shops.

The net floor space and land requirements for the different

TABLE 4.2 POSTAL SERVICES - INVESTMENT AND ANNUAL OPERATIONS COSTS FOR DIFFERENT UNITS (DOLLARS)

Cost item / Postal unit	Class A	Class B	Class C	Class C1	Postal agencies
Investment costs					
Buildings:	160 000	34 000	18 000	12 000	-
Ancilliary facilities:					
Air-conditioning	1 100	1 100	-	-	-
Electricity and water connection	3 000	2 500	-	-	-
Road access	2 100	2 000	1 200	1 200	-
Parking	1 000	1 000	800	-	-
Equipment and transport	45 800	24 200	19 800	2 300	100
Contingencies	10 000	4 200	2 200	1 000	-
Quarters	220 000	80 000	40 000	20 000	-
Total investment	443 000	149 000	82 000	36 500	100
Operation costs					
Emoluments	81 300	62 800	13 000	7 100	-
Supply and services	9 700	5 000	2 000	700	200
Maintenance of buildings	1 000	700	500	200	-
Total operation	92 000	68 500	15 500	8 000	200

units are:-

	Floor space in square feet	Land area (acres)
Class A	8 000	0.75
Class B	2 500	0.4
Class C	1 000	0.3
Class C1	1 000	0.3

The total land requirements includes open space, parking facilities and access roads.

4.4 STAFF REQUIREMENTS

The minimum staff requirements for different postal units are shown in Table 4.3.

TABLE 4.3 STAFF REQUIREMENTS

Group \ Postal unit	Class A	Class B	Class C	Class C Phase 1
Managerial and professional	-			
Executive and sub-professional	2			
Clerical and technical	8	3	2	1
Subordinate and manual	6	8	2	1
Total	16	11	4	2

The staff requirements for a postal agency will normally be part time and covered by a single person, usually a shop-keeper.

CHAPTER 5

POLICE SERVICES

In this Chapter certain population thresholds for the planning of different police units are established. They should meet the demand for economic operation and the strategic requirements of a given police station in any specific locality. These population thresholds are designed to suit population centres of varying sizes.

5.1 THE PRESENT SITUATION

Generally, the location of police stations/posts is decided by the present settlement pattern and the local security situation. Although the present average for Sarawak is one policeman to every 239 people as compared to one to 317 in Peninsular Malaysia and one to 204 in Sabah, their distribution by geographical area is far from even. In 1970, for instance, the census returns showed that there were 332 policemen and detectives, or one policeman to 178 persons in Miri District as compared to one to 1 437 in Baram District and one to 1 866 in Bintulu District.

In some closed societies, longhouses and isolated remote kampong areas, there are no resident police though the population of such settlements often exceed 500.

5.2 THE STRUCTURE OF POLICE STATIONS

Figure 5.1 shows the structure of police stations and posts in Sarawak and their related population thresholds.

The existing structure has several advantages namely:-

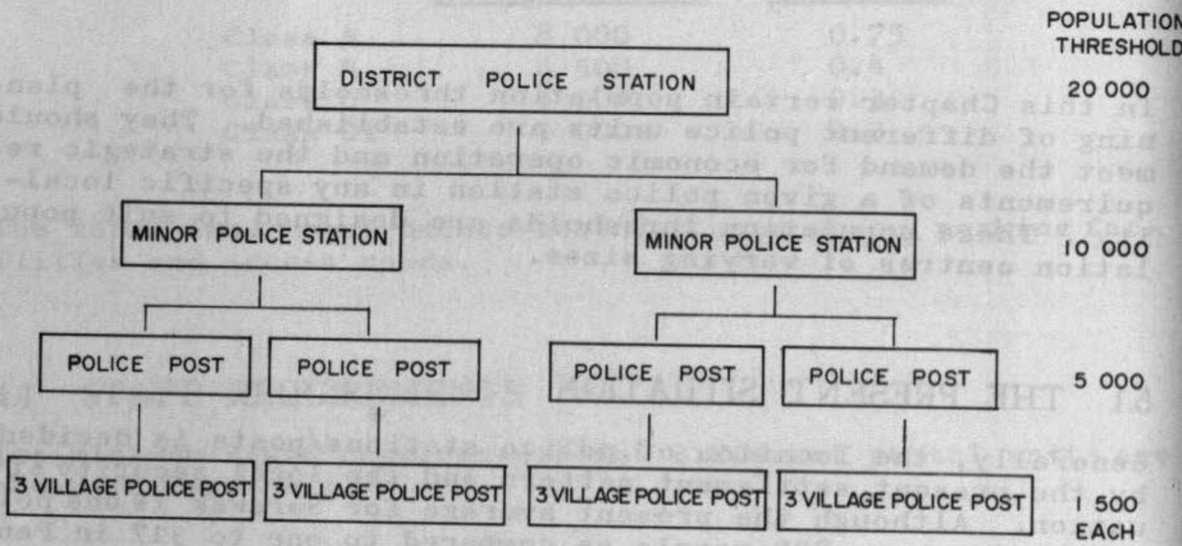
(a) the population thresholds for the four different levels of station/post correspond roughly to those for other services such as education, postal and medical services;

(b) the differentiation of police units into four levels ensures economy with respect to building and equipment costs, and an optimal use of manpower;

(c) the system ensures that the police services are brought near to the people, who can feel that the government is concerned about their security.

FIGURE 5.1

STRUCTURE OF POLICE STATIONS



5.3 PHYSICAL REQUIREMENTS AND COSTS

Land area requirements for police stations/posts will vary with the locality, availability of land, the staffing and their operation requirements, that is depending on the station/post's rank in the structure.

The investment and annual operation costs for different police units are given in Table 5.1.

TABLE 5.1 INVESTMENT AND ANNUAL OPERATION COSTS FOR DIFFERENT POLICE SERVICE UNITS (DOLLARS)

Cost item \ Police unit	District police station	Minor police station	Police post	Village police post
Investment costs				
Police buildings	204 500	133 500	70 700	10 700
Equipment	85 000	62 500	23 000	3 600
Quarters	360 000	103 000	25 800	-
Contingencies	33 000	15 000	6 000	700
Total investment	682 500	314 000	125 500	15 000
Operation costs				
Personal emoluments	114 000	43 000	15 400	3 350
Services and supply	23 000	14 000	4 300	-
Maintenance	10 000	4 000	1 800	350
Total operation	147 000	61 000	21 500	3 700

5.3.1 District Police Station

A maximum of five acres is preferable for this unit, though three acres may be the basic minimum in urban centres where availability of land is limited.

This area will contain basically the administrative building, other ancillary buildings, parade ground etc. The detailed breakdown appears in Table 5.2.

TABLE 5.2 DISTRICT POLICE STATION - PHYSICAL REQUIREMENTS AND INVESTMENT COSTS

Facility	Floor space (square feet)	Costs $
Buildings:		
Administration building	4 000	80 000
Other ancillary building	4 000	80 000
One generator house	400	8 000
One toilet	450	5 000
One garage with 4 parking spaces	512	2 000
Ancillary facilities:		
Security fencing	1 500 (1)	12 000
Electrical installation		3 000
Water supply installation		2 000
One flag pole		500
One parade ground		12 000
One standby generator		10 000
Communication equipment		31 000
Two land rovers		30 000
One heavy motor cycle		2 500
Furniture for station		2 000
Two air-conditioners		2 200
Arms		7 300
Total		289 500
Quarters:		
Six unit quarters	5 760	150 000
Two by 12 door barracks	14 000	190 000
Furniture		20 000
Total		360 000
Contingencies		33 000
Grand total		682 500

Note (1) In linear feet.

The total investment cost for this unit is $680 000 and the recurrent expenditure is $147 000 per annum. The detailed breakdown appears in Table 5.2.

5.3.2 Minor Police Station

For this unit, a gross area of two to three acres is required, sufficient to accommodate an administration block of around 3 000 square feet; space for two quarters, eight barrack type quarters, service area and parade ground.

Initial investment cost would be about $315 000. Recurrent expenditure is about $60 000.

5.3.3 Police Post

The land area required is around one acre for an administrative block, a motor cycle shed, a service area and a four-door barrack.

Investment cost is $125 000 and the recurrent expenditure is $21 000 per annum.

5.3.4 Village Police Post

For this unit an area of 0.25 to 0.5 acre will be sufficient. Total initial investment cost would be $15 000 and the recurrent expenditure would be $3 700 per annum.

5.4 STAFF REQUIREMENTS

Manpower requirement standards will be different between large urban centres and small semi-urban and rural settlements for reasons such as higher incidence of crime and other social disturbances in areas of large population concentration. The overall situation in Sarawak shows that between 1961 and 1970 the number of cases of crime reported to the police had increased 38.9 per cent or an annual compounded rate of 3.4 per cent growth. This situation therefore tends to suggest that more policemen would be required to suppress the constantly rising rate of crime. With this view in mind it is suggested here that the urban standard be one policeman to 250 population and in semi-urban/rural settlements, one policeman to 500 population, some of whom, could be stationed in towns from where they can move out to places where they are needed. In this context therefore any police station/post of the Minor Police Station class and below is considered to have a location in semi-urban/rural settlements. The staff requirements are shown in Table 5.3.

TABLE 5.3 STAFF REQUIREMENTS

Police unit / Classification	District police station	Minor police station	Police post	Village police post
Managerial and professional	-	-	-	-
Executive and sub-professional	2	-	-	-
Clerical and technical	5	3	-	-
Subordinate and manual	25	9	5	1
Total	32	12	5	1

TABLE 5.4 DISTRICT POLICE STATION RECURRENT EXPENDITURE PER ANNUM

	$
Personal emoluments:	
Two inspectors	12 000
One sergeant	5 300
Three corporals	17 500
20 constables	62 400
Three constable/drivers	9 720
One clerk/typist	3 020
Two IMG	4 200
Total	114 140
Operating expenditure:	
Telephone rentals	510
Maintenance of radio equipment	1 800
Vehicle maintenance and fuel	7 600
Water	150
Electricity	800
Office stationery	5 000
Maintenance of buildings	10 000
Contingencies	7 000
Total	32 860
Total emoluments and expenditure	147 000

TABLE 5.6 MINOR POLICE STATION RECURRENT EXPENDITURE PER ANNUM

	$
Personal emoluments:	
One sergeant	5 300
One corporal	5 500
Eight police constables	26 720
One clerk/typist	3 024
One IMG	2 100
Total	42 644
Operating expenditure:	
Telephone rentals	510
Maintenance of radio equipment at 10 per cent capital cost	1 800
Vehicle maintenance	3 500
Motor cycle maintenance	600
Water consumption	150
Electricity consumption	480
Office stationery	4 200
General maintenance of buildings at 2 per cent capital cost	4 000
Contingencies	3 000
Total	18 240
Total emoluments and expenditure	60 884

TABLE 5.5 MINOR POLICE STATION - PHYSICAL REQUIREMENTS AND INVESTMENT COSTS

Facility	Floor space (square feet)	Costs $
Buildings:		
Administration building	3 000	60 000
Other ancillary buildings	2 000	40 000
One generator house		8 000
One toilet		2 500
One garage with two parking spaces		1 000
Ancillary facilities:		
Security fencing	1 440 (1)	11 500
Electrical installation		2 000
Water supply installation		2 000
One flag pole		500
One parade ground		6 000
One standby generator		10 000
Communication equipment		31 000
One land rover		15 000
One heavy motor cycle		2 500
Furniture		2 000
Arms		2 000
Total		196 000
Quarters:		
Two quarters		50 000
One barrack block (eight doors)		48 000
Furniture		5 000
Total		103 000
Contingencies		15 000
Grand total		314 000

Note (1) Linear feet.

TABLE 5.7 POLICE POST - PHYSICAL REQUIREMENTS AND INVESTMENT COSTS

Facility	Floor space (square feet)	Costs $
Buildings:		
Administration building	3 500	70 000
Toilet		700
Ancillary facilities:		
Communication equipment		11 100
One heavy motor cycle		2 500
Furniture		1 500
One flag pole		500
Security fencing	800 (1)	6 400
Arms		1 000
Quarters:		
Four door barrack		24 000
Furniture		1 800
Contingencies		6 000
Total		125 500

Note (1) Linear feet.

TABLE 5.8 POLICE POST - RECURRENT EXPENDITURE PER ANNUM

	$
Emoluments:	
Four police constables	13 350
One IMG	2 100
Total	15 450
Operating expenditure:	
Maintenance of radio equipment at 10 per cent capital cost	200
Motor cycle maintenance for vehicle	600
Electricity	150
Water consumption	100
General building maintenance	1 800
Contingencies	1 500
Total	4 350
Total emoluments and expenditure	19 800

TABLE 5.9 VILLAGE POLICE POST - PHYSICAL REQUIREMENTS AND INVESTMENT COSTS

	$
Buildings:	
Administration building	7 000
Toilet	500
Ancillary facilities:	
Communication equipment	3 500
Fencing	3 200
Arms	100
Contingencies	700
Total	15 000

TABLE 5.10 VILLAGE POLICE POST - RECURRENT EXPENDITURE PER ANNUM

	$
Personal Emoluments	3 340
Other operation expenses:	
Maintenance of radio equipment at 10 per cent	350
Total	3 690

CHAPTER 6

THE FIRE SERVICES

The fire services in Sarawak, in general, are poorly developed. The best developed fire services are in Kuching, Sibu and Miri.

In the Kuching urban area there were about 43 firemen of all grades serving a total of around 100 000 population in 1971, thus giving a fireman-population relationship of around one to 2 300.

Fire occurrences in Sarawak are generally infrequent, possibly due to heavy rainfall, short dry spells, the use of not easily inflammable building materials, building density controls and observance of fire precaution rules.

The following is a brief description of the minimum size and staffing of fire brigades at the District and Sub - District level located in urban centres of 10 000 and 5 000 people respectively.

6.1 PHYSICAL REQUIREMENTS AND COSTS

The major fire fighting equipment comprises the following: fire engines with pumps, fire ladders, compressed air breathing apparatus, foam-making equipment and fire hoses.

The physical requirements and costs for the two different types of fire stations are shown in Table 6.1, which shows an investment cost including quarters of $380 000 for a District Fire Brigade and $150 000 for a Sub-District Brigade. The annual operation costs for the two levels are $34 000 and $16 000 respectively.

The total land requirements for a District Fire Brigade are estimated at 1.5 acres, for a Sub-District Fire Brigade 0.8 acre.

TABLE 6.1 DISTRICT AND SUB-DISTRICT FIRE BRIGADE - PHYSICAL REQUIREMENTS AND COSTS

Cost item	District fire brigade		Sub-District fire brigade	
	Size in square feet	Costs $	Size in square feet	Costs $
Investment costs				
Buildings:				
Buildings including parking space for engines	1 800	40 000	1 000	25 000
Ancillary facilities:				
Water supply		2 000		1 000
Electricity		2 000		1 000
Car park		800		500
Roads		1 600		1 000
Fencing		8 000		5 800
Fire engines		136 000		36 000
Ancillary equipment		2 000		1 000
Quarters	41 000	190 000	17 000	80 000
Total investment	42 800	382 400	18 000	151 300
Operation costs				
Emoluments		26 000		12 000
Services and supply		4 000		2 000
Maintenance of buildings		4 000		2 000
Total operation	-	34 000	-	16 000

6.2 STAFF REQUIREMENTS

The staff requirements for the two units are shown in Table 6.2.

TABLE 6.2 STAFF REQUIREMENTS

Group	District fire brigade	Sub-District fire brigade
Clerical and technical	1	
Manual	9	5
Total	10	5

PART II
TRANSPORT

CHAPTER 7
ROAD COSTS

Estimates of road construction and maintenance costs are presented for budgetary purposes. These estimates are based on information supplied by Public Works Department (PWD), Kuching, and data from land development schemes and timber companies.

7.1 MAIN PUBLIC ROADS

There are four public road standards, trunk, secondary, improved feeder and feeder. Table 7.1 shows the estimated cost of constructing main public roads according to PWD design.

TABLE 7.1 ESTIMATED COST OF CONSTRUCTING AND IMPROVING MAIN PUBLIC ROADS

A. COSTS OF NEW CONSTRUCTION(1)

Road standard	Design			Costs $'000/mile		
	Surface type	Width formation (feet)	Pavement (inches)	Construction	Surface	Total
Trunk	Pre-mix	44	24	250	260	510
Secondary	Pre-mix	36	20	200	220	420
Improved feeder	Bitumen sealing	30	18	150	150	300
Feeder	Gravel	28	14	120	30	150

B. COSTS OF IMPROVEMENTS(1)

Road standard		Costs $'000/mile		
From	To	Construction	Surface	Total
Improved feeder	Trunk	140	260	400
Feeder	Trunk	180	260	440

C. BRIDGE CONSTRUCTION COSTS (PERMANENT BRIDGES OVER 40 FEET)

Concrete and steel bridges	Pavement width 28 feet	Cost per linear foot $2 000

Note (1) Exclusive of major bridges and land aquisition.

7.2 LOCAL ROADS

Access to villages, smaller centres and individual farms would be provided by local roads of lower standards. Table 7.2

TABLE 7.2 ESTIMATED COSTS OF LOCAL ROADS (LOW COST ROADS EXCLUDING LAND AQUISITION)

Detail	M$ per mile
1. Local primary road: 18 to 20 feet wide pavement	
Basic construction costs (earthworks, drainages etc.)	24 000
8 inch stone pavement (2 600 cubic yards per mile)	36 000
Labour and equipment	15 000
Total	75 000
2. Local secondary road: 14 feet wide pavement	
Basic construction costs (earthworks, drainage etc.)	11 000
6 inch stone pavement (1 370 cubic yards per mile)	19 000
Labour and equipment	5 000
Total	35 000
3. Local tertiary road: 10 feet wide pavement	
Basic construction costs (earthworks, drainage etc.)	7 000
4 inch stone pavement (650 cubic yards per mile)	9 000
Labour and equipment	4 000
Total	20 000
4. Earth road (track): 10 feet wide	
Basic construction costs	6 000
5. Bridges for local roads (over 40 feet long)	
Width 14 feet; timber: $400 per linear foot	
Bailey: $700 per linear foot	
Stone costs:	$
Cost of crushed stone ex-quarry	6
Transport (30 miles at $0.26 per cubic yard/mile)	8
Total cost at work site	14

shows cost estimates for four classes of local roads. These roads are of low cost standard, and alignment standard with no built in features which allow for future improvement to main road standards.

7.3 ROAD MAINTENANCE COSTS

The cost of maintaining main public roads, both paved roads, gravel and stone roads, is estimated at:-

Routine - $5 000 per mile per year;
Periodic - $12 000 per mile each fourth year.

The cost of maintaining local roads is estimated roughly at:-

Local primary - $3 500 per mile per year;
Local secondary - $2 500 per mile per year;
Local tertiary - $1 500 per mile per year;
Earth - $1 500 per mile per year.

7.4 ROAD ADMINISTRATION

The PWD is at present responsible for the construction and maintenance of the main public road network and access roads to micro-wave stations and land development schemes. Local councils in Sarawak are in general responsible for maintenance only of roads in the urban areas, while local rural roads are generally under the responsibility of the Administration. The construction of local roads is usually carried out on a gotong royong basis with the people in the area supplying the labour. Maintenance of these roads is the responsibility of the people benefiting from the roads.

The present system of road administration has worked well but increasing modernisation and specialisation indicates that the system ought to be reviewed. A revised organisational set-up might be:-

(a) Local councils: It is considered that only councils in the main urban areas are in a position to build up a rational and efficient road maintenance organisation. The construction of roads in these urban areas (for example Sibu, Miri) can be undertaken by PWD or private contractors on request by the Council.

(b) Public Works Department: Public Works Department should as now be responsible for all main public roads, and for access roads to estates, groups of individual farms and smaller centres and for roads within the smaller urbanised areas.

(c) Private roads: It is suggested that all roads within estates and farms except the public access road should be the responsibility of the estate and the individual farmer.

The essence of this proposal is that the responsibility of the PWD should be extended to include local access roads such as the local roads in Riam and Bakam and roads now maintained by the District Councils. This additional activity of PWD could be financed through a State Road Fund based on a small local gasoline tax.

7.5 ROAD NETWORK DENSITY

Road access is a pre-requisite for modern agricultural development. The farmer must have a suitable opportunity to bring in agricultural inputs and to bring out farm produce and provide access to public and private services.

It is suggested that no farm in a development area should on average be more than 0.5 mile from the nearest public road, constructed and maintained as a public service. The minimum local access road requirement in agricultural development areas with individual farms would then be about 0.4 chain (rubber) to 1.3 chains (oil palm) of access and harvesting roads per gross area. Of this about 0.13 chain per acre would be secondary access road.

CHAPTER 8

TRUCK TRANSPORT COSTS

8.1 INTRODUCTION

The development of efficient truck transport depends heavily on a progressive and well implemented transport policy.

8.2 SUMMARY

The considerations on truck transport costs made here indicate clearly that the level of transport costs depends heavily on the following factors:-

- the standard of the road network;
- the load capacity of vehicles used;
- the transport operating and management efficiency;
- the efficiency of the terminal operations (cargo handling).

It is obvious that good roads facilitate better service than roads of lesser standard. Studies made in other countries indicate that the vehicle operating costs on a well maintained gravel road are about 30 per cent higher than on a good paved road. Temporary bridges can only accommodate rather small trucks and prohibit the use of larger and more efficient vehicles which the roads and permanent bridges are designed to accommodate. It is therefore highly recommended that temporary bridges are avoided as far as possible and in any case replaced by permanent bridges as soon as possible.

Truck transport costs decrease with increasing vehicle load capacity as long as the terminal time does not make up more than about 60 to 70 per cent of the total round trip time. There are further significant benefits to be obtained by more extensive use of the transport equipment, by better transport organisation giving higher load factors and by improvement and speeding up of the cargo handling.

Based on the general considerations, some assumptions and estimates have been made on the future road transport costs. It is assumed that vehicles with up to 25 ton load capacity can be utilised on the main road network and that the efficiency of transport organisation and operation have developed a significant step further from the present situation. The estimated cost of future road transport varies from about 11 to 12 cents per ton-mile for long distance transport of bulk commodities on paved roads to about 25 cents per ton-mile for short distance transport on gravel roads (based on fuel prices, mid 1973).

The estimated transport cost equations are only meant to be indicative. The cost of each specific transport operation ought to be studied and calculated separately.

8.3 PRESENT TRUCK TRANSPORT COSTS

Truck transport in Sarawak is mainly carried out by five to six ton lorries operated by a driver/owner. Few companies have more than two to three lorries. Commercial truck transport is almost exclusively carried out on a per trip basis, that is the shipper rents a truck for each task to be carried out.

There is no regulation of truck transport charges. Operators are free to negotiate charges with the shipper. However, operators in practice follow an unofficial tariff of rates which is worked out by the lorry owners associations. Some present transport rates given as charges for hire of a lorry by transport distance are presented in Figure 8.1. The average ton mile cost for transporting goods some 50 miles and over is around 25 cents in the Fourth Division for full load one way and return empty. The rates obtained for the Kuching area appear to be about 20 per cent lower reflecting a larger market and better roads.

8.4 ANALYSES OF TRUCK TRANSPORT COSTS

Estimated costs are based on information obtained in Malaysia and on studies made in other countries. The main sources of information are listed in Appendix II.

The main factors affecting transport costs can in general be grouped as being:-

- volume and characteristics of the transport demand;
- standard of the road network;
- type and size of vehicles used;
- basic cost of owning and operating the trucks;
- characteristics of the transport operation.

It is assumed that the volume and characteristics of transport demand does not interfere with the influence of the other factors. The basic vehicle operating costs are estimated assuming that the roads are paved and in good condition.

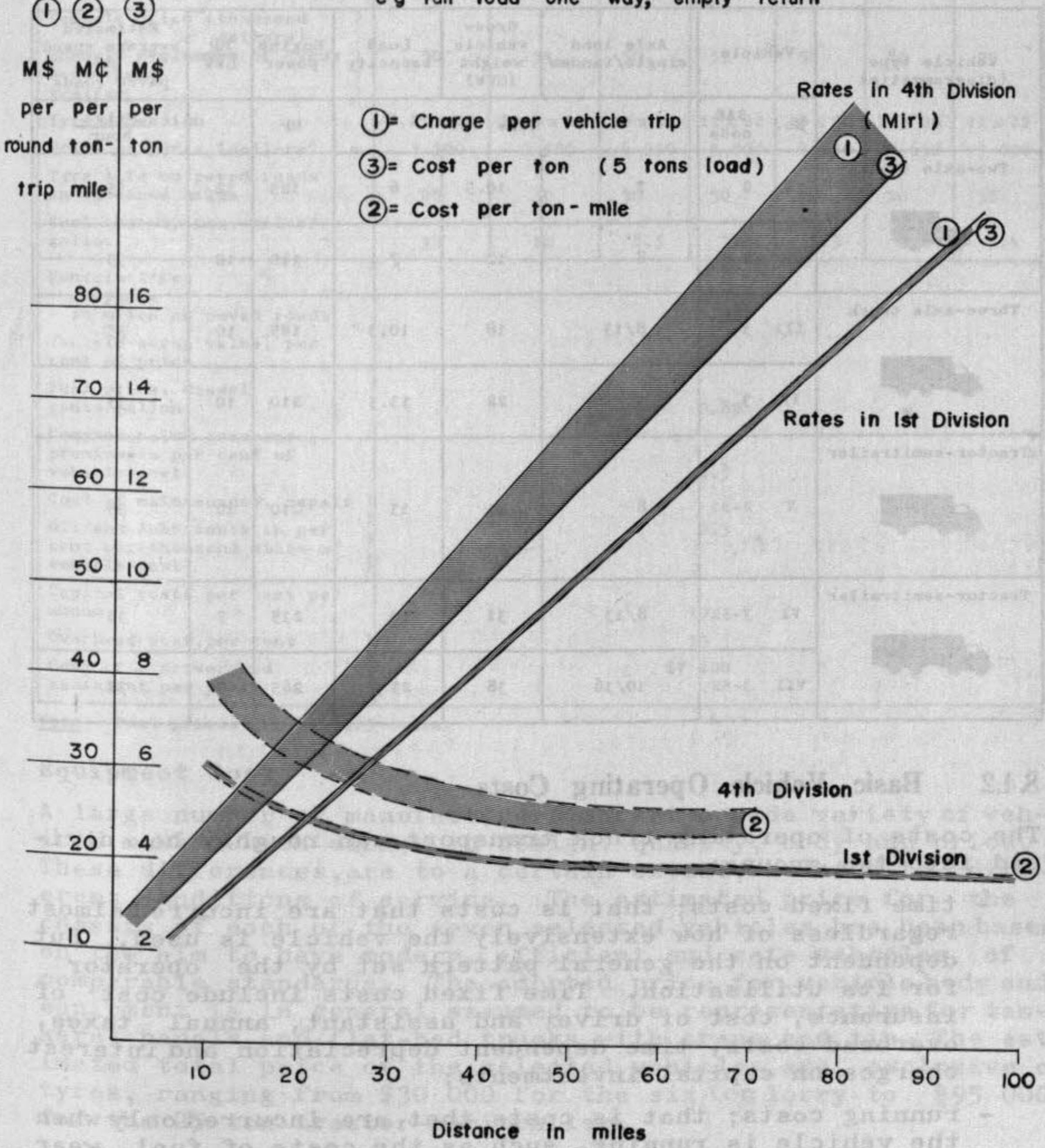
8.4.1 Vehicles Selected for Analyses

Estimates of truck operating costs have been made for seven different vehicles reflecting variations in axle-loads and

FIGURE 8.1

PRESENT TRUCK TRANSPORT CHARGES, SAMPLES

NOTE: The sample rates exclude handling charges
The load factor is assumed to be 50%;
e.g full load one way, empty return



number of axles. The vehicles range from a two axle truck with six ton load capacity to a five axle tractor semitrailor combination with a 25 ton load capacity. The basic technical data of the selected vehicles is presented in Table 8.1. The engine-power gross vehicle weight ratios adopted are assumed to enable the single trucks and the three-axled tractor semitrailer combination to keep an average speed of 35 miles per hour and the five-axled tractor-semitrailers to keep an average speed of 32 miles per hour on paved roads.

TABLE 8.1 TECHNICAL CHARACTERISTICS OF SELECTED TRUCKS

Vehicle type (diagrammatic)	Vehicle		Axle load single/tandem	Gross vehicle weight (GVW)	Load capacity	Engine power	HP/GVW	Estimated average speed on paved roads
	No.	SAE code	Tons			HP		Miles/hour
Two-axle truck 	I	2	7	10.5	6	125	12	35
	II	2	8	12	7	140	12	35
Three-axle truck 	III	3	8/13	18	10.5	185	10	35
	IV	3	10/16	22	13.5	210	10	35
Tractor-semitrailer 	V	2-S1	8	21	13	210	10	35
Tractor-semitrailer 	VI	3-S2	8/13	31	20	215	7	32
	VII	3-S2	10/16	38	25	265	7	32

8.4.2 Basic Vehicle Operating Costs

The costs of operating truck transport can roughly be divided into two groups:-

- time fixed costs; that is costs that are incurred almost regardless of how extensively the vehicle is used, but dependent on the general pattern set by the operator for its utilisation. Time fixed costs include cost of insurance, cost of driver and assistant, annual taxes, overhead costs, time dependent depreciation and interest charges on capital investments;
- running costs; that is costs that are incurred only when the vehicle is running, such as the costs of fuel, wear and tear of tyres, maintenance, repair, oil, lubrication and depreciation due to running wear and tear.

A summary of the estimated basic cost data is presented in Table 8.2; the estimated detailed truck operating costs are presented in Table 8.3. All costs are calculated inclusive of present custom duties, excise duties and sales tax as they apply.

TABLE 8.2 ESTIMATED BASIC DATA ON SELECTED TRUCKS

Item \ Vehicle no. / SAE code	I 2	II 2	III 3	IV 3	V 2-S1	VI 3-S2	VII 3-S2
Load capacity in tons	6	7	10.5	13.5	13	20	25
Vehicle price (thousand dollars) Chassis exclusive of tyres body-works trailer	30	34	50	55	58	80	95
Tyre dimension	8.25 x 20	10.0 x 20	10 x 20	11 x 22	10 x 20	10 x 20	11 x 22
Price of tyres (dollars)	1 500	2 500	4 250	5 000	4 250	7 650	9 000
Tyre life on paved roads in thousand miles	20	30	30	30	30	30	30
Fuel consumption, miles/gallon	13	12	8.5	7.5	7.5	6.0	5.4
Vehicle life: in years in miles on paved roads	 10 300 000						
Vehicle scrap value, per cent of price	10						
Fuel price, diesel cents/gallon	0.82						
Comprehensive insurance, premium in per cent of vehicle cost	2.5						
Cost of maintenance, repair Oil and lubricants in per cent per thousand miles of vehicle cost	0.3						
Capital costs per cent per annum	10						
Overhead cost, per cent	10						
Cost of a driver and assistant per year	$7 200						

<u>Note</u> Fuel prices are at 1973 costs.

Equipment Cost

A large number of manufacturers market a wide variety of vehicle makes which differ in design, quality, body and price. These differences, are to a certain extent, related to different conditions of service. The estimated price for the chassis of each of the seven selected vehicles has been based on the aim to have modern, efficient and safe vehicles of comparable standards. The adopted price for vehicle body and equipment is in general assumed to be representative for tankers, panels and flat-bed trucks with crane and tip. The estimated total price of the selected vehicles are, exclusive of tyres, ranging from $30 000 for the six ton lorry to $95 000 for the 25 ton tractor-semitrailer.

It is assumed that all the vehicles have an economic life of ten years and 300 000 miles with a scrap value of ten per

TABLE 8.3 TRUCK OPERATING COSTS (ON PAVED ROADS)

Item		I	II	III	IV	V	VI	VII
	Vehicle number	I	II	III	IV	V	VI	VII
	Load capacity, tons	6	7	10.5	13.5	13	20	25
	SAE code	2	2	3	3	2-S1	3-S2	3-S2
Vehicle time fixed costs, $/year	Depreciation, interest (1)	3 300	3 850	5 750	6 350	6 600	9 300	11 000
	Insurance	800	900	1 350	1 500	1 550	2 200	2 600
	Road licence	500	550	700	800	600	800	900
	Total	4 600	5 300	7 800	8 650	8 750	12 300	14 500
Assumed efficient operating time per year		1 shift: 1 800 hours per year 2 shifts: 3 400 hours per year						
Vehicle time costs $/hour	1 shift	2.55	2.95	4.30	4.80	4.85	6.85	8.05
	2 shifts	1.35	1.55	2.25	2.55	2.60	3.60	4.25
Cost of driver and assistant	1 shift	$7 200 per year, $4 per hour						
	2 shifts	$14 400 per year, $4.20 per hour						
Vehicle running costs cents/mile	Depreciation (1)	5.10	5.70	8.30	9.20	9.65	13.30	15.80
	Fuel	6.30	6.80	9.60	10.90	10.90	13.70	15.20
	Tyres	7.50	8.30	14.20	16.70	14.20	25.50	30.30
	Maintenance, repair, etc.	9.00	10.20	15.00	16.50	17.40	24.00	28.50
	Total	27.90	31.00	47.10	53.30	52.15	76.50	89.80

Note (1) Depreciation due to wear and tear has been assumed to equal half the vehicle cost over 300 000 miles on paved roads. The depreciation and interest charges included as a vehicle time cost item is taken as the annual capital recovering cost less the depreciation included as a running cost item.

cent. It has further been assumed that about half the depreciation is due to running wear and tear, the other half to wear and tear by time and obsolescence. Depreciation due to running wear and tear has thus been calculated as 0.17 per cent of the vehicle cost per thousand miles. The annual time dependent depreciation and the interest charges have been taken as the average annual capital recovery cost less the average annual depreciation due to running wear and tear. The reason for using this somewhat complicated procedure is to enable the calculations to indicate a truer picture of the effects that vehicle utilisation and operating efficiency have on transport costs, rather than taking depreciation as a pure time cost. The interest rate has been assumed to be ten per cent per annum.

Other Costs

It has been assumed that all vehicles carry comprehensive insurance at an annual cost of 2.5 per cent of the equipment purchase price. The annual road licence costs have been calculated according to the tariff of the Road Tariff Ordinance. The monthly cost of a driver and assistant has been assumed to be $600 including salary and benefits. The overhead costs have simply been assumed to amount to ten per cent of the total operating costs.

Fuel

All the selected vehicles are assumed to be diesel powered.

The estimated average fuel consumption on paved roads given as miles per gallon is presented in Table 8.2 for each of the selected vehicles. The price of diesel oil is taken as $0.82 per gallon (at 1973 prices).

Tyres and Tubes

The purchase price of tyres and tubes has been based on the assumed tyre dimensions used on the vehicles and the retail selling price less an assumed discount of 20 per cent. The useful life of the tyres have been estimated to 20 000 miles for tyre dimensions 8.25 inches by 20 inches and to 30 000 miles for the larger tyres when used on paved roads.

Maintenance, Repair, Oil and Lubrication

The cost of maintenance and repair is the most problematic cost item. It depends heavily on the vehicle type and quality, type of use, the skill of drivers, the operation and depreciation policy of the truck operator and the required standard of road traffic safety. The cost of maintenance and repair together with the cost of oil and lubrication have on the basis of experience from other countries been estimated at 0.3 per cent of the vehicle purchase price per thousand miles on paved roads.

Summary of Operating Costs

The estimated total annual vehicle time fixed costs vary, as presented in Table 8.3 from $4 600 for the six ton truck to $14 500 for the 25 ton tractor-semitrailer. The estimated vehicle running costs vary from about 28 cents per mile for the six ton truck to about 90 cents per mile for the 25 ton tractor-semitrailer combination (at 1973 prices).

8.4.3 Operating Characteristics

The operating factors of significant importance are:-

- average vehicle speed;
- transport distance;
- terminal time;
- utilisation of transport capacity (load factor);
- total yearly operating time.

The average vehicle speed, as presented in Table 8.1, has been assumed to be 35 miles per hour for single trucks and the three-axled vehicle combination, and to be 32 miles per hour for the five-axled vehicle combinations.

The terminal time, that is the time used for loading and unloading varies considerably with goods type and with the type of handling method and equipment used. The terminal time can usually be divided into a fixed time for parking, paper work, rest and the like, and on loading-unloading time which are proportionate to the load in tons. The fixed terminal time has for calculation purposes, been taken as being half an hour per trip. Three alternative goods handling rates have been used:-

(a) 24 tons per hour which should indicate mechanised handling of bulk cargo and unitised cargo;

(b) 12 tons per hour indicating efficient manual handling;

(c) four tons per hour indicating traditional manual handling of general cargo.

The load factor for calculation purposes has been assumed to be 50 per cent, indicating that the trucks on average are carrying a full load one way, and return empty.

A driver is assumed to work about 2 000 hours a year. However, it is assumed that only 90 per cent of this time or about 1 800 hours, is efficiently used in connection with driving and terminal handling. It is further assumed that the time used efficiently in a two shift system amounts to only 3 400 hours per year reflecting shorter working time as a compensation for shift work or higher driver costs per hour.

8.4.4 Transport Costs (On Paved Roads)

The procedure of calculating the average cost of carrying out a transport task can be illustrated by the following simple model:-

$$K = \frac{1}{2.L.f} \left(C_t\left(\frac{2.d}{v} + T\right) + C_d.2.d \right) .\left(1 + \frac{s}{100}\right)$$

Where:
- K = transport cost per ton;
- C_t = the average driver and vehicle cost per operating hour;
- C_d = the vehicle running cost per mile;
- s = overhead cost in per cent of truck operating costs;
- L = vehicle load capacity in tons;
- f = the load factor (average utilisation of transport capacity);
- d = transport distance (one way);
- v = vehicle speed;
- T = total terminal time.

The expression within the brackets on the right side of the equation gives the average total cost of performing the round trip. The total cost of the round trip is then divided by the amount of load carried, the overhead cost is added and the result provides the transport cost per ton. Any costs of services provided by terminals are not included.

On the basis of the basic operating costs presented in Table 8.3, the operating characteristics given in Section 8.4.3 and the model presented above, a calculation exercise has been carried out. This calculation is made to indicate the order of magnitude of transport costs following the assumptions and estimates made, and to indicate the influence alternative vehicle load capacities and transport operating characteristics have on the transport costs.

Influence of Vehicle Load Capacity

It is an accepted fact that truck transport costs decrease with increasing vehicle load capacity. This is illustrated in Figure 8.2 which indicates that a 25 ton tractor - semi-trailer can operate at a cost 30 per cent below that of a six ton lorry under the conditions listed. The benefit of increasing load capacity depends, however, heavily on the cargo handling efficiency and the transport distance. It is, as illustrated in Figure 8.1, more costly to use heavier trucks on distances less than 50 miles if the cargo handling rate is only four tons per hour.

Influence of Operating Characteristics

The truck transport costs are highly dependent on operating characteristics, such as cargo handling rate, number of shifts worked, operating efficiency and the average load factor. The influence of the specific values of these characteristics on the transport costs is illustrated in Figures 8.2, 8.3 and 8.4.

Operating the equipment in two shifts instead of one can cut transports cost by ten to 15 per cent. Efficient utilisation of the working hours and the equipment load capacity is, however, equally important to keep the costs down. If an efficient transport company or organisation can manage to get return cargo amounting to 20 per cent of the vehicle transport capacity, the average transport cost would decrease by ten per cent compared to the general operating pattern of a full load one way and an empty return trip. If efficient management can increase the average utilisation of drivers and equipment by say 20 per cent, the average transport cost would again decrease by about ten per cent. It is costly to have drivers and expensive equipment idle; carrying cargo on a return trip which has to be made anyway, costs virtually nothing.

FIGURE 8

INFLUENCE OF VEHICLE LOAD CAPACITY AND TERMINAL TIME ON TRANSPORT COSTS, SAMPLE

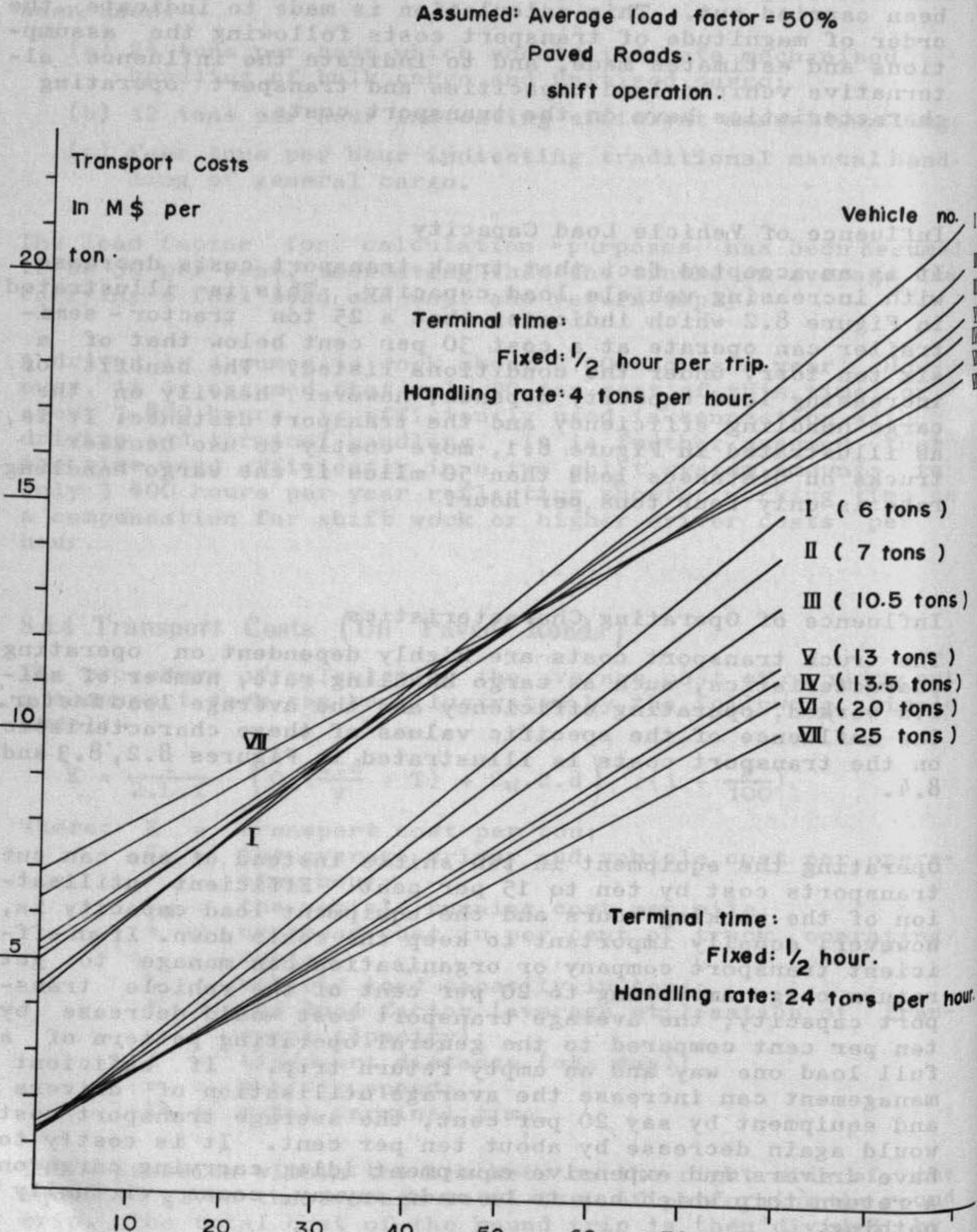


FIGURE 8.3

INFLUENCE OF VEHICLE LOAD CAPACITY, OPERATING TIME AND CARGO HANDLING RATE ON TRUCK TRANSPORT COSTS, SAMPLES

Assumption: Paved Roads, 50% Load Factor

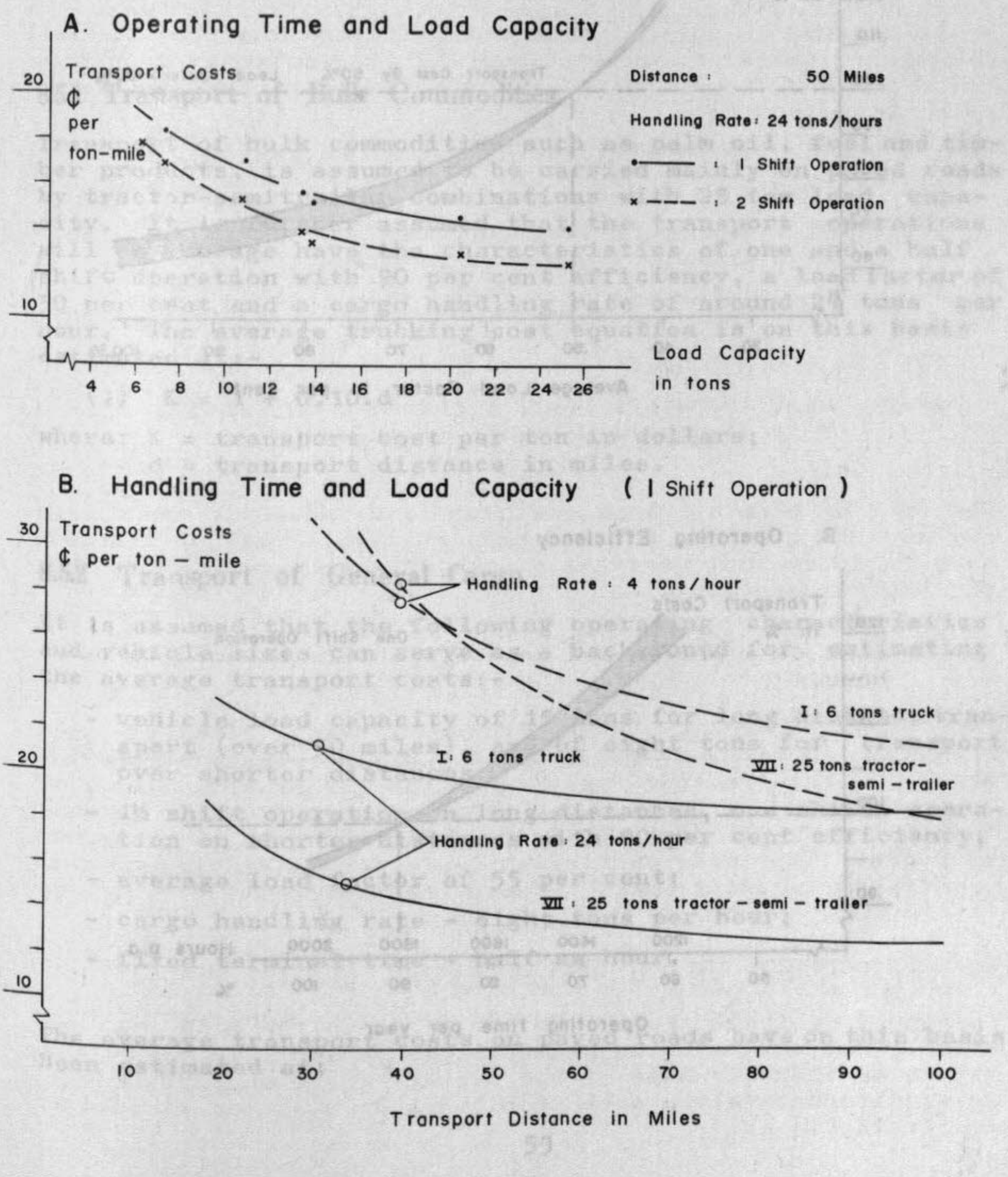
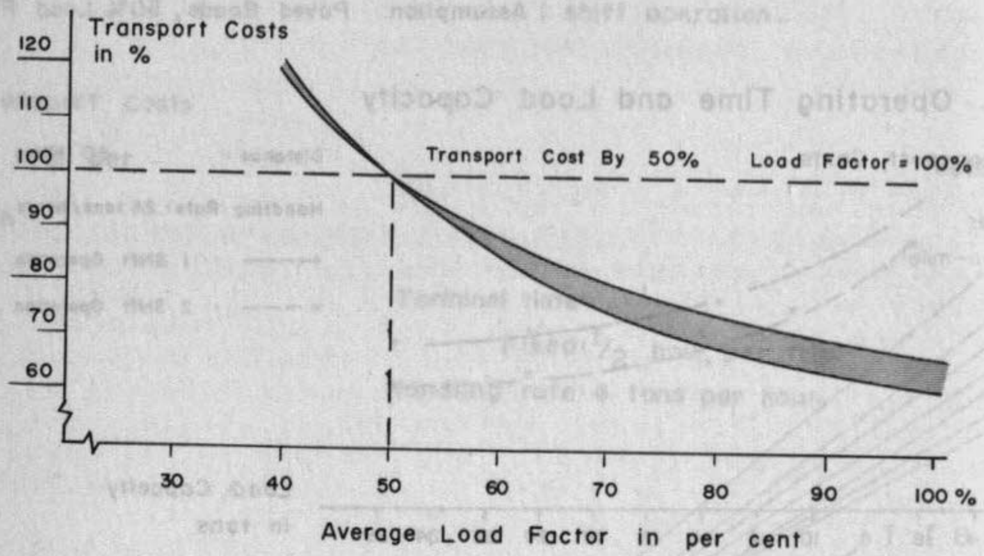


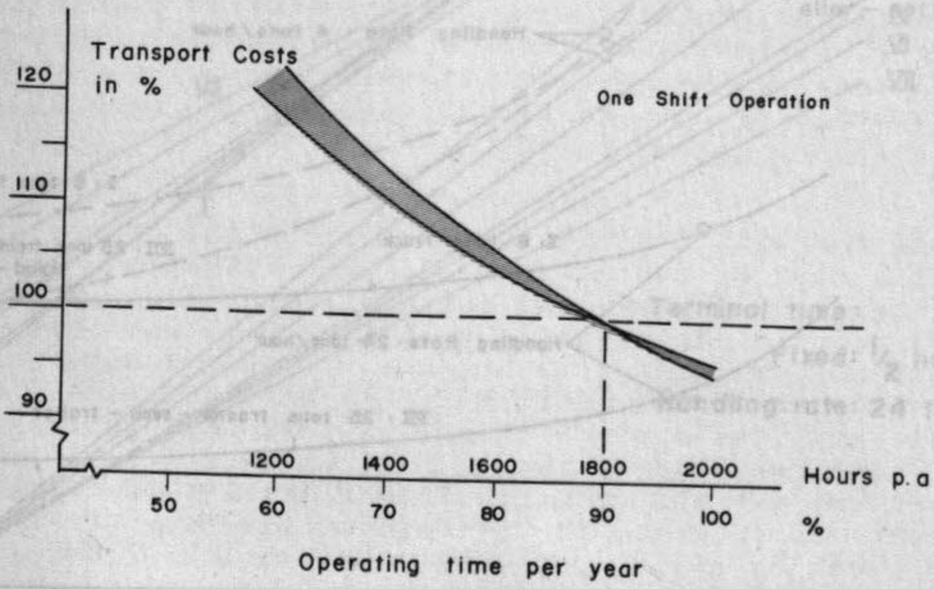
FIGURE 8.4

INFLUENCE OF LOAD FACTOR AND OPERATING EFFICIENCY ON AVERAGE TRANSPORT COSTS

A. Load Factor



B. Operating Efficiency



8.5 FUTURE TRANSPORT COSTS

It is assumed in general that the development of cheaper and more efficient road transport services will follow the pace of the road infrastructure development, and the general economic and social development. It is assumed that vehicles with up to 25 ton load capacity are permitted to use the main road network and that the commercial road transport services are run by fairly large and well-managed transport companies.

On the basis of the assumptions and considerations made in the proceeding sections, some estimates have been made of the average future transport costs.

8.5.1 Transport of Bulk Commodities

Transport of bulk commodities such as palm oil, fuel and timber products, is assumed to be carried mainly on paved roads by tractor-semitrailer combinations with 25 ton load capacity. It is further assumed that the transport operations will on average have the characteristics of one and a half shift operation with 90 per cent efficiency, a load factor of 50 per cent and a cargo handling rate of around 24 tons per hour. The average trucking cost equation is on this basis estimated at:-

(1) $K = 1 + 0.10.d$

where: K = transport cost per ton in dollars;
d = transport distance in miles.

8.5.2 Transport of General Cargo

It is assumed that the following operating characteristics and vehicle sizes can serve as a background for estimating the average transport costs:-

- vehicle load capacity of 15 tons for long distance transport (over 50 miles), and of eight tons for transport over shorter distances;
- 1½ shift operation on long distances, one shift operation on shorter distances with 90 per cent efficiency;
- average load factor of 55 per cent;
- cargo handling rate - eight tons per hour;
- fixed terminal time - half an hour.

The average transport costs on paved roads have on this basis been estimated at;

Long distance transport (over 50 miles) on paved roads:-

(2) $K_2 = 3 + 0.12.d$

where K_2 = transport costs per ton in dollars;
d = transport distance in miles.

Short distance transport (less than 50 miles) on paved roads:-

(3) $K_3 = 2 + 0.14.d$

where K_3 = transport costs per ton in dollars;
d = transport distance in miles.

It is assumed in general that vehicle operating costs on well maintained gravel roads are about 30 per cent higher than on paved roads. The estimated average transport costs on gravel roads will thus be:-

Long distance transport (over 50 miles) on gravel roads:-

(4) $K_4 = 3 + 0.16.d$

where K_4 = transport costs per ton in dollars;
d = transport distance in miles.

Short distance transport (less than 50 miles) on gravel roads:-

(5) $K_5 = 2 + 0.18.d$

where K_5 = transport costs per ton in dollars;
d = transport distance in miles.

The cost of terminal services have to be added to the trucking cost to give the total transport costs. It is assumed here that terminal costs as a rule of thumb amounts to $2 per ton per handling.

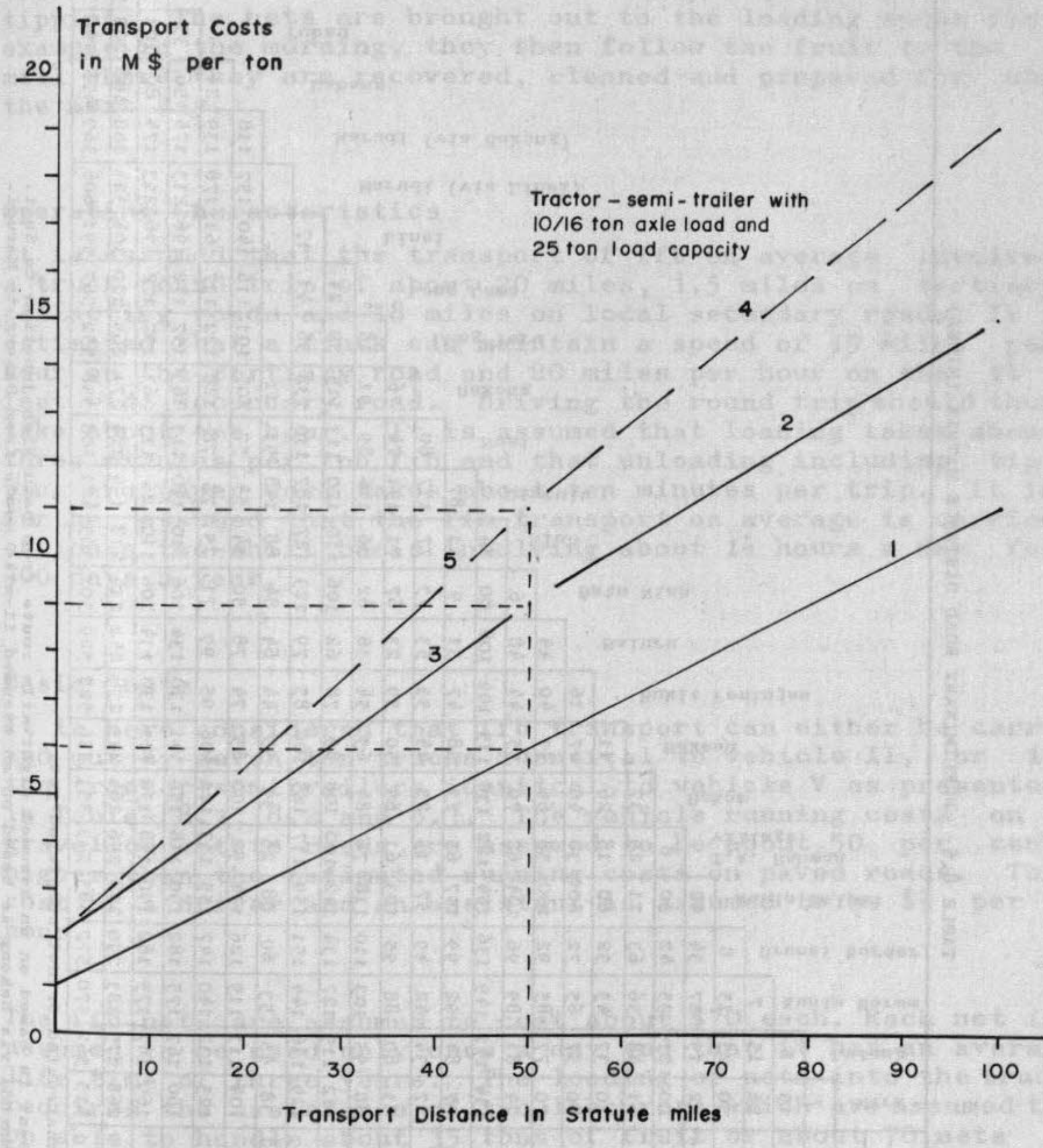
8.5.3 Summary

The estimated average future transport costs, given as cost equations in Sections 8.5.1 and 8.5.2, are presented in Figure 8.5. The transport cost equations giving the transport cost per ton as a function of the transport distance, should together with the preliminary road distance table presented in Table 8.4 provide sufficient basis for estimating the future truck transport costs between the centres.

8.6 TRANSPORT OF OIL PALM FRUIT (FFB)

Transport of fresh fruit from the field to the mill is one significant cost item in palm oil production. In the following an estimate is made of the average ffb transport costs using alternatively a seven ton truck or a 13 ton tractor-semitrailer.

ESTIMATED FUTURE TRUCK TRANSPORT COSTS



NOTE: a. 1 = Transport of Bulk Commodity on Paved Roads with 10/16 ton axle loads on single/tandem axles

2 & 3 = Transport of General Cargo on Paved Roads

4 & 5 = Transport of General Cargo on Gravel Roads (8/13 ton axle loads)

b. Average Load Factor : 50 per cent

c. Terminal Costs are not included

TABLE 8.4 PRELIMINARY ROAD DISTANCE MATRIX (MILES)

Node No.	Town village	Miri	Lutong	Kuala Baram	Brunei border	Kuala Belait	T.A. Rahman village	Bakam	Bekenu	Bukit Peninjau	Beluru	Batu Niah	Niah	Bintulu	Suai	Bakong	Long Teru	Long Lama	Linei	Marudi (via Linei)	Marudi (via Bakong)	Labang	Tubau	Belaga	Tatau	Sibu	Kuching
400	Miri																										
401	Lutong	7																									
402	Kuala Baram	15	8																								
403	Brunei border	22	15	7																							
632	Kuala Belait	30	23	15	8																						
405	T.A. Rahman Village	12	19	27	34	42																					
406	Bakam	20	27	35	42	50	8																				
408	Bekenu	41	48	56	63	71	29	37																			
407	Bukit Peninjau	30	37	45	52	60	18	26	11																		
423	Beluru	50	57	65	72	80	38	46	27	16																	
416	Batu Niah	70	77	85	92	100	58	66	51	40	44																
414	Niah	74	81	89	96	104	62	70	55	44	48	6															
430	Bintulu	134	141	149	156	164	122	130	115	104	108	80	84														
419	*Suai	77	84	92	99	107	65	73	58	47	51	9	13	87													
422	*Bakong	27	34	42	49	57	15	23	44	33	53	73	77	137	80												
425	*Long Teru	73	80	88	95	103	61	69	50	39	23	67	71	131	74	76											
429	*Long Lama	88	95	103	110	118	76	84	65	54	38	82	86	146	89	91	15										
428	*Linei	112	119	127	134	142	100	108	89	78	62	106	110	170	113	115	39	24									
420	*Marudi (via Linei)	129	136	144	151	159	117	125	106	85	79	123	127	187	130	132	56	41	17								
	(via Bakong)	38	45	53	60	68	26	34	55	44	64	84	88	148	91	11											
435	*Labang	104	111	119	126	134	92	100	85	74	78	50	54	54	57	107	101	116	140	157	118						
436	*Tubau	125	132	140	147	155	113	121	106	95	99	71	75	75	78	128	122	137	161	178	139	21					
351	*Belaga	160	167	175	182	190	148	156	141	130	134	106	110	110	113	163	157	172	196	213	174	56	35				
446	*Tatau	160	167	175	182	190	148	156	141	130	134	106	110	26	113	163	157	172	196	213	174	80	101	136			
300	*Sibu	268	275	283	290	298	256	264	249	238	242	214	218	134	221	271	265	280	304	321	282	188	209	244	108		
100	*Kuching	555	562	570	577	585	543	551	536	525	529	501	505	421	508	558	552	567	591	608	569	475	496	531	395	287	

Notes * Road link not constructed or not completed yet.

Road distance to Suai is based on an assumed eight-mile route from Batu Niah junction to Suai.
Road distance to Marudi via Bakong is based on an assumed 11-mile route from Bakong to Marudi.

Transport Method

The most rational method for ffb transport now practised, involves the use of nets and trucks equipped with crane and tip. The fresh fruit bunches are put into nets which hold about half a ton of fruit each, the nets are hoisted onto the truck with the crane. The fruit is dumped at the mill by tipping, The nets are brought out to the loading spots for example in the morning, they then follow the fruit to the mill where they are recovered, cleaned and prepared for use the next day.

Operating Characteristics

It is assumed that the transport of ffb on average involves a truck round trip of about 20 miles, 1.5 miles on tertiary collecting roads and 18 miles on local secondary roads. It is estimated that a truck can maintain a speed of 15 miles per hour on the tertiary road and 20 miles per hour on the 14 feet wide secondary road. Driving the round trip should thus take about one hour. It is assumed that loading takes about three minutes per ton ffb and that unloading including tipping and paper work takes about ten minutes per trip. It is further assumed that the ffb transport on average is carried out on a two-shift basis involving about 14 hours a day for 300 days a year.

Basic Costs

It is here considered that ffb transport can either be carried out by seven ton trucks identical to vehicle II, or 13 ton tractor-semitrailers identical to vehicle V as presented in Tables 8.1, 8.2 and 8.3. The vehicle running costs on gravelled estate roads are assumed to be about 50 per cent higher than the estimated running costs on paved roads. The cost of a driver and an assistant is assumed to be $4 per hour.

The ffb nets are assumed to cost about $70 each. Each net is assumed to be used only once a day and that it has an average life time of three years. The loading of nets into the truck requires the assistance of two labourers which are assumed to be able to handle about 35 tons of fruit or about 70 nets during one shift. Labour is assumed to cost $6 per day.

Total Transport Costs

On the basis of the assumptions made above and the vehicle operating cost estimates presented in Table 8.3, the average transport cost per ton of ffb has been calculated as in Table 8.5. The cost of nets and handling labour are found to be $0.50 per ton, the transport to cost $2.50 per ton when seven ton trucks are used and \$2.10 per ton when 13 ton tractor-semitrailers are used.

TABLE 8.5 ESTIMATED COST OF TRANSPORTING OIL PALM FRUIT (FFB) FROM FIELD TO MILL

1. Basic characteristics:
   - round trip; 1.5 miles on tertiary roads, speed 15 miles per hour;
     18 miles on secondary roads, speed 20 miles per hour.
   - loading: three minutes per ton.
   - unloading: ten minutes flat per trip.
   - two shifts working 14 hours a day, 300 days a year.
   - seven ton truck: 1.5 hours per round trip, nine trips a day;
   - 13 ton truck: 1.85 hours per round trip, seven trips a day.

2. Trucking costs (dollars)

Vehicle load capacity	7 tons	13 tons
Vehicle time cost per year Driver cost per hour Vehicle running cost per mile	5 300 4 0.42	8 750 4 0.78
Total vehicle and driver cost per round trip	16.37	25.60
Transport cost per ton including some seven per cent for administration, breakdowns, etc.	2.50	2.10

3. Cost of handling (nets and labour)

		\$/ton
Nets	$\$70 \times \frac{2}{300 \times 3} =$	0.16
Labour	$\$6 \times \frac{2}{35} =$	0.34
Total		\$0.50

Benefits of Using Heavier Trucks

The calculations made above indicate that 13 ton trucks can carry out the ffb transport 15 per cent, or about \$0.40 per ton, cheaper than seven ton trucks. A 13 ton truck would, however, be almost twice as long as a seven ton truck and will thus demand a somewhat better road alignment or wider road pavement on the curves. An important question is how this will affect the road costs.

It is considered that road requirements for oil palm plantations amounts to about 1.2 chains of roads per acre, which will cost about $240 to construct. It can be assumed that the cost of earth works which is the main cost item to be affected by demands for higher alignment standard, amounts to about 25 per cent of the total cost or about $60 per acre. If the earth work costs are depreciated over 20 years with ten per cent interest, the annual cost would be about $7 per acre.

The expected oil palm fruit yield is about ten tons per acre per year. The benefits in transport costs by using 13 ton trucks would thus amount to about $4 per acre per year. The calculation exercise indicates thus that the road earth work costs can increase up to 50 per cent and still leave a transport system with 13 ton trucks to provide cheaper service than a system involving seven ton trucks. It is therefore recommended that the use of heavy trucks should be seriously considered when oil palm plantation schemes are to be implemented. The tipping of fruit bunches from a 13 ton truck should not involve any more problems than that for a seven ton truck because side tipping can be used.

PART III
PUBLIC UTILITIES

CHAPTER 9

WATER SUPPLY

9.1 INTRODUCTION

The need for a sufficient supply of pure water to all members of the population may be taken as fundamental in any society. The practicability of providing water supplies to small scattered communities requires examination, and in these circumstances a compromise may be needed both on the quality and quantity of the water supply.

Sarawak is fortunate in its climate and topography in that it possesses many rivers with dependable flows sufficient for large water supplies, and they are well distributed across the country. On the other hand natural gradients in the populated areas tend to be very flat, and hence water supply to larger towns by gravity is seldom possible. As a result of these two characteristics a pattern has been established for the engineering of the larger water supplies, which commonly makes use of a river intake without weir, treatment works beside the river, and pumping through a pipeline of appreciable length to supply the main service reservoir or reservoirs for the town or other settlement. In the case of coastal towns the length of the pipeline is usually determined solely by the need to abstract water sufficiently far inland to avoid salinity due to intrusion of sea water at times of very low flow. Pollution of the rivers upstream of water intakes is thought to be negligible at present, so far as the effect on treated urban supplies is concerned, but a health risk exists in the very common use of untreated river water supplies by the rural communities inland.

9.2 ALTERNATIVES AVAILABLE

It is possible to provide water supplies by a number of means other than that outlined in the introduction, such as by use of rain water stored from run-off from roofs or other small impervious areas (roof catchments) by abstraction from ground water, or by impounded storage behind dams. In addition variations on the river abstraction method can be made if there is available a significant drop in elevation between the source and the settlement, or along the path of the river or stream. Various approaches are more suited to settlements of one size rather than another, as shown in Table 9.1. This Table contains a number of generalisations and it is included to give background information. Types of supply numbered one to five are all used in small supply schemes for longhouses and kampongs by the Rural Health Improvement Scheme, and no treatment is given in these circumstances. Types 2, 5, 6 and 7 are suitable, with treatment, for towns of any size but, due to Sarawak conditions as explained above, only Type 5 is in common use.

TABLE 9.1 WATER SUPPLY ALTERNATIVES

Type No.	Description	Order of cost	Sensitivity to dry spells	Water quality	Water treatment requirement	Level of maintenance needed	Suitable in principle for	Normally used for
1	Shallow wells (lined and covered)	Cheap	Very sensitive	Variable	Variable	Slight	Very small settlements	Very small settlements
2	Gravity supply from river	Moderate	Very sensitive	Variable	Essential	Slight	All sizes	Small inland settlements
3	Roof catchments	Moderate	Extremely sensitive	Good	Slight	High	Very small settlements	Very small settlements
4	Hydraulic ram supply from river	Moderate	Very sensitive	Variable	Desirable	Slight	Small settlements	Small settlements
5	Pumped river abstraction	Expensive	Very sensitive	Variable	Essential	High	All sizes	Towns
6	Impounded gravity supply (dams)	Expensive	Slight	Good	Desirable	Medium	All sizes	Not used
7	Deep wells	Moderate to expensive	Slight	Good	Slight	Medium	All sizes	Not used

It is considered that greater use should be made of roof catchments (Type 3) with individual house storage tanks in situations where there is no possibility to provide a piped water supply, or where a considerable period of time must elapse before a piped supply can be installed. These conditions will apply to scattered settlers houses, isolated small bazaars and also to the water needed for any cattle owned by settlers. A method for rational design of roof catchments is given in Supporting Report No. 1, Part I, and examples of the application of this method are given in later sections of this chapter.

For the purposes of this manual, Types 3 and 5 only will be considered in detail. However there may well be particular cases in the Study Area where Type 6, impounded source, should be considered at the stage of detailed feasibility studies. The possible advantages are reliability of supply in dry spells, reduced length of pipeline, and the ability to maintain a small but sufficient catchment area as an unexploited and unpolluted reserve. This last reason may assume major importance in later stages of development of the Region.

While the use of untreated water supplies is unavoidable from practical considerations in small scattered communities, it cannot be recommended. The much greater availability of treated water in large communities, with elimination of many health risks as a result, is one reason among many why urbanisation of the rural areas is recommended by the Consultants.

9.3 PUBLIC HEALTH EFFECTS AND PRECAUTIONS

Many diseases can be transmitted by impure water supplies.

The list is headed by cholera and typhoid, which are fortunately reasonably well under control in Sarawak at present, although their occasional development in epidemic form due to contaminated water supplies is an ever-present risk. Large numbers of cases of dysentery and gastro-enteritis occur in the State, and it can safely be assumed that much of this is due to organisms conveyed by water, or is due to inadequate quantities of water available for necessary domestic cleaning, washing and food preparation. The reduction of these debilitating diseases, which can be fatal in infants, must be a high priority of policy. The virus diseases of poliomyelitis and infectious hepatitis are also known to be water-borne, and cases of the latter occur in the State in significant numbers.

The experience in epidemics of water-borne disease in Europe and other more economically developed countries in the last 40 years, in circumstances where it has been possible to identify the source with some certainty, has led to the conclusion that more than one line of defence against infection should always be provided. That is to say, a reliable pure water supply requires that one disinfecting process should be sure of remaining operative even when unforeseen events cause interruption of another. With heavily polluted water sources modern practice would provide at least three lines of defence, the most usual sequence being:-

(a) storage for at least two, and preferably 30 days;

(b) clarification by coagulant-aided settlement, followed by filtration;

(c) chlorination.

In Sarawak conditions the use of (b) and (c) should be sufficient in the short-term, except in special cases, such as where a river intake is located downstream of an industrial plant which uses, but is not allowed to discharge, toxic materials.

It is virtually impossible to guarantee a pure and disinfected water by chlorination unless it has first been clarified by removal of suspended solids and organic matter in solution, therefore the provision of process (b) above, the conventional water treatment process, is essential for supplies derived from rivers. Where chlorination is not available then the water for drinking should be boiled by the consumer.

9.4 WATER SYSTEM REQUIREMENTS

9.4.1 Quantity

A brief study of the existing conditions in Sarawak reveals an enormous variation in the quantity of water consumed, that is to say, drawn from the supply each day, per head of the population. Consumption is usually expressed in imperial gallons per head per day (ghd). The amounts range from 100 ghd, at the estate villages of the Sarawak Land Development Board (SLDB) at Lambir and of Sarawak Oil Palms (SOP) Sdn. Bhd., to 12 ghd at Meradong (Third Division), which is the lowest figure quoted by the PWD for their schemes (1971). Twelve ghd is also the design figure used by the Rural Health Improvement Scheme. When the figures are as low as 12 ghd it can be assumed that the consumers have access to a second source of lower quality for washing. Consumption of water is closely related to the means of supplying it to the user and to the charges levied. Consumptions of 60 ghd and above normally only occur either when charges are negligible or non-existent, or else in high income households where standard charges are considered of little account.

Distribution is made either through shared communal standpipes or by connections to each household unit. It is impracticable, without elaborate or expensive supervision, to charge individuals for water drawn from standpipes. It has therefore been found that distribution from standpipes can easily lead to extravagant and wasteful use of water. This occurs when a relatively large number of pipes, such as one for every five houses, is provided and the taps are left running because no-one has any interest in turning them off. This appears to be the situation at Tunku Abdul Rahman Village and the SOP Estate. If the number of standpipes is restricted then there is the probability that the effort of carrying sufficient water for the needs of personal hygiene will be considered too great, with a consequent deterioration in public health. Thus consumption will drop but for the wrong reasons.

If individual house connections are provided then the users will draw sufficient water for personal hygiene, though they may also waste it. Waste can however be limited to be acceptable figure by making a suitable small charge to the householder by metering water consumed. Experience has shown that the charge for water need not be high to secure reasonable consumption, sufficient for both personal hygiene and public sanitation, which can be considered as being in the range of 25 to 50 ghd. Metered connections to each household are therefore recommended for all future works.

Very large consumption is also reported for institutions such as schools and military camps. Wasting water is bad training in citizenship, and it is suggested that those in charge of these institutions should regard water as an accountable commodity like all other materials used.

The consumption figures given above are calculated as (total consumed divided by estimated population served). This ratio only approximates to domestic consumption in the smallest of rural communities. As soon as schools, shops, offices, etc., appear in the settlement then of course they consume water in addition to the domestic use. As the town grows larger so does the proportion of water taken for non-domestic functions, which include the needs of industry, street and market cleaning, Government departments, vehicle cleaning, etc. Non-domestic consumption in Kuching is half of the total, and in Singapore it has commonly been around 60 per cent of the total.

It has become customary to quote consumption figures for planning new works which vary from a low figure in scattered rural areas to a high one in urban areas. This convention obscures the fact that true domestic consumption varies only slightly with increase in the standard of living; the larger part of the increased consumption is due to more extensive commercial and industrial use of water. In certain cases it should be possible to estimate specifically for the needs of new industrial development, as when industrial estates are being planned. However, this is not generally possible. In later paragraphs a system is put forward in which is intended to maintain a visible distinction between domestic and other water needs. If this is not done then confusion can arise when checking domestic use for health or waste considerations, or when designing sewerage schemes.

Water tariffs in the larger towns of Sarawak make use of three main charging categories, based on the political or social decision that non-domestic users should pay more than domestic users. This decision is extended, in the case of Kuching, to include schools and similar institutions in the favoured domestic tariff, and a compromise tariff is offered to shopkeepers and other persons who live at their place of work, and for whom it is not practicable to separate the water used for domestic and commercial purposes. The use of this charging system does not yield directly any statistics of true domestic consumption, and certain assumptions to obtain figures for this at Kuching and Miri have been made in the present study (see Appendix III.1). As a result it is found that the true domestic consumption by persons in Kuching supplied through meters is about 25 ghd (1971), and in Miri it is about 22 ghd (1973) averaged over the whole population served. These figures and those available for Singapore show reasonable consistency, with the proportions of non-domestic consumption rising with the size of the town. They are summarised in Table 9.2.

Some uncertainty about the figures in Table 9.2 must remain because of the difficulty of accurately assessing the number of persons served by each water meter; in existing towns there are many people without piped water supplies to their dwellings.

In new settlements dwellings without individual piped water supply should not be permitted, and therefore it should be possible to assess actual domestic consumption provided demographic statistics are maintained. However it is important for public health as well as statistical purposes that, if

TABLE 9.2 APPROXIMATE WATER CONSUMPTION IN SELECTED TOWNS

City/town	Order of population served	Consumption ghd		Domestic as percentage of total
		Domestic	Total	
Singapore	2 000 000	25	62	40
Kuching	100 000	25	50	50
Miri	25 000	22	35	60

Note These figures exclude persons supplied by standpipes.

The Singapore figures are from published information (Khong, K.S., 1971) and the Sarawak figures are from data supplied by Kuching Water Board and the PWD.

and when sub-division of housing lots should occur in later years, new separate metered connections to the water main are made, as is done currently by the PWD.

For purposes of new settlements in the Study Area the following provisional method of estimating water consumption is proposed. All sizes of settlement are assumed to need an average of 25 gallons per head per day (ghd) for basic domestic use. In addition to this a supplementary quantity for other purposes should be allowed as follows:-

Agricultural village (2 500 population or less)	20 per cent of basic domestic use	5 gallons, giving 30 ghd total consumption
Small town (2 000 to 8 000 population)	40 per cent of basic domestic use	10 gallons, giving 35 ghd total consumption
Sub-Regional centre (8 000 to 12 000 population)	67 per cent of basic domestic use	17 gallons, giving 42 ghd total consumption
Regional centre	100 per cent of basic domestic use	25 gallons, giving 50 ghd total consumption

If and when more details of the types of industrial and commercial development become known, then more precise forecasts can be made. These figures represent the quantities expected to flow through consumers' meters. A separate allowance must be made for losses in transmission.

A loss of water between leaving the treatment works and its receipt in the consumers' pipe is unavoidable, and losses of up to 15 per cent of the treatment works output are not uncommon. A well-constructed new system should however have losses much less than this. Losses are due mainly to leakage at pipe joints and other small leaks in pipes, while there are also losses due to routine flushing and the flushing of pipelines after repairs. If the losses in a town system rise much above 15 per cent then steps should be taken to identify and repair points of leakage.

In the demand studies an addition should be made for losses to the consumption figures given above. The amount varies with the length and size of pipes in the distribution system, smaller pipes having proportionately higher losses. The following provision for losses is proposed:-

	Total consumption ghd	Losses Per cent of sales	Losses Gallons	Total output ghd
Agricultural village	30	20	6	36
Small town	35	15	6	41
Sub-regional centre	42	15	6	48
Regional centre	50	15	8	58
Rubber or palm oil factory	-	10	-	-

In existing towns with old reticulation systems losses may be higher than 15 per cent and 20 per cent can be allowed in these cases (for example Miri and Marudi).

9.4.2 Treatment

Sarawak surface waters are generally of suitable quality for rendering into a supply of pure and non-corrosive water after fairly simple conventional treatment. The principal contents of the raw water which must be reduced or eliminated by treatment are the fine particles in suspension, miscellaneous vegetable matter in solution and the dissolved iron. It is also necessary to correct the natural acidity by the addition of an alkaline solution or a suspension of lime. Settlement, after the addition of chemical coagulants, followed by filtration in sand-bed filters achieves a satisfactory reduction in the components mentioned above and in colour and turbidity which are associated with them, as well as reducing certain other constituents. After filtration a dose of chlorine should be added to the water to disinfect it of any bacteria or viruses which may remain and, after a suitable interval, the acidity corrected to a value slightly on the alkaline side of neutral. A minimum chlorine residual of 0.4 milligrams per litre should be ensured; this figure may have to be increased in particular circumstances.

The resulting treated water should conform to accepted international standards of water purity such as those of the World Health Organisation published in 1971.

The use of chlorine gas in place of tropical chloride of lime is a more reliable means of securing the necessary residual chlorine content, and it is recommended that this be used in future water treatment plants when practicable. However, the existing use of chloride of lime for plants smaller than two million gallons per day will continue so long as distribution costs and difficulty in the securing of skilled operators preclude the use of gaseous chlorine.

9.5 THRESHOLD CONSIDERATIONS

It is the policy of the Sarawak Government to make fully treated water supplies available to all communities so far as is practicable both economically and technically. However even the smallest water treatment plant requires skilled operation and supervision, and this factor makes it impracticable to provide this service in many cases. It is estimated that an independent water supply system with treatment cannot cover even its day-by-day operating costs with a population served of fewer than 2 000 to 3 000, corresponding to an output of 65 000 gallons per day(gpd). This assumes every person paying for water at the highest domestic rate now charged by the PWD; there would inevitably be some who could not. The PWD prefer to avoid, for economic reasons, constructing new plants smaller than 150 000 gpd. Although there will without doubt be cases where an exception must be made it is considered, generally speaking, that a settlement population of 4 000 is the smallest which can afford a fully treated water supply in circumstances where the source and treatment works cannot reasonably be combined with other settlements. The above conclusion assumes the minimum use of water for non-domestic purposes. Obviously where such use is paid for in significant amounts, the population threshold can be reduced.

A check of the present settlements supplied by the PWD shows, using 1971 figures, that of 14 fully treated supplies, five came below the above threshold on a water production basis, and eight came below it on a population basis. The smallest community supplied with treated water was Panderuan with an estimated population of 550 and a supply of 19 000 gpd.

The existing two Water Boards, at Kuching and Sibu, are required to be self-financing for capital works (investment) as well as for operation and maintenance. In smaller towns and where the industrial/commercial sales of water are small it will not be possible to finance investment out of revenue, so that Government assistance will be needed. In the smallest towns and settlements, if they are to have a proper water supply, both the investment cost and a part of the maintenance cost will have to be borne by Government or, in the case of new communities, by the appropriate development authority.

9.6 STAFFING

The Hydraulics Branch of the PWD is responsible for all water undertakings in Sarawak, except for those at Kuching and Sibu which have their own statutory boards. The Hydraulics Branch is at present seriously under-staffed in the Fourth Division, and possibly in other parts also with the result that key members are overworked.

An outline staff chart is given in Table 9.3 to show the order of staff considered necessary for fully efficient operation and maintenance. Examples are of towns in the Fourth Division but they could be adapted to other settlements having independent schemes with river intakes, full treatment, pumping and distribution.

TABLE 9.3 PROPOSED WATERWORKS STAFF

Location \ Staff group (1)	Approximate population served	Professional	Executive	Clerical and technical	Manual	Total
Miri: Headworks	30 000	-	1	4	18	23
Town services		-	2	10	34	46
Divisional office	150 000	2	3	6	2	13
Marudi	5 000	-	1	4	9	14
Sub-Regional Centre	10 000	-	3	7	28	38
Small settlement	<3 000	-	1	1	6	8

Note (1) Classified according to Sarawak Government (1971).

The numbers given for Marudi (5 000 population) and the sub-regional centre (8 000 to 12 000) allow for a complete meter reading and billing service. The numbers given for small settlements are the minimum for continuous operation without administrative or maintenance staff. All the numbers given presume the use of simple manual controls for pumps, filters, chemical dosing gear, etc.

9.7 DESIGN EXAMPLES

9.7.1 Water Supply to Sub-Regional Centre

Sub-Regional Centre is the term used to describe new towns in the Study Area having a population range of 8 000 to 15 000, and current plans assume a value of 12 000 as typical. Such a town would require 25 ghd for domestic use and about two-thirds as much for other uses. The supply would have to make allowance for the inevitable losses in any reticulation system, "unaccounted water", as well as the need for greater than usual supplies at times of peak demand due, for instance to excessively hot weather or the drying up of other sources for garden watering. Output for the peak 24 hours may be taken as 20 per cent above normal, but this should be realisable partly from service storage and partly by overloading the treatment works, so the design output of the treatment works would be set at intermediate figures.

In this instance the design population figure would only be reached over a period of 12 years and the waterworks would be built with minimum provision for enlargement beyond the needs of the design population; that is to say suitable space on the ground would be planned but no structures put up to cover needs in excess of those initially being met. The method of sizing the plant is summarised in the following Table. For budgeting purposes it is assumed that the whole of the civil works and two-thirds of the plant would be provided in the first stage, with the balance of the plant installed when demand reached half of the design figure.

TABLE 9.4 WATER SUPPLY FOR SUB-REGIONAL CENTRE

	Gallons per day
Design population: 12 000	
Domestic consumption: 25 ghd, equivalent to	300 000
Non-domestic consumption, provisional allowance (this figure should be derived in more detail if possible)	200 000
Total average metered sales	500 000
Unaccounted water lost in system	75 000
Extra quantity delivered in peak period	60 000
Design capacity of works	635 000
Extra quantity supplied on peak day from service storage	60 000
Peak outflow from service storage	695 000

Peak instantaneous outflow from service storage: 2½ times the above rate

Storage provided:	Gallons
Pure water tank at treatment works (12 hours*)	300 000
Service reservoir(s) in town areas (12 hours)	300 000

Pipeline

Trunk mains: 8 inches or 9 inches diameter (asbestos cement) - depending on length, cost of pumping, etc.

Distribution mains: 8 inches, 6 inches, 4 inches and 3 inches diameter

Note * The time in hours is that for which the reservoir could supply at the average rate without replenishment.

Even in areas of similar rainfall it is not possible to generalise on the size of river or catchement area needed for a given supply, since river flow conditions are affected by many factors. As an instance of this it was found that streams having their source in the Lambir Hills sustained flows during the 1973 drought much better than larger rivers in the Study Area. This was probably due to the gradual release of water from shallow ground water storage in the sandy formations at Lambir.

The system would consist of a river intake with pumping station delivering to the treatment works inlet. If the treatment works can be sited on a convenient hill less than 0.5 mile from the intake so that the town is fed by gravity, this would be done. However ease of access to the treatment works site is essential, and the site must have an area at the same elevation for unforeseen future needs. If this cannot be arranged the use of hill sites is better avoided, and the criteria for treatment works siting are that it be near the intake but on ground not liable to flooding and with good access also not liable to flooding. For larger plants a natural slope of between five per cent and ten per cent is desirable. In Sarawak conditions the alignment of main roads largely predetermines the points at which headworks can be sited, and the road route usually forms the best route for the trunk mains.

The trunk mains would deliver, either by pumping or by gravity, into an elevated service reservoir or reservoirs close to the town, from which the supplies would be distributed by a network of six inches and four inches diameter pipes. The use of three inches diameter pipes should be restricted to headers along short streets where there is no possibility whatever of later extension or of the development of any bulk supply demand. Each house or other living unit should have its own separate indoor supply, with separate meter at the property boundaries.

9.7.2 Water Supply to Group of Agricultural Villages and Palm Oil Factory

For this example three villages and one palm oil processing factory will be assumed to share one water supply. The villages will be taken as having a design population of 2 000 each and the factory as rated at 72 tons per hour of fresh fruit bunches, working 20 hours a day maximum. The domestic consumption will be the same as in the previous example (25 ghd), but due to the greater relative lengths of distribution pipelines a larger allowance is made for unaccounted water. The sizes and capacities of the system are shown in Table 9.5.

The comments on the source, treatment works and delivery works in paragraph 9.4.1 are equally applicable to this case. Security of the factory supplies, for which only a small storage is provided, should be assisted by avoiding pipeline routes to it which pass through villages or other areas where construction work may take place. As far as practicable each of the three villages should have its service reservoir at the same elevation above the houses, for equality of the service.

9.7.3 Roof Catchments

It is standard PWD practice to provide cisterns for rainwater storage at Government quarters where no piped water supply exists. Recent installations are of cubical galvanised sheet

TABLE 9.5 WATER SUPPLY TO AGRICULTURAL GROUP

	Gallons per day
Design population: three at 2 000 = 6 000	
Domestic consumption: 25 ghd, equivalent to	150 000
Non-domestic consumption, including estate use other than for factory	50 000
Total average metered sales	200 000
Unaccounted water lost in village systems	40 000
Extra quantity delivered on peak day	24 000
Total output excluding factory	264 000
Factory: 72 x 20 x 1.5 = 2 160 tons/day	484 000
Wastage on factory quantity	48 000
Design capacity of works	796 000
Extra quantity on peak day from service storage	24 000
Peak outflow from service storage	820 000
Peak instantaneous outflow from service storage at villages: 2½ times peak daily rate	

Storage provided	Gallons
Pure water tank at treatment works (12 hours)	400 000
Service reservoir at village (12 hours)	40 000
do	40 000
do	40 000
Service reservoir at factory (6 hours)	150 000

Pipelines

Trunk mains: 9 inches or 10 inches diameter (asbestos cement)

Gravity main supply one village: 4 inches diameter

Distribution mains: 4 inches and 3 inches diameter (6 inches may be needed where service reservoir has insufficient head)

tanks having a side of four feet, which contain 400 gallons. Batteries of these tanks are in use in certain places (12 are installed at the dispensary in Tun Openg Bazaar) so it may be assumed that they are cheaper than any larger alternative. (This standard tank is reported as costing $130, or 33 cents per gallon, which compares favourably with the rate for reinforced concrete ground level reservoirs of 60 cents per gallon.) It is not known on what basis the capacity is established, therefore this section will give guidance on sizes and yields. The hydrological basis for this design is given in Supporting Report No. 1, Part I. It must be made clear that a water supply from this source is open to pollution by birds and vermin and any water for drinking and cooking must be boiled.

Whatever the design yield of a roof catchement and its cistern, the user ought to have a simple means to prevent accidental over-drawing of the supply. If he does not he is likely to draw water at too high a rate and therefore will run dry too soon. Subsidiary tanks, or "day tanks", should be provided which are filled each morning with a standard day's supply. All water used would be taken from the day tank, the connection between it and the main cistern remaining shut until next morning. The yield required for domestic use must be set as low as possible, and normally the use of an alternative source for washing will be possible. In this case a yield of 12 ghd, as adopted by the Rural Health Improvement Scheme, would be sufficient. However one 400 gallon tank at a household of six persons, will only yield the required 72 gallons per day for five rainless days, so that it is clear that either lower consumption figures must be set or storage must be increased. Runs of at least seven rainless days are experienced once annually in most parts of the Study Area, and longer runs are common.

The same means of water supply are suitable for livestock in the proposed cattle farming developments. One livestock unit (equals to one adult beast) requires 10 ghd, and roof catchments to provide for two or three livestock units would be appropriate. They can be combined with the shelters from sun and rain which the animals require.

The relationship between roof area, cistern size and yield, for conditions where the probability of shortage is one occurrence in two years have been summarised in Supporting Report No. 1, Part I. Some results of these calculations are tabulated in Table 9.6 for convenient reference.

TABLE 9.6 SIZING OF ROOF CATCHMENTS AND CISTERNS

Reference	Mean annual rainfall (mm)	Roof area (square feet)	Cistern size (gallons)	Yield (gallons per day)
a	2 800	500	400	20
b	2 800	500	800	30
c	2 800	500	1 600	45
d	2 800	800	800	36
e	2 800	800	1 600	58
f	2 800	2 000	800	40
g	2 800	2 000	1 600	80
h	2 800	2 000	2 400	100

9.8 COSTS

9.8.1 Investment Costs

The capital or investment cost of recent water supply schemes for small towns in Sarawak has approximated to one dollar for each gallon per day of rated output. Thus a scheme for 1.5 million gallons per day (mgd) has cost $1.5 mn. This figure is understood to include river intake works, treatment works, pumping station and all trunk pipelines, but not the distribution system nor the engineering design and supervision expenses. As the length of pipeline is obviously not a standard quantity for a particular size of scheme, costs for pipelines are given separately in this Report. The use of pvc pipes in place of asbestos cement in the smaller sizes has, in appropriate cases, considerable advantages.

The cost figures tabulated in Table 9.7 are used in this Study; they are intended as current prices for work carried out by contract, excluding the cost of engineering design and supervision.

TABLE 9.7 INVESTMENT COSTS FOR WATER SUPPLY SCHEMES

Item	Details	Diameter (inches)	Investment cost
Headworks	River intake, treatment works, pure water storage and pumping station, including all plant		80 cents per rated gallon per day
		Diameter (inches)	$ per foot
Pipelines	Asbestos cement class C pipes, including laying	3	5.17
		4	6.00
		6	7.50
		8	10.45
		9	11.45
		10	12.70
		12	15.70
		15	20.00
		(18	27.00)
Service reservoirs	Reinforced concrete (at ground level)		60 cents per gallon stored
Service reservoirs	Steel or concrete (on elevated tower)		$1 per gallon stored
Individual house connections	Main tapping, meter and 0.75 inch pipe in trench		$190 each - 1 acre lots $150 each - ¼ acre lots $130 each - 1/6 acre lots

It will be seen that the costs of Headworks and Service Reservoirs are given as directly proportional to size, that is, there are apparently no "economies of scale". This is not strictly true since studies elsewhere have shown that investment costs do not rise quite as steeply as the size of the utility; however, this effect is small within the size range of about ten to one with which we are concerned, and the accuracy of the figures given is not such as would justify the refinement of a scale factor. For pipelines the situation is quite different, and there are large economies to be made by combining flows of water in one large pipeline as compared with several smaller ones. For example the water conveying capacity of an eight inch pipe is about six times that of a four inch pipe, while the cost is only greater by a factor of 1.6.

The figures given above for individual house connections include all pipes laid in the ground, whether in public or private land, but they exclude plumbing work within the house.

Before detailed plans of street alignments and housing are available it is useful to have simple rules for estimating the costs of distribution systems (also known as reticulation systems). These consist for the most part of small pipelines, of six inches diameter or less in new rural settlements, with the connections to individual houses made in 0.75 inch or one inch diameter pipes. The width of house frontage controls these costs, although the distances perpendicular to road alignment also affect them.

In an agricultural village having one acre lots with 100 feet wide frontages the distribution system, using the above unit rates, costs about $140 per head. In high density urban housing (six units per acre), this sum falls to about $110 per head. Intermediate densities will require interpolated values. These costs may easily amount to as much as one-third of the whole cost of a water supply scheme.

9.8.2 Operating Costs

Operating costs are defined to include supply of all necessary labour, materials and spares, maintenance expenditure and all administrative costs associated with the undertaking. Operating costs are taken to exclude loan servicing charges, payments to sinking fund or any other provision for depreciation.

Figures are available for the costs of operating water intakes and treatment works (headworks) per unit of water produced. A more useful figure is the cost of operating a complete water undertaking per unit of water sold, since the headworks cost is less than half the total. Operating costs are inevitably higher on a unit basis for small works than for large ones, and they will also tend to be higher in the early years of a new works, when it is likely to be running much below the designed capacity and the staff are probably less skillful than they will become later.

The figures available for headworks only are as follows:-

		Cents/1 000 gallons
Kuching Water Board	1971	28.4
Sibu Water Board	1971	22
Miri (Lambir)	1973	44

By scaling up these figures to include operation and maintenance of pipelines, plant and distribution systems, and by making adjustment for probable losses, a basic unit cost of $1.10 per unit of one thousand gallons sold is derived. It is assumed that systems selling less than 1.0 mgd will cost more, namely $1.30 and $1.50 per unit respectively for plants between 0.5 and 1.0 mgd and those between 0.2 and 0.5 mgd. In costing studies it is further assumed that costs in the first years of operation would be up to 50 cents per unit higher.

9.8.3 Revenue

The present charges for water are the same for the three major towns, Kuching, Sibu and Miri, but vary in the case of smaller town supplies where higher rates are usually charged. It is recommended that all public water supplies should be charged at the same rate through out the State, as is now the practice in Peninsular Malaysia. The rates charged at present in the three largest towns could be adopted for all other undertakings, subject to the variation for sewerage explained below. Water rates in the major towns can be summarised as follows; they yield on average a revenue of $1.60 per thousand gallons.

Tariff	Rate per thousand gallons $	Minimum monthly charge $
Commercial	2.00	11.00
Domestic/commercial	1.50	8.00
Domestic	1.25	2.50
Stand pipes	1.00	-
Shipping	6.70 approx.	-

These tariffs have been unchanged since 1962 and they should not be increased without good reason. In the case of Sibu and Kuching they are currently sufficient to cover sinking fund and loan charges as well as operation and maintenance. Financial self-sufficiency should clearly be an objective in any new State-wide organisation for water supplies.

Minimum charges in smaller towns have been reported as acting to discourage connection to the system, when as high as $5 or more for domestic consumers. Clearly this situation is undesirable for reasons of public health, and a uniform minimum charge of $3 or $4 per month is recommended. The exact figure should be based on social/economic values and not on water engineering costs.

As and when main or small community sewerage is extended to areas served with piped water, so should an enhanced water rate be charged to provide revenue for the sewerage service. If other means are not available to encourage householders to make connections to the new sewers then it may be necessary to charge for sewerage to all houses in sewered roads, whether connected or not.

Main sewerage costs roughly one to two times as much as water supply. The correct charge to make for sewerage is again a social/economic matter, and it is not of course tolerable to charge in proportion to the investment costs. A surcharge for sewerage of 30 cents per thousand gallons of water consumed is proposed, with an increase of $1 in the minimum monthly charge. These rates do not apply where septic tanks are installed by the individual owner on his property; in these cases the investment cost is borne by the owner but maintenance should be at the public expense.

CHAPTER 10

SEWERAGE AND SEWAGE DISPOSAL

10.1 INTRODUCTION

Water supply and distribution followed by sewage collection and disposal form part of the whole cycle of water use and individual aspects of this cycle cannot be considered in isolation if reasonable living conditions in urban areas are to be maintained. "Waterborne sewerage systems are normally the most effective means of urban waste (water disposal, and water and sewerage facilities should therefore be considered as part of an integrated system carrying "new" and "used" water, Unfortunately because sewerage systems may cost as much or more than the water systems and because the value of a sewerage system to an individual is often much less apparent to him than it is to society as a whole, sewerage is often given even lower priority than piped water in developing countries" (World Bank 1971).

Over the years, great strides have been made in the technical aspects of collecting and treating both domestic sewage and industrial wastes and, although improvements are still being made, methods are available for treating all the commoner forms of pollution. A great deal of experience of using these methods has also been gained over the years and performance expectations have been well established. In developing countries the technical problems confronting authorities and industrialists responsible for liquid waste disposal are much less difficult to overcome than are the problems associated with ineffective legislation and administration and the shortage of finance.

It is not the object of this section to set forth criteria for the design of sewerage and sewage disposal systems; it is essential that the systems should be surveyed, designed, and the construction supervised by competent public health engineers who are experienced in this type of work. Many excellent design manuals on public health engineering are readily available. The section is therefore limited to describing briefly the principal features of sewerage and sewage disposal systems, and discussing the aspects which particularly concern Sarawak and the assumptions on which the investment and operating cost estimates have been based.

Confusion sometimes arises as to the difference between "sewerage" and "sewage". The terms are defined in the British Standard Code of Practice 2005: 1968 as:

Sewage — Waterborne human, domestic and farm waste. It may include trade effluent, subsoil or surface water;

Sewerage	A system of sewers and ancillary works to convey sewage from its point of origin to a treatment works or other place of disposal.

Partly because of the confusion caused by the similarity of these two words the practice has arisen in the USA of using the term "wastewater" in place of sewage and "sewer system" in place of sewerage. The expressions used in this report are those defined in the British Standard Codes of Practice and the Oxford English Dictionary. A list of terms used in the USA, which differ in some details, are given in "Glossary - Water and Wastewater Engineering" published by the American Society of Civil Engineers.

10.2 EXISTING SANITARY ARRANGEMENTS

10.2.1 Towns

None of the towns of Sarawak is at present served by municipal sewerage system, although some housing estates and military establishments have their own sewerage and sewage disposal arrangements. The only communal sewage treatment plant in the Study Area, other than those at military, establishments serves a development of about 90 houses at the Gilbert Estate in Miri. The plant, which consists of a communal septic tank and biological filter, is unsatisfactory as it is located close to dense housing development and the effluent flows into an open roadside ditch passing through the town. When the plant was inspected it was found that the flow was bypassing the septic tank and filter which has become blocked through lack of maintenance.

Sewage from most urban houses is generally passed to septic tanks. As the towns are usually situated on the flat plains, where the water table is close to ground level, effluent from the septic tanks cannot percolate into the ground and the liquor flows to open surface drains or natural water courses which become polluted.

Attempts have been made to relieve the situation by providing filter beds to treat the septic tank effluent but due to bad design and lack of maintenance the filters are not very effective. In Miri the District Council require that the effluent from septic tanks should pass through a filter of graded gravel but the arrangement normally serves no purpose as the gravel is permanently flooded and anaerobic, with the result that it becomes clogged and the effluent "short circuits" across the top from the inlet to outlet.

10.2.2 Rural Areas

In most rural areas the arrangement for the disposal of excreta are frequently inadequate. However, an extensive programme to improve rural sanitation is being carried out, throughout the State, by the Medical Health Department under the Rural Health Improvement Scheme. Under this scheme the rural people are encouraged to provide and use pour-flush pit latrines and are given technical and financial assistance in their construction.

10.3 SEWERAGE SYSTEMS

10.3.1 Design Period

The length of time through which the capacity of a sewer will be adequate is referred to as the design period. Once determined, consideration must be given to the quantity of waste water to be handled. Because the flow is largely dependent upon the population served and water consumption, lateral and collecting sewers should be designed for peak flows corresponding to the population at saturation density.

Trunk sewers in congested urban areas should be designed for a period of at least 25 years; some authorities recommend a design period of up to 50 years, but in the Study Area it is unlikely that predictions of flows could be made with any degree of reliability for such long periods ahead. For trunk sewers in less densely developed areas and for pumping stations and other structures which can readily be duplicated or augmented, it may be more economical to design for a period of less than 25 years. The optimum design period should be determined in the light of projected future flows, the prevailing rate of discount on investment funds, and limits on available finance.

10.3.2 Average Sewage Flows

The average dry weather sewage flows will comprise domestic sewage, industrial effluents and infiltration water.

Projected domestic sewage flows will be derived from predicted per capita water consumptions. Not all water supplied to the domestic consumer is returned as sewage to the sewerage system even where a connection is available: a proportion of the water will be used for garden watering, car washing, watering livestock and other purposes (known as "consumptive use"). The proportion will vary with different types of development; for design purposes the following proportions may be assumed:-

Type of development	Consumptive use
Flats	None
Dense (urban) housing	10 per cent
Less dense (sub-urban) housing	20 per cent

The projected average daily dry weather domestic sewage flow is estimated for each year by multiplying the projected population served by the per capita flow.

Projected flows of industrial effluent can only be estimated by detailed consideration of the size and type of industrial process involved. In the absence of any other data, an average daily flow of 1 500 gallons per acre may be assumed for "dry" industries. This quantity should be taken only as a very approximate guide or "first estimate".

10.3.3 Peak Sewage Flows

Although combined sanitary and storm sewers are frequently encountered in old communities, separate systems are desirable and used with few exceptions in new systems. The major advantages of separate systems are the protection of water courses from pollution and the exclusion of storm water from the treatment system with a consequent saving in treatment plant construction and operating cost. As most of the towns are situated on flat alluvial plains, with the consequent need for pumping of sewage, it is not possible to conceive of any circumstance under which a combined system of sewers would be feasible within the Study Area. With separate systems, storm water will be excluded from the foul sewers as far as practicable. It will be impossible, however, to eliminate all storm water from foul sewers; some will inevitably enter through domestic drainage systems, manhole covers and illicit connections.

The critical consideration in the design of sewers is the maximum rate of flow that the sewers will be required to accommodate. The maximum flows are generally represented as the product of average dry weather flows and peak flow factors (ratio of peak to average flow). In large sewers, in which the flow is contributed from a wide area, the fluctuations are damped by the variation in time taken by sewage entering different sections of the system to reach the length of sewer under consideration. Moreover, the balancing effect of the levels of sewage rising and falling in open channel flow has a further damping effect.

The peak flow factors are frequently represented as a function of the tributary population. Various formulae have been adopted for peak flow factors and these are well illustrated in the American Water Pollution Control Federation Manual of Practice No. 9.

A simpler approach, which may be satisfactory for the design of smaller sewerage systems and which has been found in practice to give satisfactory results, is to use a peak flow factor of six for smaller sewers and pumping stations serving tributary populations of up to about 10 000, and a factor of four for sewers and pumping stations serving populations greater than 10 000. This approach should not, however, be used for large systems.

10.4 SEWAGE TREATMENT AND DISPOSAL

10.4.1 Methods of Sewage Treatment

Conventional sewage treatment is generally effected by two main processes. The first process consists of sedimentation, after screening or disintegration of solids, which removes about 65 per cent of the suspended solids and about 35 per cent of the imposed BOD loading. Chemical coagulants can rarely be justified economically and their use is mainly limited to the pretreatment afforded to certain industrial effluents. The second process is biological, the sewage being brought into contact with aerobic micro-organisms either suspended in the liquid as activated sludge or forming a film on the media of percolating filters. Further sedimentation is necessary to remove the activated sludge or humus and other matter formed in the biological process. Where an effluent of exceptionally high quality is required it is necessary to use micro-strainers, sand filters or maturation ponds in order to capture a higher proportion of the solids formed during the biological process. These additional measures are often referred to as tertiary treatment but, as they merely represent an extension of the secondary stage, they are better described as effluent polishing methods.

As an alternative to the conventional processes mentioned above, in suitable climatic conditions primary treatment can be provided in anaerobic ponds (see Figures 10.1 and 10.2) in which organic matter is precipitated and partly stabilised by anaerobic digestion; and secondary treatment can be provided by aerobic action either in aerobic ponds or in mechanically aerated ponds. The process in which the micro-organisms are sustained in aerobic ponds differs from that which occurs in the activated sludge process or with percolating filters in that the ponds depend on the work of algae to help produce the oxygen required to maintain aerobic conditions; in mechanically aerated ponds, mechanical aerators either supplement or replace algae as a means of providing the required oxygen.

After conventional methods of treatment have been employed to ensure that the sewage effluent is to the required standards, a residue of solid matter, normally referred to as sludge, remains to be disposed of. Having regard to the volume of sludge produced from the primary and secondary sedimentation of sewage, dewatering of sludge to facilitate handling is usually essential.

FIGURE 10.1

TYPICAL OUTLINE DESIGN OF SEWAGE TREATMENT WORKS STABILISATION POND METHOD

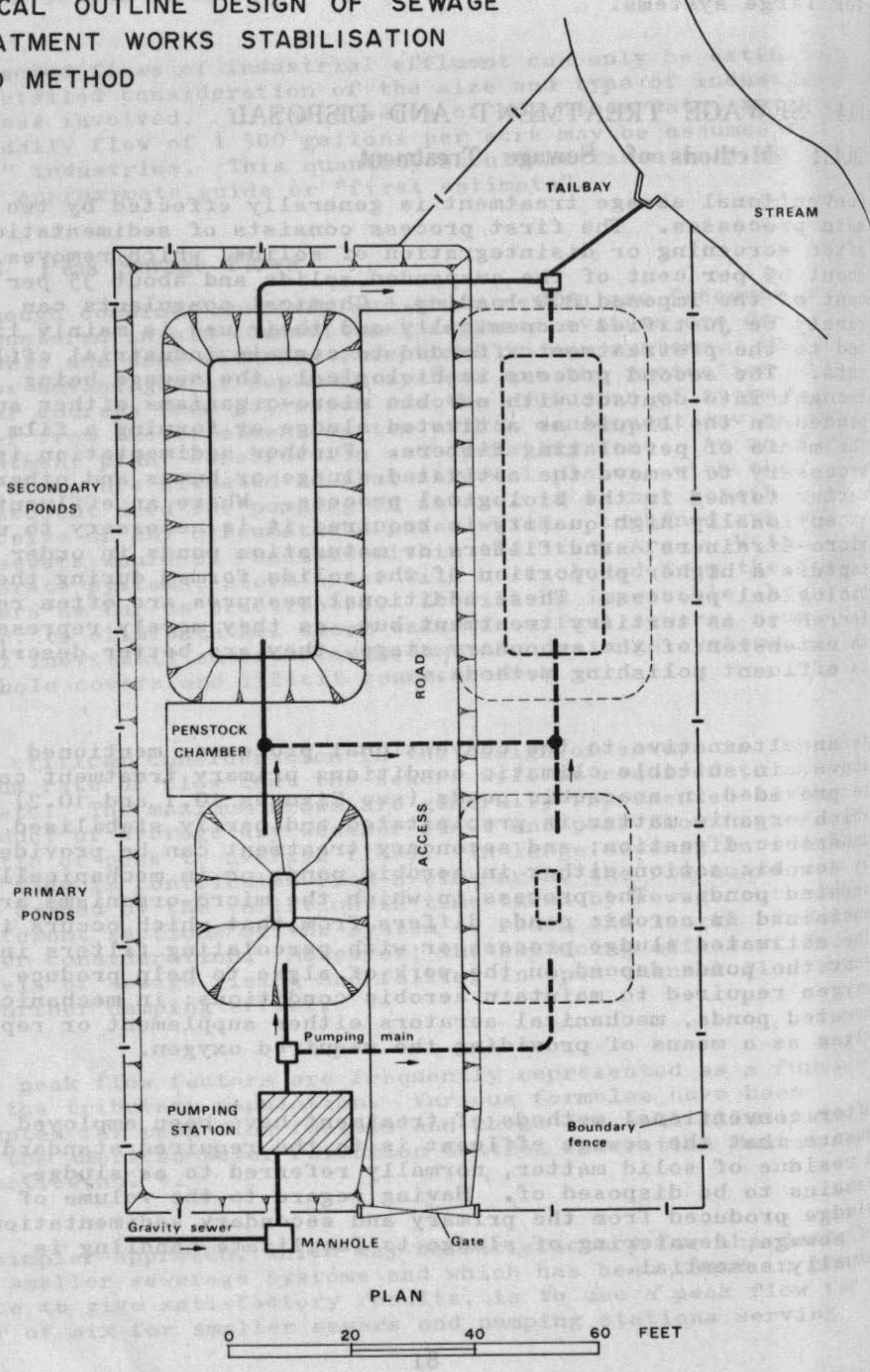
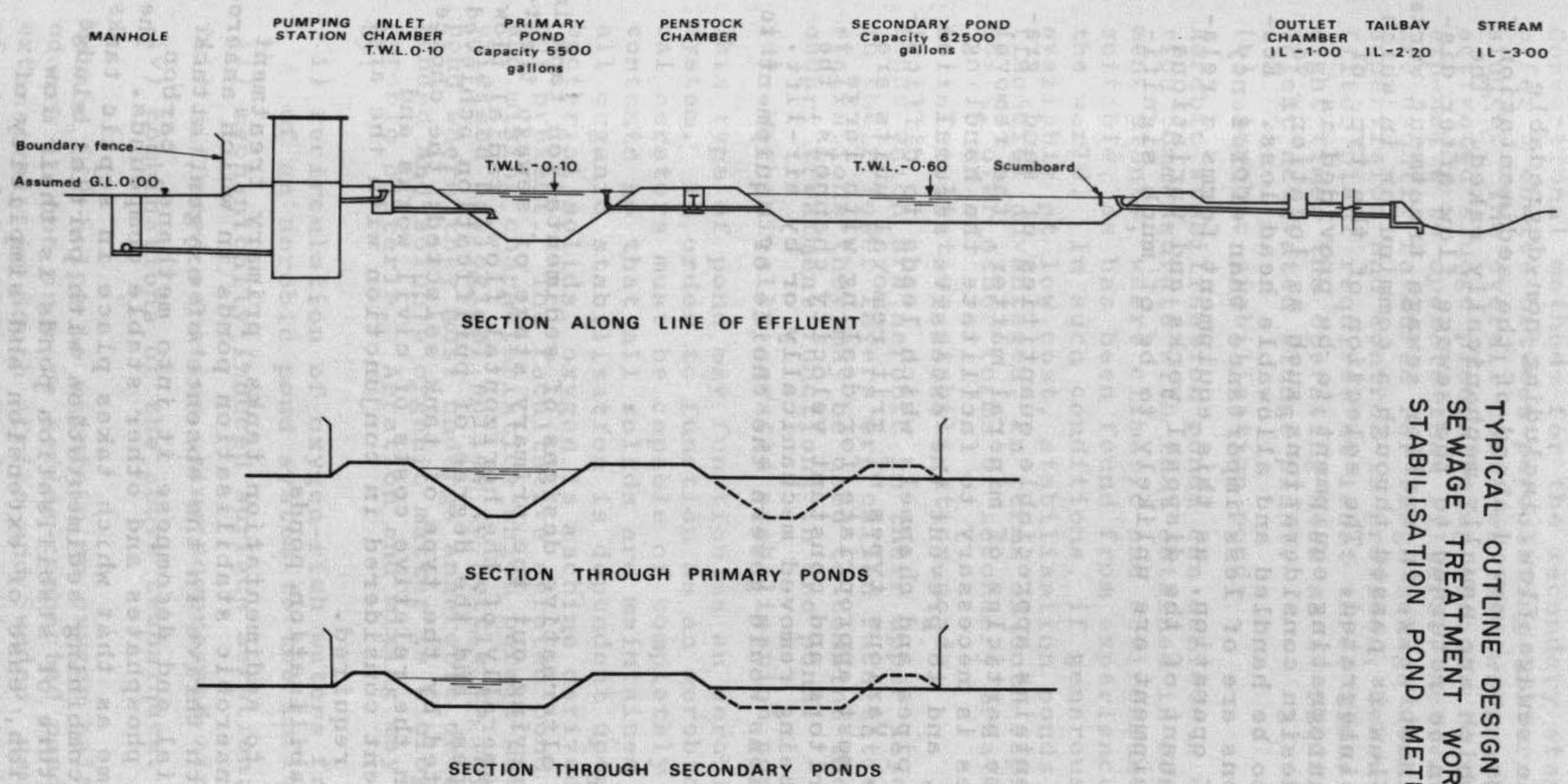


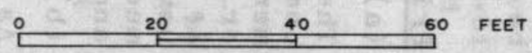
FIGURE 10.2

TYPICAL OUTLINE DESIGN OF SEWAGE TREATMENT WORKS STABILISATION POND METHOD



Notes

1. Initial Works shown in full lines; future extensions shown dotted.
2. Initial Works sized for a design population of 60 with provision for duplication.
3. Levels based on assumed ground level 0·00 ft.
4. Slopes in cut 1 : 1½; slopes in fill 1 : 2.



10.4.2 Stages of Sewage Treatment

Preliminary Treatment

(a) Screening

Gross solids in the sewage flow, including non-degradable matter such as rags, are removed ahead of the sedimentation tanks by screens which are usually mechanically raked. The screenings may then be returned to the sewage flow after disintegration. Alternatively, in smaller sewage treatment works, the whole sewage flow is passed through a comminutor in which the solids are disintegrated. The selection of the type of screening and disintegrating equipment to be provided is usually based on design considerations such as location, volume of material to be handled and allowable head loss. Economic considerations are of less importance than efficiency and reliability of operation, as this equipment forms a relatively small component of the disposal works and variations in the cost of equipment are unlikely to be of much significance.

(b) Grit removal

When the sewage contains appreciable quantities of sand, gravel or other minute particles of mineral matter, the removal of these substances is necessary to facilitate the handling of primary sludge, and to prevent the excessive accumulation of grit in tanks, pipes and channels which leads to difficulties in operation. Various types of grit removal units are available. Those most appropriate for dealing with large flows include detritors and constant velocity channels, the accumulated grit being removed mechanically or by air-lift. Design considerations would govern the choice of equipment to be provided.

Primary Treatment

(a) Sedimentation

There are several alternative designs of sedimentation tank in common use for carrying out the primary stage of sewage treatment. They are generally of the horizontal flow, radial flow or upward flow types, and the degree of purification achieved is not much affected by the type of tank selected; the choice usually depends on the relative costs of civil works and mechanical equipment considered in conjunction with the area and value of land required.

(b) Anaerobic stabilisation ponds

As an alternative to sedimentation tanks, primary treatment can be given in anaerobic stabilisation ponds in which anaerobic bacteria, which thrive in the absence of oxygen, attack the organic material and decompose it into methane, carbon dioxide, ammonia, phosphates and other stable compounds. The process is the same as that which takes place in septic tanks or Imhoff tanks, combining sedimentation with partial sludge digestion. A feature of stabilisation ponds is their low cost of construction, ease of extension and simplicity of operation and maintenance.

Secondary Treatment

(a) Conventional methods

Conventional methods for the secondary stage of treatment offer a choice between percolating filters and activated sludge. The overall costs of the two processes are similar, activated sludge plants being cheaper to construct but more expensive to operate than filters. Activated sludge plants are usually favoured for large sewage works, when adequate supervision and control is provided, because a percolating filter plant requires at least three times as much land and eight times the operating head as is required for an equivalent activated sludge plant.

(b) Aerobic stabilisation ponds

Aerobic stabilisation ponds can achieve a degree of purification commensurate with that obtained in conventional treatment plants, where climatic and environmental conditions are suitable, as has been found from experience in many parts of the world. In such conditions, if generous areas of land are available at low cost, stabilisation ponds offer considerable financial advantages, in terms of both capital and operating costs, over other forms of secondary treatment.

(c) Facultative stabilisation ponds

Ponds which are aerobic in their upper layers and anaerobic in their lower layers are called facultative. In small installations they may be used to combine the primary and secondary treatment functions in one pond.

(d) Mechanically aerated stabilisation ponds

This type of pond may function as an aerobic or facultative system. In order to function as an aerobic pond the mechanical aerators must be capable of completely mixing the pond contents so that all solids are maintained in suspension; all organic stabilisation is dependent upon the suspended bacterial solids, oxygen is machine derived and algae are not present. The facultative aerated pond has velocities and mixing characteristics which permit much of the non-oxidised biological solids to settle to the bottom of the pond where they must undergo anaerobic decomposition; suspended and soluble organic matter is biologically treated by aerobic bacteria. Aeration and mixing may be accomplished by:

i) recirculation of oxygen-rich waters from the effluent of an aerobic pond system to the influent area;

ii) mechanically induced surface aeration;

iii) diffused aeration using compressed air;

iv) combinations of the above techniques.

Method (i) helps to maintain an oxygen balance and eliminate odours in one or more series-connected ponds and is employed extensively in South Africa and Sweden, usually with a form of stepped loading. Surface aerators can be rotating brushes or caged rotors as used in the Passveer oxidation ditch to agitate the surface of the liquid as it circulates;

alternatively, they can be Cone Aerators which may be fixed in one position (pier mounted) or used as floating units. Generally 10 to 20 per cent of the total oxygen required results from oxygen transfer across the surface interface, and the rest is provided through mixing and entrapment of air. For sub-surface aeration, both the coarse bubble air gun and diffused air through perforated tubing systems are used. Considerably less maintenance has been associated with the air gun system than with the perforated tubing. Lower capital and operating costs are normally associated with surface aeration devices. Although less power is required for a facultative aerated pond than for a completely mixed aerated pond, land requirements to achieve the same degree of treatment are greater and the odour potential has been a problem in some installations.

Effluent Polishing

In the conventional treatment processes, the last stage is one of sedimentation to remove activated sludge or, after biological filtration, humus sludge. Both types of suspended matter are liable to go through phases when they become particularly difficult to precipitate and sedimentation of secondary sludge is less positive than for primary sludge. Consequently, effluent polishing methods are used at some sewage treatment works where it is essential for a high effluent standard to be constantly maintained. Effluent polishing to the required standard can be achieved by various methods but those usually adopted are rapid or slow sand filtration, micro-straining or detention in maturation ponds. Any of these methods will improve effluents from which most of the soluble organic matter in the sewage has already been removed by biological treatment.

Chlorination

If it is necessary to discharge sewage effluents into rivers which are used for public water supplies, sterilisation by means of chlorine may be necessary. Chlorination of effluent is carried out in many places in the USA but is very little used in other parts of the world. There are some objections to the general adoption of the practice of chlorinating sewage effluents, chiefly related to the cost involved and to the fact that not much is known about the effects of chlorinated effluents on the ecology of the receiving water course. It is unlikely that the chlorination of effluents would be necessary or desirable in the project area in the foreseeable future.

Sludge Handling and Disposal

Large volumes of sludge are produced in both the conventional primary and secondary treatment processes. The solids content of many of these sludges is very low (two to eight per cent) and, in that condition, sludge presents a difficult handling problem. The volume of sludge can be reduced by anaerobic digestion which stabilises putrescible organic sludges and renders them more amenable to dewatering without nuisance. Sludge digestion may be divided into two types (mesophilic and thermophilic) which differ in respect of the temperature at which the digestion takes place. Mesophilic digestors which in colder climates make use of the methane gas, produced during the digestion process, to maintain the sludge at a temperature of approximately 30 degrees centigrade, would operate satisfactorily in the Study Area at ambient temperatures. The period of digestion would be about one month. By increasing the temperature to 50 degrees centigrade in a thermophilic digestor, the period of digestion can be reduced to about 17 days. High temperature digestion of this kind is unusual however because it is difficult to control.

Most authorities have to dewater their sludges and a common method of doing this is to run the sludge onto underdrained drying beds where by drainage, decantation of surface water and evaporation it can be dewatered to a spadeable consistency of 25 to 40 per cent solids. Sludge drying beds have the disadvantage that they require large areas of land and do not function well during periods of frequent heavy rain and high relative humidity. There are several mechanical means of dewatering sludge and those most favoured depend on filtration under pressure either in vacuum filters, or filter presses. Both are unaffected by weather conditions and occupy comparatively little space but both require the prior addition to the sludge of chemical conditioners, such as lime and copperas (ferrous sulphate), or a polyelectrolyte. Sludge can also be given heat treatment such as the Porteous process, which involves heating it under pressure, but the process is expensive and produces a highly toxic supernatant liquor which has to be treated.

Other methods of sludge treatment include air drying and incineration of sludges which have first been concentrated by filtration or centrifuging, but such methods are also expensive and transfer some pollution to the atmosphere. Composting of domestic refuse with sewage sludge can produce a useful soil conditioner. After removing metals, wood and other unwanted material from the refuse, it is combined with sludge and the mixture is fermented under aerobic conditions, usually in a mechanical plant such as a rotating inclined drum into which air is blown. A difficulty is that the water content of the mixture has to be limited and, in dealing with the wastes from any one community, there is usually much more sludge than can be used unless its water content is considerably reduced. Even if the potentiality of agriculture to absorb a suitable end product is proved, composting rarely becomes an attractive financial proposition and can normally be regarded solely as a convenient and by no means inexpensive method of refuse and sludge disposal.

Having regard to local circumstances, dewatering of either raw or digested sludge on sludge drying beds followed by land disposal, would seem to be the most suitable method for handling and disposing of sludge from conventional sewage treatment works in the immediate future; at a later stage, the provision of mechanical dewatering plant to handle the increasing volumes of sludge would merit consideration. These sludge disposal problems would not arise with a stabilisation pond system of sewage treatment: the primary anaerobic or faculative ponds would be designed on the basis of sludge accumulation and desludging is normally necessary only when the pond is half-filled with sludge. The rate of sludge accumulation will depend on the suspended solids content of the raw sewage and the digestion rate; the frequency of desludging will depend on the volume of the tank provided and desludging should only be necessary at intervals of five years or more. Desludging would be carried out during periods of prolonged dry weather and dewatering would not be necessary as the liquid sludge, which has some manurial value, could be applied directly onto agricultural land. If land is cheap and readily available, and soil conditions are such as to make pond construction easy, the layout of the works can be arranged so that, when accumulation of sludge in the primary ponds reaches the maximum level, new ponds are constructed and the old ones are filled in.

10.4.3 Degree of Treatment

The degree of sewage treatment depends on the methods of disposal of the final effluent. In the Study Area the possible methods of disposal are by discharge to a stream, a river, or directly to the sea. Appropriate effluent standards depend on the ability of the receiving waters to assimilate the pollution load imposed and the uses which are made of them. In general sewage may require only limited treatment to remove coarse solids if the discharge is into very large rivers in good condition or into the sea at an adequate distance from the shore. At the other extreme, extensive treatment is necessary where receiving waters are unable to assimilate much additional pollution.

Methods of sewage disposal appropriate for use in the coastal towns of the Study Area would involve one of the following:

(a) primary and secondary treatment to reduce the pollution load by 95 per cent, and the suspended solids by 90 per cent, and to destroy between 80 per cent and 95 per cent of the pathogenic organisms; effluent treated to this degree would be suitable for discharge to a stream, a river, or to the sea at low water level;

(b) primary treatment only to reduce the pollution load by (say) 35 per cent, and the suspended solids by (say) 65 per cent, followed by discharge to a large river estuary or to shallow water through a short marine outfall; or

(c) disintegration and screening to remove gross solids followed by discharge by a long marine outfall; in this case discharge should be made at a depth of not less than six fathoms (36 feet)

No blanket recommendation can be made as to which arrangement will be the most suitable for use in the Study Area. Each system should be considered in the light of the prevailing conditions. However, as most of the communities served will have populations of less than 20 000, and in view of the abundance of flat, low value land, it is probable that stabilisation pond treatment, followed by disposal to a river or inshore coastal waters, will prove the most economical arrangement for the majority of towns.

10.4.4 Disposal of Industrial Effluents

The main industrial processes within the Study Area, either existing or planned, are:-

- palm oil processing;
- rubber processing;
- timber processing;
- prawn freezing;
- glass manufacturing; and
- the liquifaction of natural gas.

Palm oil processing produces large quantities of very strong effluent. Studies are being carried out by the Malaysian Agricultural Research and Development Institution to determine economical methods for disposing of the effluents but no satisfactory process has yet been demonstrated. Present techniques rely on the detention of the effluents in very large stabilisation ponds, which may either be artificially created or result from natural ground formations.

Rubber processing also produces large quantities of strong effluents. Work carried out by the Rubber Research Institute of Malaysia has shown that despite their strength, the effluents are amenable to treatment by biological oxidation. In the past treatment has been mainly by biological filtration, but treatment is also possible in stabilisation ponds or mechanically aerated ponds.

Proposals have been made to establish timber complexes which will in the early stages be limited to timber sawing but may later include veneer and plywood plants. The small quantities of effluent produced from these processes can readily be discharged to the public sewers for treatment in admixture with domestic sewage, or separate treatment and disposal arrangements can be made. There are at present no proposals for pulp or paper manufacture; these processes would present greater effluent disposal problems if they were to be introduced.

Prawn freezing is carried out in Miri; the effluents from the factory may be passed to the public sewers for treatment with domestic sewage.

Little or no effluents are produced from either glass manufacture or from the liquifaction of natural gas.

10.5 UNSEWERED AREAS

10.5.1 Sewerage Priorities

A main waterborne sewerage system, which carries all liquid wastes away from populated areas for subsequent safe disposal, is clearly the most satisfactory method of sanitation. For urban areas, no other method should be considered except as a temporary expedient. Where the development is dense, a sewerage system provides not only the most satisfactory but also the most economical method of sanitation. However, where population is sparse the cost of sewering each house can be prohibitive and other less costly methods of sanitation may be adopted without serious risk to public health.

Attempts have been made at economic comparisons between sewerage and other methods of sanitation, but these are of little immediate value in developing countries where the amount of sewerage work to be undertaken is likely to be determined by constraints on investment funds rather than economic considerations.

The following general principles should be adopted for development in the Study Area:-

(a) all new urban development with a density greater than four houses to the acre,(four houses to the acre is probably the highest density at which the effluent from septic tanks can be disposed of within each property boundary) should be served by a communal sewerage system which is, or can at a later time, conveniently be connected to a main sewerage system, or for which satisfactory communal sewage treatment and disposal arrangements are made; and

(b) priority in the sewerage of existing development should be given to those areas which are most densely populated.

10.5.2 Other Methods of Sanitation

The sanitary disposal of human excreta is a basic requirement for the maintenance of good public health. For domestic development in unsewered areas there are three types of sanitation arrangements commonly used.

(a) Septic Tanks

Septic tanks may receive the water closet wastes and sullage water from one or more property. Suspended solids in the wastes settle to the bottom of the tank and there undergo anaerobic digestion. The liquor then passes through an outlet pipe for subsequent disposal. Septic tanks must be emptied when the solids which build up in the bottom of the tank have occupied the volume allowed for them; generally about once every 12 to 18 months.

As a guide the following sizes are proposed for small septic tank installations (see Figures 10.3 and 10.4).

Number of Persons served	Septic Tank size (galls)	Horizontal Dimension (feet)
6 (minimum)	710	2.75
12	990	3.25
20	1 320	3.75
50	2 580	5.25

The effluent which flows from a septic tank may be as strong as that of untreated sewage and contain large numbers of pathogenic organisms. The safe disposal of the effluent is therefore essential if loss of amenity and danger to public health is to be avoided.

Preferred methods of disposal of septic tank effluent are:-

i) by dilution, if there is adequate flow in the receiving watercourse;

ii) by a soakaway pit, if the ground is sufficiently porous and the water table is sufficiently low;

iii) by sub-surface irrigation where the ground is less porous;

iv) by surface irrigation over a grass plot where ground conditions are unsuitable for sub-soil irrigation: an area of about one square yard per person is required.

The effluent may be further treated by detention in a stabilisation pond or, if shortage of land makes this impracticable, by passing through a biological filter bed.

(b) Conservancy tanks

Conservancy tanks or cess pits differ from septic tanks in that all of the liquid wastes are retained in them. When the tanks are full, the wastes are removed by tanker to a

FIGURE 10.3

TYPICAL OUTLINE DESIGN OF SEWAGE TREATMENT WORKS SEPTIC TANK METHOD

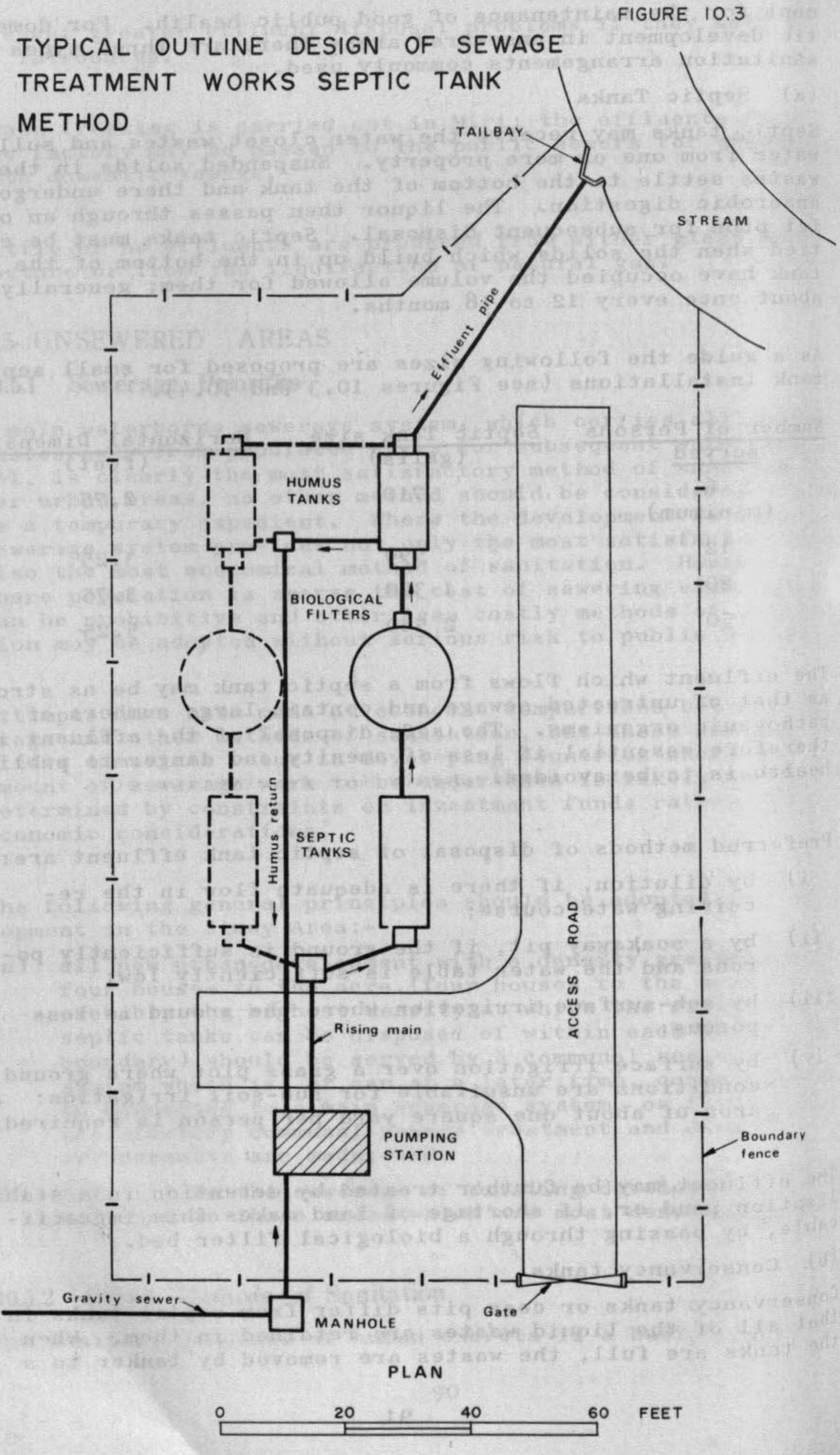
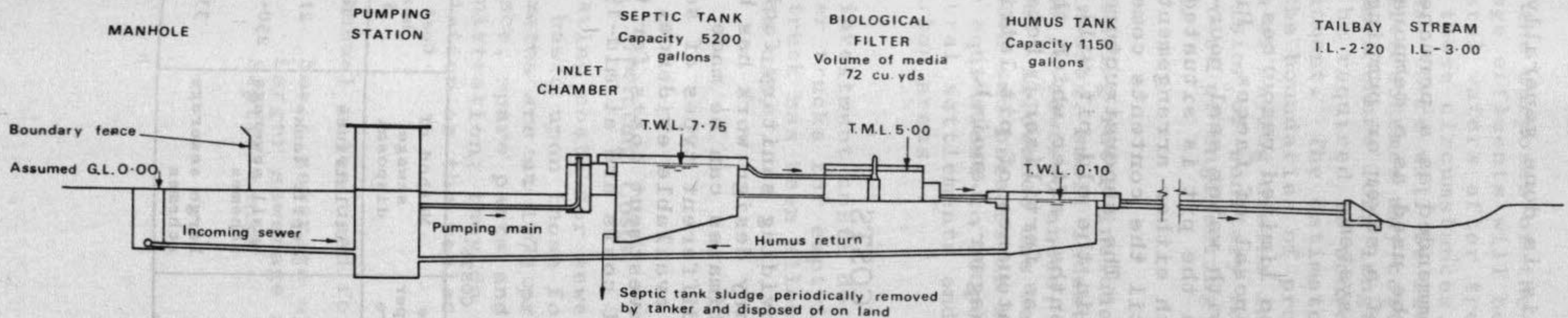


FIGURE 10.4

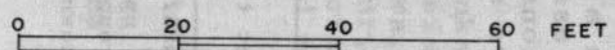
TYPICAL OUTLINE DESIGN OF SEWAGE TREATMENT WORKS SEPTIC TANK METHOD



SECTION ALONG LINE OF EFFLUENT

Notes:

1. Initial Works shown in full lines; future extensions shown dotted.
2. Initial Works sized for a design population of 60 with provision for duplication.
3. Levels based on assumed ground level 0·00 ft.



suitable place for safe disposal. This is done generally once every one to seven days.

Conservancy tanks would never be recommended as a permanent method of sanitation and should only be used as a temporary expedient prior to the construction of a sewer or pumping main to connect into a main sewerage system.

(c) Pit latrines

Pit latrines may be used where, due to limited resources, no other method is available for the disposal of faeces. Pit latrines may be used in conjunction with water seal pour-flush pans, or as earth privies where the pit is situated directly below the latrine slab. With either arrangement faecal matter passes into the pit until the contents come to within about two feet of the surface. The superstructure is then moved to a new pit. The faeces in the old pit will be digested by bacteria in nine to 12 months, after which the pit contents may be removed and used as fertiliser. Details of the construction and sanitary maintenance of pit latrines is well documented (Ross Institute, Wagner, Lanoix).

10.6 INVESTMENT AND OPERATING COSTS

10.6.1 Investment Costs

Accurate estimates of the cost of providing sanitary facilities can only be made after preliminary design work has been carried out. However approximate estimates can be made based on a unit per capita rate for different types of sanitation, assessed in the light of all available evidence. The assumptions used in estimating the investment costs for this Study are set out in Table 10.1. All costs are at mid-1973 prices.

TABLE 10.1 INVESTMENT COSTS

Settlement type	Housing density	Housing units per net acre	Average persons per net acre	Method of sewage disposal	Cost per head $
Agricultural	Low	1	6	Pit latrines	18
Various: upper income groups	Medium	3-4	15-20	Septic tanks	210
Smaller towns	High	6	31	Small sewerage schemes	250-330
Regional centres	High	6-10	30-55	Large sewerage schemes	330

For the purposes of the estimates it has been assumed that sewage effluents will be discharged to rivers or to inshore coastal waters after treatment in stabilisation ponds. Under these circumstances, and contrary to normal expectations, there will be little or no economy of scale, and smaller schemes may cost less, per capita, than larger schemes where long lengths of trunk sewer or pumping main may be required to convey sewage to a suitable site for treatment. The estimates include for taking the sewers up to the boundaries of properties but do not include for the cost of laying drains inside private properties or for the provision of sanitary facilities inside the houses, or for the cost of engineering design and supervision of construction.

Estimating rates include for the cost of sewering schools, businesses, small industries and non residential institutions in sewered areas, but not for serving major industries. Allowance has been made for sewering schools, places of work and bazaars in medium and low density areas at a rate equivalent to 10 per cent of the population for agricultural settlements and 20 per cent for unsewered urban or suburban areas.

The investment costs do not include for the purchase of tanker trucks for emptying septic tanks. A figure of $35 000 per truck has been allowed in instances where septic tanks are in use.

10.6.2 Operating Costs

Operating costs for sewerage systems and septic tanks have been based upon those for similar systems in Malaysia. The estimates are at 1973 prices and include for repairs, maintenance, spare parts and stores, power, fuel, labour, and administration; they do not include for loan servicing, depreciation or the replacement of obsolete plant and machinery.

The annual rates used for estimating operating costs are:-

Small sewerage systems	$ 5 per capita
Larger sewerage systems	$ 4 per capita
Septic tanks	$30 per tank

CHAPTER 11

DRAINAGE, CLEANSING AND STREET LIGHTING

11.1 INTRODUCTION

This chapter deals briefly with services related to drainage and public health engineering which were not covered under the previous two chapters. The services in question are usually administered by the local government authority of the area and they can be regarded primarily as urban services. They are:

Construction and maintenance of surface channels for conveying water from all sources;

Operation and maintenance of refuse collection service;

Cleansing and scavenging of streets, drains and public paved areas, including markets;

Street lighting (maintained by SESCO through a tariff charged to local authority)

The functions of grass cutting and maintenance of open spaces, and of mosquito control are normally controlled by the same departments in local councils as are those listed above, and they may be carried out by the same labour force. The labour costs for these jobs are included in the estimates.

The above services cannot as yet be expected in rural areas in Sarawak, and no provision has been made for them there or in new agricultural villages in the estimates. In an urban community however, and especially in areas where people congregate for purposes such as buying, selling and eating, the maintenance of good services in these categories is essential for public health, and they fill an important function in improving the standard of urban life.

11.2 SURFACE DRAINAGE

11.2.1 Main Channels

Any piece of land of more than a few acres contains natural watercourses for discharge of run-off water from rainfall. When the piece of land is developed into an inhabited area with roads,houses, etc: it is most likely, and in large areas inevitable, that the natural drainage pattern will be interfered with. Artificial channels which suit the development pattern are therefore necessary. The layout of these channels must form a part of the initial planning and it should, wherever possible, be done by an experienced drainage engineer.

Design of main drainage channels requires knowledge of the catchment area, its slopes and degree of vegetation cover, of storm rainfall and run-off and of the hydraulic behaviour of the channel itself. In many parts of Sarawak, and especially the coastal towns, there is sufficient natural slope to the ground for good hydraulic performance. In these circumstances it will be difficult if not impossible to avoid temporary flooding of the adjacent land during a heavy storm, and if there are areas of the catchment exposed to erosion it is probable that any drainage channel on flat land will accumulate sediment. Deposition of sediment (silting) in the main drainage channels cannot be avoided in many instances, though it can be reduced by the measures outlined in the following section. Sediment can quickly fill the channel so that it becomes useless.

When it is clear that silting is likely to be a problem then consideration should be given to minimising the effort and cost of removing the sediment. Although it may well be impossible to control the quantity of sediment it is often possible to arrange for it to be deposited at a convenient point. This is done by providing a basin where water velocities are low so that silting will occur there rather than further downstream. The sediment basin must be sited at the upstream end of the length of channel to be protected, and it should be on ground where the most economical type of mechanical excavator can be used, and where there is good access for trucks to remove the material. A basin of this sort will involve use of a machine which can excavate below water level, and it offers the prospect of reducing or eliminating the clearing out of long lengths of channel with difficult access. In new developments the reservation of strips of land as flood plain bordering the more important channels should be considered. The flood plain strips should be not less than 30 feet wide on each side of the channel; this width may be increased to 100 feet for large channels. The strips should be grassed over at a level at least one foot lower than adjacent roads and gardens.

If it is impossible to provide an adequate width of reservation for smaller channels due to existing development on the land, then it may be necessary to provide them with concrete lining. However concrete lining is not consistent with clearing out by mechanical means and it should not normally be necessary for main channels of small gradient.

Regular clearing of sediment from main channels will ensure that local flooding of short duration following heavy storms is reduced as much as possible. However, all development in flat areas should be planned in the knowledge that local flooding cannot be avoided. All building entrances, and roads where practicable, should be raised at least one or two feet above the surrounding ground level to reduce the flood risk.

11.2.2 Erosion

Main and other channels on steeply sloping ground should always be concrete lined to reduce erosion and limit the sediment which will tend to deposit downstream where slopes are flatter. Construction sites on sloping ground are particularly vulnerable to erosion; where practicable a belt of the original vegetation should be preserved around the site to act as an absorbent silt barrier until the site has been covered with grass or solid paving. Concrete lining of the drainage channels should be done at the earliest possible stage of construction.

Almost all construction works will temporarily, if not permanently, worsen the drainage and silting situation downstream of them, and effective administrative arrangements to make the developers responsible for these consequences are required.

11.2.3 Road-Side Drains

Nearly all roads require some form of open drain at both sides, or at least at the side where ground levels rise above them. These drains are usually small in section since their flow is discharged at pre-determined intervals into culverts or other channels. In residential areas it may be difficult to provide road-side drains with sufficient gradient, but they are particularly necessary there to reduce waterlogging of the road verges and adjoining gardens. Drains should be made deep enough so that water levels are normally about two feet below the road. In the very flat topography of many Sarawak towns there is often no alternative to allowing septic tank effluent into roadside drains. This is undesirable, but it may be unavoidable for some areas in the short term.

The nuisance caused by domestic waste materials is much reduced if the drains are concrete lined, thus encouraging faster flow and reducing obstruction by vegetation. Vegetation around the level of a water surface is very difficult to cut, and it encourages mosquito breeding. These drains are too small to clear out by machine, and for hand clearing a concrete lining is of assistance. For these reasons all roadside drains should be concrete lined to a height well above average wet season water level; lining up to adjoining ground level is not necessary.

Maintenance and clearing out of roadside drains would be simplified, and their condition improved, if a good refuse disposal service exists and house-holders can be educated to using it in preference to flushing solids into the drains. Likewise an improvement in the condition of drains can be made by encouraging the discharge of all domestic waste water (sullage) into the sewers or septic tanks. Legislation should be introduced to prohibit the deliberate dumping of any solid matter into drains of any sort or on road verges and public urban areas.

11.3 REFUSE COLLECTION AND DISPOSAL

The regular collection and hygienic disposal of solid refuse is a very important part of the services run by any local authority. In regional centres daily collection from residences and twice daily collection from markets and bazaar areas should be the objective; this is current practice in Kuching. In sub regional centres and smaller settlements a lower standard may have to be accepted, but the minimum should be collections twice-weekly from residences and once daily from markets and bazaars.

Refuse bins should be of an approved type, with well-fitting lids, and they should be mounted on a stand which dogs cannot overturn. Householders must be responsible for this, and their co-operation sought so that the speed and cleanliness of the collection work is improved. Specially constructed covered trucks are essential for an efficient service, and the use of the dual-tip compression loading type vehicle, which enables a much heavier load to be transported than on a simple tipping truck, has been found satisfactory in Kuching. Employment of contractors for refuse collection, as is done in Miri, is not consistent with use of the more specialised vehicles, and it is therefore likely to be less economical. Use of contractors is not recommended except as a temporary measure.

Refuse disposal dumps should be sited at least 0.5 mile from any habitation and should not be in a place where prevailing winds can carry smells, smoke or dust back into the town. Care should be taken in siting the dumps to ensure that liquid draining from them does not pollute watercourses.

It is essential that tipping at the refuse dump is controlled, by spreading and compacting the material as it arrives. Each day's refuse should be covered daily by a six-inch layer of soil to exclude vermin. This work requires a significant input of mechanical plant, labour and supervision.

11.4 STREET LIGHTING

Street lighting is a responsibility shared usually with the Sarawak Electricity Supply Corporation (SESCO), the full cost being borne by the local authority. Good street lighting is expensive and a relatively low standard must therefore be accepted. The cost of a system using underground cable is double that of one using overhead lines, therefore the latter are proposed for general use. Only the centres of the largest towns may be considered for lighting by means of underground cables.

General criteria cannot easily be laid down for street lighting, since it is not a service essential for health or public safety, and the money available will determine how much is installed.

For preliminary design and costing the following simplified rules had been adopted:-

"High Standard" for main roads in the centres of towns, with lamp Standards at 120 feet intervals

"Low Standard" for secondary roads in town centres and principal roads in residential areas, with lamp standards at 240 feet intervals

No lighting in other roads.

In the case of the sub regional centre at Igang these rules gave a 1990 total of 1.6 miles of High Standard lighting and 16 miles of Low Standard, costing $169 000.

11.5 COSTS

The following figures have been used in this Study for costing the works described in earlier sections. The rates per head of the population are based on the layout plan for the sub regional centre at Igang . When developed to its 1990 population of 10 000 this town is estimated to require 5.3 miles of main drainage channels of which three miles are concrete lined. The roadside drain costs are based on each person, excluding those in low density housing, paying for a frontage of 13.5 feet (70 feet per household).

(a) Main Channels ("monsoon drains"):

Concrete lined : $20.00 per foot
Unlined: $ 8.00 per foot

Cost per head : $50.00 in new settlements (1st five years)
$36.00 for population settling in developing settlements

(b) Roadside Drains :

Concrete lined : $ 7.50 per foot of drain
Unlined: $ 3.00 per foot of drain

Only the cost of the lining ($4.50 per foot) is charged to "Cleansing and Refuse Disposal", since the unlined drain cost is assumed to be covered by road rates.

Cost per head : $60.00.

(c) Refuse Collection

Ordinary five ton tipping truck $30 000
Compression loading truck $45 000
Garage and vehicle maintenance yard
large: $50 000
small: $30 000

Trucks are assumed to have a five year working life.

(d) Street Lighting

$400 per lamp standard, inclusive of all work.

"High Standard" requires 44 lamps/mile costing $17 500 per mile
"Low Standard" requires 22 lamps/mile costing $8 800 per mile

Where road layout is not known assume:-

$18 per head in new settlements (first five years)
$12 per head for population settling in developed settlement or after fifth year.

12.5.1 Operating Cost and Staffing

The labour force employed by Miri District Council for all the maintenance work associated with drains and street cleaning, grass cutting, etc: and for operating the refuse collection service, is about 80 men. Allowing for salaries of supervisory staff this labour force would cost about $280 000 per year. This figure and the corresponding one for Kuching Municipal Council were converted to a per-head basis as follows:-

	Miri District Council (1973)	Kuching Municipal Council (1972)
Total wage bill	$280 000	$700 000
Assumed population	30 000	70 000
Cost per head	$9.5	$10.0

Operating costs have therefore been taken at between $8.00 and $10.00 per head per year for large towns, and at rates varying down to $4.00 per head in very small towns, with a minimum of $5 000 per year (two labourers).

The fuel and maintenance for one truck is taken as $8 000 per year, exclusive of depreciation. One truck for refuse collection has been allowed for approximately every 6 000 of the population.

The costs of street lighting are at SESCO tariff rates, which are set high in order to cover lamp replacement, cleaning and all other maintenance. In Class I (Kuching, Sibu and possibly Miri in future) the tariff is 28 cents per kWh, and in Class II (most other towns) it is 33 cents per kWh. The cost to Fourth Division District Councils has varied between 90 cents and $2.60 per head per year in 1971 and 1972, corresponding to three per cent to eight per cent of total electricity sales. $2.00 per head per year may be used for estimating purposes.

CHAPTER 12

ELECTRICITY SUPPLY

12.1 INTRODUCTION

Reliable and sufficient supplies of electricity are an essential service in an expanding society. SESCO is a statutory body established in 1962 to construct and operate electricity installations in Sarawak. It also has the duty to advise the State Government on all matters relating to electricity supplies. The supply systems for all major towns are owned and operated by SESCO, which had 24 independent systems at the end of 1972. Outside the larger towns the provision of electricity has been left in the past to small scale private operators who secured the necessary licences from the State Chief Electrical Inspector. SESCO also is in the position of a private operator having to obtain a license from the Chief Electrical Inspector for each separate undertaking. However in the future SESCO can and should take over the licences from other operators when they become available, and it should become the electricity supply authority for all new development.

The large distances and relatively small populations in Sarawak make it unlikely that any national electricity grid would become economic between now and 1990. Each system will therefore remain electricity independent, and, except in a few special cases, each station is likely to be powered by gas turbines or oil or gas driven reciprocating engines. Hydro-electric power schemes in the Second and Seventh Divisions are being studied by other consultants. There is not at present any use of or commitment to use hydro-electric power, of which there are vast resources, in the State, located very far from any load centre. It is possible that very small hydro-electric stations may be feasible for new settlements where the cost of transporting fuel oil would be high.

New rural electricity supplies are currently financed in equal proportions by SESCO, the Sarawak Government and the Federal Government. It would be advantageous if this arrangement can be applied to all new settlements in the Study Area up to and including sub regional centres (with a design population ultimately of 12 000).

It is desirable that all new settlements should be provided with electricity supplies when their population rises to 1 000 or more. If implemented, this would cover provision of electricity to most of the future population in the Study Area.

12.2 CURRENT SITUATION

This section summarises very briefly SESCO's existing practice in providing electricity supplies to smaller communities with populations of 15 000 and below. For larger towns, and in particular for Miri and Bintulu, it is not possible to generalise. The summary given here is intended to be applicable to new settlements except where mentioned otherwise.

12.2.1 Generation

Electricity is generated at 415 volts three phase alternating current by generators direct coupled to diesel engines. The size of individual units varies between 25 and 600 kilowatts (kW). Two or more generating sets are usually provided in each station, with additions made to meet rising demand. The power stations are supplied with fuel by the oil company's road tanker, contract transport or small marine craft in the case of coastal towns. Inland towns without road access are supplied using 40-gallon oil drums taken up river by SESCO.

Maximum demand has increased generally by between 11 per cent and 20 per cent each year, although this may be exceeded after significant extensions to the transmission network. The consumption of electricity has increased at a more stable rate of about 15 per cent each year. Load factors vary widely, with recent figures for Fourth Division stations of between 26 per cent and 66 per cent.

12.2.2 Transmission

Electricity is transmitted at 11 000 volts or 6 600 volts except for very small systems using low voltage only. Where the final length of a transmission line is expected to exceed five miles the higher voltage is used. More than half of the existing route mileage is laid underground including all sections in urban areas.

12.2.3 Distribution and Domestic Sales

Supplies are distributed at low voltage, 400/230 volts, on lines which are overhead in nearly all cases. Kilowatt-hour meters are installed on all consumers premises and are read monthly. Sales to domestic consumers are on one of two tariffs: "Lighting and Fans" or "Combined Domestic". Quantities sold on the Lighting and Fans tariff declined drastically between 1969 and 1971 due to transfers to other tariffs. The combined sales under the two tariffs mentioned above have declined because of transfers from Lighting and Fans to the Commercial tariff. Trends in true domestic sales are therefore difficult to observe over the past four years.

12.2.4 Electricity Tariffs

SESCO supplies are sold on three classes of tariff depending on the size and location of the system. Class I tariffs apply only to the two largest towns, Kuching and Sibu, although it is expected that Miri will shortly justify transfer to this class. Class II applies to all other systems with the exception of three small ones in the Third and Fifth Divisions. The hours of supply are restricted in the case of a few small stations. The difference between the tariff classes is considerable, as shown in the Table 12.1.

TABLE 12.1 TARIFF IN CENTS PER KILOWATT-HOUR UNIT (kWh)

	Combined Domestic (exceeding 60 kWh per month)	Commercial (exceeding 5 000 kWh per month)	Industrial (exceeding 5 000 kWh per month)
Class I	10	12	7
Class II	14	14	11
Class III*	20	20	20

* The Class III tariffs apply to consumption exceeding 20 kWh per month.

It will be seen that Class I industrial consumers enjoy the advantage of paying only 65 per cent of the amount charged to similar Class II consumers, and that other Class I categories also enjoy a similar though smaller advantage. The use of Class I tariffs would form an incentive to industrial development in the area where they applied, and their adoption for Miri and later for Bintulu is desirable.

For systems in the Study Area generally the Class II tariffs would apply; they are reproduced in Appendix III.2 for convenient reference.

12.2.5 Size of System

The 1970 figures for installed system capacity, compared with the census populations for the towns served, show no clear relationship between population and size of the electrical generating system. Industrial demand varies widely from place to place. For example Bintulu enjoys a very high capacity per head due to the large demand from sawmills in a rather small town. The range of values is narrowed slightly when considering installed capacity per consumer, that is per household or other consumption meter, but figures still vary by a factor of three. However the average for the whole State is very nearly equal to one kilowatt per consumer, and this figure is closely followed by the eight new rural systems established since 1964. In the latter the number of consumers is about one per 11 persons of the total population in the two cases where figures are available, whereas the State average is one consumer per 14.8 persons of the urban population. The figures mentioned are shown in Table 12.2, at the foot of which are added proposed criteria for new settlements, which are discussed in section 12.4.

TABLE 12.2 SIZE OF SELECTED SYSTEMS

	Installed Capacity kW	Number of Consumers	Capacity per Consumer kW	Population Served	Capacity per head kW
1970 Figures					
Kuching	17 000	15 400	1.1	110 000	0.15
Sibu	5 200	6 900	0.8	50 100	0.10
Lundu	170	200	0.8	2 700	0.06
Serian	450	290	1.6	2 200	0.2
Betong	170	310	0.6	2 700	0.06
Mukah	280	500	0.6	1 700	0.2
Lawas	210	210	1.0	2 300	0.09
Miri	2 080	3 000	0.7	35 700*	0.06
Bintulu	1 150	870	1.3	4 400*	0.3
Marudi	410	580	0.7	4 700*	0.09
Limbang	819	700	1.2	6 500	0.13
Others	---	---		---	
Total for all towns served by SESCO	32 090	30 400	1.05	205 800	0.16
Total for Malaysia 1969**	664 000	399 000	1.7	-	-
Study proposal for:					
Agricultural Village	150	250	0.6	2 000	0.075
Sub-Regional Centre	1 800	2 000	0.9	12 000	0.15

* Population given in the volume "Community Groups" of the "1970 Population and Housing Census of Malaysia", published by the Statistics Department Malaysia, March 1972, and not corrected by the Governments. These figures are known to contain errors in the case of Fourth Division towns.

** Figures taken from World Bank Sector Paper "Electric Power", 1971.

The published figures in SESCO Annual Reports show that the rates of growth in the period 1961 to 1971 have averaged 13.5 per cent per year for maximum demand and 15.3 per cent per year for annual consumption. The difference reflects the improvement in the load factor. The installed capacity at each station is frequently closely equal to twice the maximum demand. This is not intended to represent 100 per cent standby capacity, since the situation reflects provision for future growth as well as standby (reserve)capacity.[24] Because of the wide range of machine sizes used in their systems SESCO are able to switch units from one system to another when constructing enlargements to their power stations. The number of sets installed varies from two for some very small stations to eight at Kuching, the commonest cases being those with four or five sets.

It is assumed that in a situation where the ratio of growth in demand is high the installed capacity at any date should be sufficient to cover the following year's anticipated peak with the largest or one of the largest units out of use. This rule may govern the amount of plant installed though it will be modified by the aim of securing a station having the best number and sizes of units. A given power station site has usually a definite upper limit to the plant which can be accommodated, whether from reasons of space and surrounding amenity, fuel supply or the capacity of the outgoing transmission system.

12.2.6 Staffing

The new 1973 staff establishments for Miri, including in the District Office the management staff for the Fourth and Fifth Divisions, and for Marudi are summarised in Table 12.3. This is a revised establishment, appointments to which have not been completed, but it provides guidance on future staff needs. Table 12.3 excludes the staff stationed at Bintulu and in the Fifth Division.

TABLE 12.3 STAFF OF EXISTING STATIONS

Unit / Staff Group*	Professional	Executive	Clerical and Technical	Manual	Total
Marudi, inclusive	-	1	5	6	12
Miri, Power station	1	2	12	11	26
Miri, Transmission and distribution	-	5	11	20	36
Miri District Office	2	-	16	8	26

Note * Classification according to Sarawak Government (1971)

The relative system sizes for comparison, expressed as maximum power demand, are as follows:

Marudi	200 kW
Miri	2 600 kW
Bintulu	800 kW
Total 4th Division	3 600 kW
Total 5th Division	700 kW

12.3 DEVELOPMENT ALTERNATIVES

Places served by SESCO systems have hitherto been too widely separated to justify joining up of the transmission lines to combine two or more systems. However in the Niah-Suai Detailed Plan Area for example there will be a number of settlements within a radius of ten miles of the sub regional centre which could possibly be served by one central electrical power station. The position expected in 1990 should be as shown in Table 12.4.

TABLE 12.4 THE NIAH-SUAI DETAILED PLAN AREA

Settlement	Population	Distance from SRC
Sub-Regional Centre - Igang	10 000	0
Galasah	2 000	7 miles
Lamaus	2 000	9 miles
Sebanah	2 000	8½ miles
Ensabang	2 000	10 miles
Telabit	2 000	5 miles

Based on the approximate cost figures given in Section 12.4.5.1 it is not expected that a central power station with transmission lines to the villages would be competitive in investment (capital) cost with six separate systems. However, the operating costs and efficiency may favour the central power station and therefore the two alternatives will require closer examination at the detailed planning stage.

Another expected feature of the Regional development would be a number of large sawmills or timber complexes. It is reported that each timber complex would require steam-turbine-driven generators rated at 2 000 kW. The nature of the peak demand and the load curve are not known, but even a peak load of 1 000 kW would be difficult to accommodate within a medium sized SESCO system. It seems probable that power generation for sawmills would be better left outside the SESCO systems, since the former have a possible source of energy from burning wood by-products and they are likely to be remote from the larger settlements. However the feasibility of connecting the electricity system at a timber complex to the distribution network of any nearby settlements should be examined at the detailed planning stage.

SESCO are understood to be now studying a possible scheme for SLDB's Bukit Peninjau estate, with or without connection to Ladang Empat estate village near it. The situation in Lambir Subis Development Area has some resemblance to that in the Niah-Suai Area from the electricity supply aspect; in both cases there will be a large palm oil processing mill which can act as a limited source of power for an adjacent village, but other villages in the area will be widely separated. Inter-connection at low voltage is not practicable at distances much above one mile, and demands are unlikely to be large enough to justify the investment needed for high voltage transmission.

12.4 DESIGN CRITERIA AND EXAMPLES

It is general policy of the Government and of SESCO to provide electricity supplies to all communities able to justify them, within the limits of available staff and capital. The community should be prepared and able to pay for electricity on the Class III tariffs and be of sufficient size to provide a peak demand of 20 to 30 kilowatts initially.

The above requirements for the particular settlement should be met in new settlements proposed by the Study, since all are expected to develop to a population of 2 000 or more. Some existing centres within the Study Area which have no supplies at present will require them as soon as practicable, and in some cases SESCO have detailed planning in hand already. Bekeku is an instance of an important bazaar centre, although small in population, which will be provided with a SESCO system in the near future. Although Bekenu's 1970 population was only 700 it is planned to provide it with a 60 kW power station.

The size of installation to be provided in existing settlements or for enlargements of present systems must be carefully considered in each case. However 50 to 60 kW installed capacity is the normal minimum which is consistent with the 20 to 30 kW peak demand referred to above. No existing SESCO systems are smaller than 56 kW installed.

Two basic types of new settlement are considered as design examples: sub-regional centres and agricultural villages. The sub-regional centres are expected to grow, over a period of 15 years, to a population of 8 000 to 12 000. At that stage about two thirds of the employed population would be engaged in commercial and industrial activities, the remaining being in agriculture. It is assumed that, by the time the population reached 12 000, there would be 1 800 electricity consumers and that they would require an installed capacity of 1.0 kW per consumer. This would give a 1990 total of 1 800 kW installed, with a corresponding peak demand of 1 200 kW. To suit the supposed sizes of individual units an actual installation of 1 850 kW is suggested. A possible phasing of the installing of this plant is given in Table 12.5.

The agricultural village would by 1990 reach a population of between 1 500 and 2 500. 95 per cent of the employed population would be agricultural workers. The demand for supplies would grow more slowly than in the centre because new settlers would probably be less able to afford connections. A three year lag between arrival of new settlers and their ability to pay for electrical supplies is assumed. In a representative village of 2 100 persons it is assumed that a third of the population would not want electricity supplies and that there would be 250 consumers. They would be rated at the lowest installed capacity derived from existing SESCO stations which is 0.6 kW per consumer. The theoretical installed capacity for the population is therefore 150 kW, but

TABLE 12.5 PHASED DEVELOPMENT OF POWER STATIONS
(denoted by demand and sizes of generating sets in kilowatts)

Year	Galasah Agricultural Village			Sub-Regional Centre			Remarks
	Peak Demand	Installed Plant		Peak Demand	Installed Plant		
		New Set	Total		New Set	Total	
1975	Nil	Nil	Nil	Nil	Nil	Nil	Settlers established in Village
1976	Nil	Nil	Nil	Nil	30 + 60	90	Demand from institutions in SRC
1977	Nil	Nil	Nil	50	-	90	
1978	Nil	30	30	100	100	190	
1979	15	-	30	250	250	440	Growth of SRC slows
1980	30	30	60	500	500	940	
1981	50	-	60	700	500	1 440	
1982	60	-	60	800	-	1 440	30 kW and 60 kW sets removed and installed in Villages
1983	60	60	120	850	-30 - 60	1 350	
1984	65	-	120	900	500	1 850	
1985	70	-	120	950	-	1 850	
1986	70	60	180	1 000	-	1 850	
1987	75	-	180	1 050	-	1 850	
1988	75	-	180	1 100	-	1 850	
1989	80	-	180	1 150	-	1 850	
1990	85	-	180	1 200	-	1 850	

1990 plant: 2 x 30 kW = 60 kW
2 x 60 kW = 120 kW
Total 180 kW

1990 plant: 1 x 100 kW = 100 kW
1 x 250 kW = 250 kW
3 x 500 kW = 1 500 kW
Total 1 850 kW

since further growth must be anticipated a larger capacity of 180 kW is adopted, which also suits the sizes of generator used. This level would be reached at different dates in each village depending on its growth. A possible phasing of the installing of the plant for the first villge to be developed of the five in the Niah-Suai Detailed Plan Area is given in Table 12.5.

The land required for the sub-regional centre's power station is two acres, sited near a main road preferably beside the industrial and away from residential areas. Office accommodation of about 800 square feet should be provided in the town centre. Power stations at the village require about half an acre of land. To reduce noise nuisance the stations should be screened, by trees or a hill, from residential areas.

12.5 COSTS

12.5.1 Investment Costs

From the table of fixed assets at cost in SESCO annual reports a relationship was obtained between the costs of the different parts of their electricity systems. At Miri the total assets have more than doubled since 1969, so the proportions have been weighted in favour of this large recent expenditure at Miri's new station. The adopted proportions are given in Table 12.6, in which typical world-wide values given by the World Bank are shown for comparison. The absence of a long range transmission network in Sarawak causes a smaller proportion to be devoted to transmission and distribution.

TABLE 12.6 COST PROPORTIONS AS PERCENTAGES

	1971 SESCO Figures		Adopted Figures	World Bank Range
	Average all systems	Miri		
Buildings	15	24	20)	
Generating Plant	37	35	36) 56	30-50
Transmission and Distribution	43	32	39	50-70
Other Assets	5	9	5	-
Total	100	100	100	100

The component of offshore costs has in recent years been held to between 35 and 40 per cent of total expenditure.

The costs per kilowatt of generating plant vary considerably with the size of set: the figures used are given in Table 12.7. The cost of complete electricity systems has been obtained by regarding the generating plant, at 36 per cent of the total, as the controlling item.

Table 12.7 also indicates the sizes of generator set commonly used in smaller towns in Sarawak.

TABLE 12.7 INVESTMENT COSTS

Size of Set (kW)	Rate per kW ($)	Cost of Set ($)	Cost of Complete System ($)
30	700	21 000	60 000
(50)	(685)	(34 000)	(95 000)
60	680	41 000	115 000
100	650	65 000	180 000
250	580	145 000	410 000
500	500	250 000	700 000
1 000	475	475 000	1 340 000

In cases where lengths of transmission lines are required, additional to the distances normally required within an urban area, the cost is taken to be $27 000 per mile. This is based on the actual cost of the line from Miri to Bukit

Lambir. The above figure applies to 11 kV or 6.6 kV overhead lines.

12.5.2 Operating Costs

Operating costs for the past three years of the Fourth Division stations and Limbang in the Fifth Division are listed in Table 12.8, together with the overall SESCO average costs. The figures given exclude provision for depreciation and loan servicing charges.

TABLE 12.8 OPERATING COSTS (in cents per kWh)

	1970	1971	1972
Miri	8.6	8.4	8.1
Bintulu	13.1	12.1	12.4
Marudi	17.3	17.1	15.9
Limbang	10.0	9.3	8.9
SESCO average	7.9	7.8	7.6

The SESCO average figures are dominated by the Kuching and Sibu systems which account for 79 per cent of consumption. Miri accounts for a further eight per cent of the total leaving the 21 smaller stations with 13 per cent of the total consumption between them. Miri's costs may drop by up to one cent in 1973 with full use of natural gas by the new dual fuel engines. Fuel costs amount to about one third of the costs given. Bintulu's figures are not representative of a medium sized system because of its irregular load demand from sawmills. Limbang is more representative for new settlements in its pattern of domestic and commercial demand (see Table 12.2). Although smaller in installed capacity than Bintulu, Limbang's sales of electricity have exceeded Bintulu's by 60 to 70 per cent. Although some of the new stations proposed in the Study may have smaller units than those at Marudi (70 to 150 kW) it is not proposed to use cost figures so high as Marudi's, which include heavy river freight costs for fuel. The following rates for future operating costs are used, based on mid-1973 prices and without allowance for inflation.

	Cents/kWh
Miri	7.5
Bintulu (in 1975)	12.5
Bintulu (after 1980)	8.0
New stations (small sets)	14.0
New stations (large sets)	10.0

"Small sets" refers to those of 30 kW to 125 kW

"Large sets" refers to those larger than 125 kW and not exceeding 1 000 kW

"Bintulu (after 1980)" assumes the use of natural gas, with the Bintulu rate between 1976 and 1980 reducing approximately one cent per year due to improving load factor. The figures given above, other than those for SESCO's average, do not allow for the operating costs of the Fourth and Fifth Divisions' District Office at Miri (see Table 12.3). This is assessed as being $140 000 per year independent of electricity consumption.

CHAPTER 13

TELECOMMUNICATIONS

13.1 INTRODUCTION

A good telecommunications network is a most important service required in a developing society. This service provided by Government cannot be self-supporting in present circumstances in Sarawak. The State enjoys a high level of service in this field relative to certain other public utilities, and there is evidence that the demand for telephone services is high. A major programme of capital works to improve the system is in hand as part of the Second Malaysia Plan, among which priority is being given to the following:-

- provision of more automatic exchanges, and extension of existing exchanges and the telephone network;
- construction of an intra-state and inter-state micro-wave system;
- improvements to telex facilities.

The allocation of development funds in the Mid-Term Review of the Second Malaysia Plan provides $22.5 mn for this work in the years 1974 to 1975.

13.2 SERVICES REQUIRED

The principal service supplied is the telephone system to individual subscribers. Individual subscribers include Government and local public offices, institutions, private, commercial and industrial enterprises, and private residences. In new settlements priorities between these different subscribers may have to be established due to inability to meet a sudden new demand for telephones. In this case the requirements of private commerce and industry should be given some fixed proportion of the lines available at any one time. The proportion may have to vary for different settlements, but it is suggested that basic proportions are 70 per cent private, and 30 per cent Government.

The telecommunications system provides the following additional services:-

- public telephone call boxes
- radio-telephone
- inland and overseas telegrams
- telex
- radio call service for remote settlements
- special radio services for police, civil aviation, and the civil administration.

In the future it will also provide transmission facilities for television.

13.3 CURRENT SITUATION

13.3.1 Inter-Divisional

Telecommunications between Third, Fourth and Fifth Divisions are by Very High Frequency (VHF) radio links. There are no land lines for trunk and junction circuits. Fourth Division trunk VHF stations are at Bintulu (Bukit Jepak) and Miri (Tanjong Lobang) only; this represents a longer range (100 miles) than is desirable for the system employed, which suffers periodically from poor quality transmission. Telegraphic systems appear to be worse affected than speech channels, and for this reason telegrams may have to be transmitted several times over. For the same reason telex service to Miri is poor and there are only eight telex subscribers in Miri.

The above situation will improve when the micro-wave system is commissioned (see Section 13.3.3) and the longest VHF links can be abandoned.

13.3.2 Within Divisions

Telecommunications between exchanges within Divisions are now and will generally continue to be by VHF radio links. Exceptions to this are where two exchanges are very close to one another or, in the future, where micro-wave Drop-Off stations will be available. At present in Fourth Division all exchanges are inter-connected by VHF radio except Lutong and Miri which have physical junctions (connected by land line). Automatic exchanges are provided at all places served, except for some very small rural exchanges. Telephone service lines are partly overhead and partly laid underground.

13.3.3 Micro-wave System

A micro-wave system linking the major towns in Sarawak and Sabah is under construction, and its south-western portions between Kuching and Sibu have been commissioned. Civil works construction of most of the stations in Fourth Division is well under way with two stations completed, and the system is expected to be put into use in 1975. There will be facilities for connecting into the existing telephone system (Drop-Off stations) at Bintulu and at Miri. The system continues via Fifth Division into Sabah.

13.3.4 Staffing

The numbers of staff required by the telecommunications service to operate and maintain these facilities are outlined in Table 13.1. The figures give the totals required in a town or village of the size indicated, but they exclude administration staff at Divisional level.

TABLE 13.1 STAFFING[1]

Unit \ Staff group	Professional	Executive	Clerical and technical	Manual	Total
2 000 line exchange and telegraph office	1	4	31	20	56
300 line exchange and telegraph office	-	1	10	4	15
150 line exchange	-	-	5	1	6
50 line exchange	-	-	1	1	2
Micro-Wave and VHF stations (Fourth Division)	1	2	20	6	29

Note (1) The grouping is according to the Sarawak Government (1971)

13.4 NEW SYSTEMS - GENERAL CRITERIA

The density of telephone subscribers lines per unit of population exceeds in most cases the provisions already suggested for new settlements in Peninsular Malaysia (Hunting Technical Services <u>et alia</u> 1971, and Foundation of Canada Engineering Corporation Limited <u>et alia</u> 1972).

<u>Johor</u>: Villages - 2.5 lines per 1 000 population, rising to 8 lines per 1 000 population in five years

Towns - 5 lines per 1 000 population, rising to 20 lines per 1 000 population in five years

<u>Pahang</u>: 20 lines per 1 000 population without variation in time.

Densities of between 32 and 45 per thousand exist in the Study Area and these must be expected to increase. The average for the whole of Malaysia in 1970 was 15 per thousand, with a growth rate of 6.9 per cent in the preceding five years (World Bank 1971).

The following densities for planning purposes are proposed in the Study Area:- (target populations are given in brackets)

Villages (2 000) 10 lines per 1 000 initially, rising to 15 lines per 1 000 after five years.

Smaller towns (5 000 to 15 000)	20 lines per 1 000 initially, rising to 40 lines per 1 000 after five years.
Miri and Bintulu (as and when Bintulu exceeds 15 000)	60 lines per 1 000 initially, rising to 90 lines per 1 000 after five years.

New agricultural villages will normally be not more than ten miles from a town in the population bracket 5 000 to 15 000. It is not considered that a telephone service is necessary or will be demanded by the population for a number of years, and certainly not until after the village population has stabilised at around 2 000. It is, however, a service which should come after the provision of electricity supplies, which are proposed three years after the initial establishment of the settlers. It is therefore proposed that rural telephone systems be installed five years after the initial establishment; however, radio call service can be provided at any time.

In the case of new towns a telephone system is an important adjunct to development, and installation should commence at the same time as the initial construction of other services.

A telegraph office should also be provided in all towns of 5 000 population and upwards, and provision made for telex in the larger towns. The demand for telex terminals in Miri and Bintulu can be expected to rise steeply after the microwave system is commissioned. The growth pattern of telex in Peninsular Malaysia at a similar stage should be used for guidance.

13.5 COSTS

Cost tables for preliminary estimating were prepared by the Study and the cost figures completed by Telecommunications Department in Kuching. The information is given in Tables 13.2 and 13.3, the figures must be regarded as approximate, especially in the case of VHF and micro-wave stations, where civil engineering costs may vary considerably between one site and another.

TABLE 13.2 COST OF TELECOMMUNICATIONS FACILITIES

Description	Ref. letter	System size by mean number of lines				
		3 000	1 000	300	100	30
Possible number of lines		2 000 to 6 000	600 to 2 000	200 to 600	50 to 200	Up to 50
Cost of buildings	A	$1.0 mn	$0.4 mn	$0.1 mn	$50 000	$30 000
Land requirement		1 acre	¾ acre	¼ acre	¼ acre	¼ acre
Exchange equipment, per line	B	$1 500			$1 000	
Outdoor and subscribers equipment, per line	C	$190				
All other equipment, including VHF link and telegraph office	D	$150 000			$40 000*	
Micro-wave relay station, complete	E	$1 500 000 (more if roads expensive)				
Extra for micro-wave Drop-Off facility		$450 000				
Transport, equipment for maintenance	G	$0.1 mn	$55 000	$45 000	$35 000	$20 000
Staff quarters (number of units) Class II (at $60 000) Class III (at $35 000) Class IV (at $20 000)	H	 2 2 10	 1 2 10	 - 1 4	 - - 4	 - - 1

Note * Without telegraph office.

TABLE 13.3 ANNUAL OPERATING COSTS AND REVENUE

Description	System size by mean number of lines				
	3 000	1 000	300	100	30
Possible number of lines	2 000 to 6 000	600 to 2 000	200 to 600	50 to 200	Up to 50
Costs	$	$	$	$	$
Administrative costs (Divisional level)	100 000	-	-	-	-
Staff salaries	400 000	300 000	80 000	30 000	8 000
Materials, spares, fuel and services	750 000	300 000	30 000	16 000	5 000
Maintenance of buildings	70 000	40 000	10 000	5 000	5 000
Other recurrent costs	30 000	20 000	5 000	2 000	1 000
Total	1 350 000	660 000	125 000	53 000	19 000
Revenue					
Telephone charges, per line	$700 average				
Telegrams) Radio services) Other)	10 per cent of telephone charges = $70 average				

PART IV

PRIVATE SERVICES

CHAPTER 14

PRIVATE SERVICES

14.1 INTRODUCTION

Private Services represent that part of the private sector which supplies a range of facilities to public and private consumers. The Private Services Sector provides an important complementary function to the Public Sector Services and the primary, manufacturing and construction industries which constitute the other major economic sectors. The Private Services include a wide range of activities which cannot be described in a uniform way and the figures which follow must therefore be considered as indications of the sector characteristics and applied only as a basis for future planning.

The standards are based on available local statistical material, foreign standards and other information collected locally through interviews and sample surveys.

14.2 CLASSIFICATION

Private Services are classified in five different groups, which are defined according to the service rendered and the catchment areas.

The groups are:

1. Retail trade, consumer goods
2. Retail trade, capital goods
3. Wholesale trade
4. Specialised Services
5. Other services.

The catchment areas are divided into four groups.

- Regional Centres
  i.e. Miri and Bintulu
- Sub Regional Centres
  i.e. urban areas with approximately 10 000 inhabitants and a surrounding rural area of a further 15 000 inhabitants.
- Service Centres
  i.e. urban areas with approximately 6 000 inhabitants and a surrounding rural catchment area of a further 10 000 inhabitants.
- Villages
  i.e. smaller concentrated settlements with catchment of 2 000 inhabitants and upwards.

1. Retail trade, consumer goods

This group covers all trade from shophouses, stalls etc. in goods used directly for immediate consumption (e.g. food-stuffs, clothing, books etc.) and would be represented in all urban areas, including villages.

2. Retail trade, capital goods

This group covers all trade from shophouses and workshops in goods used for production and goods which have long term use (e.g. engineering production, and hardware).

The distinction between trade in consumer and capital goods is decided by turn over. Of the two categories the group which has more than 50 per cent of total turn over will determine the classification.

Retail trade in capital goods would be represented in all urban areas.

3. Wholesale trade

This group covers all businesses in which more than 50 per cent of the turn over originates from wholesale trade. Wholesale trade will be represented primarily in regional centres and to a lesser extent in sub-centres.

4. Specialised Services

This group covers all professional activities such as medical practitioners, lawyers, auditors, engineers, architects etc. These activitiies would mainly be represented in the regional centres.

5. Other Services

This group covers miscellaneous service industries ranging from coffee-shops and cinemas to photographers and barber shops. Other services would be represented in regional centres, sub centres and service centres.

14.3 STANDARDS

It is anticipated that service standards would improve so far as this sector is concerned. This, however, does not necessarily mean that an increase will take place in the number of establishments in the existing urban areas. The improved service would arise through the development of new urban communities and improved transport whereby travelling distances from home to service place is reduced.

The structure of the private services in the different categories of urban areas would be as shown in Table 14.1.

Private Service establishments may vary in size and turn over for many reasons, including their locations. More expensive sites and buildings will necessitate higher turn over to make a regional centre establishment feasible.

TABLE 14.1 STRUCTURE OF PRIVATE SERVICES BY URBAN AREAS

	Regional Centre	Sub-Centre	Service Centre	Village
Retail shops				
- consumer goods	300	75	40	7
- capital goods	100	20	5	-
Wholesale	60	10	-	-
Spec. Services	50	-	-	-
Other Services	150	30	10	-
Total Service establishments	660	135	55	7

The distribution on employment and turn-over appears to be evenly spread on different sizes of establishments. Thus if turn-over is considered, the distribution in the retail trade is as shown in Table 14.2.

TABLE 14.2 DISTRIBUTION OF ANNUAL TURNOVER IN THE RETAIL TRADE (in dollars)

Turnover per year	Per cent
0 - 2 000	20
2 000 - 10 000	25
10 000 - 50 000	26
50 000 - 250 000	24
250 000 -	5
Total	100

Consequently only average figures have been worked out to illustrate present and future standards for private services.

It is anticipated that the future retail and wholesale trade will extend their supplies to more sophisticated imported goods and the number of items in the list of goods will thus be increased. This would usually demand bigger stocks and working capital but increased rate of turn-over and more effective trading methods should minimise the consequences of the demand for a more varied supply of goods.

The turn-over of the different types of service establishments are estimated at:

	Turnover in $/year
Retail Trade - consumer goods	40 000
Retail Trade - capital goods	175 000
Wholesale	800 000
Special Services	75 000
Other Services	45 000

The turn-over and the profit margin usually determine the building size, location, employment and cost of the establishment.

As profit margins would be approximately of the same order within each of the service groups the turn-over is used as a standard measure for the mentioned factors. Some average estimates are given in Table 14.3.

TABLE 14.3 AVERAGE ESTIMATES OF TURNOVER

	Number of employees	Floor space square feet	Establishment costs dollars
Retail Trade - consumer goods	2	1 600	110 000
Retail Trade - capital goods	3	1 800	140 000
Wholesale	8	2 000	200 000
Special Services	2	400	45 000
Other Services	3	1 000	85 000

Substitution of establishment costs, which include basic stock - the assumed equivalent to working capital - by changed standards for the use of floor space would be possible to a certain degree but this has not be considered in this chapter.

PART V
HOUSING

CHAPTER 15

HOUSING

15.1 INTRODUCTION

Housing in this context includes both construction and site preparation and development, and refers to dwelling houses of all kinds. The major part of housing should be based on a cost-pay principle, i.e. the user of the house pays for the cost of building and for maintaining the house. The essential point in such an approach is to keep the costs as low as possible in order to enable low income families to live in a reasonable house. This report has not taken into account the possibility of subsidised housing.

15.2 HOUSING NEED

The estimated need for houses must be based on certain standard assumptions. The population is increasing by approximately 2.8 per cent per year (in the whole of Sarawak) and the household size will gradually decrease as more people move from the rural sector into urban environments. At the same time a certain part of existing housing will need renewal in the future.

Considering these factors:-

- growth of population: 2.8 per cent per annum
- urban household size: 5.2 persons
- rural household size: 5.6 persons
- gradual change in the urban/rural population ratio from 25/75 in 1970 to 40/60 in 1990
- urban housing renewal: five per cent per annum of houses constructed before 1970
- rural housing renewal: two per cent per annum of houses constructed before 1970,

the future housing need in the whole of Sarawak will be:-

	1975-80	1980-85	1985-90	1990-95
No. units	7 000	55 000	64 000	75 000

In the Study Area the housing need will depend on the actual projects undertaken and the general development of the urban and rural sectors.

15.3 HOUSING COSTS

If the aim is that all households should be supplied with proper dwellings within the limitations presented by the household income, the following demands should be met: Annual housing costs (including land) should in general not exceed 15 per cent of the annual household income.

The average annual housing cost at an interest level of 10 per cent would be 14 per cent of the total construction cost and land calculated as follows:-

- seven per cent discounted interest
- two per cent maintenance
- five per cent payback = depreciation over 20 years.

The personal income available for consumption and housing is expected to increase by three per cent per annum in the years from 1970 to 1990; at the same time it is assumed that there will be 1.7 income earners per household. The number of employed per household in rural areas is expected to be two, but as average income will probably be somewhat lower in rural than in urban areas; the 1.7 factor is used in both cases.

The income distribution in 1970 has been estimated at:-

Income in \$ per year: Range	Average	Income distribution in per cent: Urban	Rural
Up to 3 500	2 000	40	70
3 500 - 7 000	5 500	35	30
7 000 - 12 000	9 000	20	-
Over 12 000	20 000	5	-

The 1990 income distribution is assumed to be:-

Income in \$ per year: Range	Average	Income distribution in per cent: Urban	Rural
Up to 5 500	3 500	40	70
5 500 12 000	9 500	35	30
12 000 - 21 000	15 000	20	-
Over 21 000	30 000	5	-

In the period from 1970 to 1990 the average incomes and their distribution will change gradually (interpolation).

On considering that the average households should be able to pay for their own housing it is relevant to calculate the average income in the different groups in the year 1980, and then let these figures represent the target figures for the housing costs and requirements. Thus the average incomes would be:

Average 1980	$ per year Per person	Per household
Low income	2 700	4 600
Lower middle income	7 300	12 400
Higher middle income	12 000	18 000
High income	27 000	32 000

The employment factor varies from the lower groups to the higher ones, therefore the number of income earners per household has been reduced to 1.5 in the higher middle income group and 1.2 in the higher income group. The possible variation in the tendency to spend differing proportions of the income for housing in different income groups has not been considered in this context.

The amount available in each household for housing purposes, and the corresponding construction and land costs are estimated as follows:-

	$ available for housing per year	Total cost of housing and land in $
Low income	700	5 000
Lower middle income	1 850	13 000
Higher middle income	2 700	19 000
High income	4 800	35 000

As mentioned the calculated figures are average figures. The specific need for different housing classes within the Study Area will depend on proposed development of rural and urban activities and their implementation. However, the average figures have been calculated in accordance with the general planning guidelines of the project, and the housing figures should be applied as general indicators where no more specific information is available.

15.4 HOUSING STANDARDS

The maximum cost level for different houses in different standard categories indicates the economic limits within which future housing needs must be covered. It does not however, describe the physical standard of the house types. This would require a thorough knowledge of construction cost and housing preferences which is not available in Sarawak today.

The main items which determine the house standards are:

- site (area and location)
- space (floor area)
- design
- materials
- facilities

- supply of public utilities
- length of life.

The extent to which these qualities can be supplied will depend on the economic limits for each house type, which in turn are determined by the income level and distribution.

The minimum requirements for a low cost house, the lowest standard, should be determined partly by traditional housing standards in Sarawak, and partly by the budget which limits the number of facilities which can be made available. Recommended minimum physical standards are as follows:-

Site: The housing area should be cleared and reasonably even, not prone to flooding or swamp vegetation. Access from a public road should be possible in a way that transport by motor car up to 150 feet from the house is possible. The size of the lot should correspond to the character of the house in a way that deficiencies in the house standard could be offset by reasonable land qualities.

Space: The floor area should be sufficient to give satisfactory living floor space for all dwellers in the household. By international standards this would mean at least 70 square feet per person. Traditional Sarawak standards are, however, far above this minimum. Within all community groups an average of 150 square feet could probably be assumed. If an average household in urban areas is 5.2 persons and in rural areas 5.6 persons the minimum would be 365 and 390 square feet respectively while local traditional standards would allow for 780 and 840 square feet respectively.

Design: The design of the house should satisfy basic sociological demands from all community groups. Possibility separation of women and men's living rooms, separate bedroom facilities, covered and yet ventilated kitchen, and a general layout which gives satisfactory protection from rain and heat.

Materials: The materials used should be durable maintaining their qualities throughout the life time of the house. No special finish in construction and use of materials will be required, but the choice of materials should satisfy basic requirements as to weather protection.

Facilities: Water should be available for the household either by metered individual connection from mains, or from a roof catchment with tank. Electricity supply is not a basic requirement.

Washing facilities should be available in the house or in a protected place close to the house. The toilet should be either a separate latrine (pit) or situated in the house where acceptable sewerage is available.

Length of life: The length of life of the house will naturally depend on materials and costs. For immediate schemes that aim at a solution of urgent housing problems, an average life of 20 to 25 years is considered to be realistic. In urban areas with tendency towards more permanent housing, particularly storied buildings, a 40 to 50 year life is assumed.

The future assessment of detailed standard requirements, both for low cost and high income houses, will however only be possible after a specific analysis of different requirements have been undertaken, including their economic evaluation and realisation.

APPENDIX I

APPENDIX I
CALCULATION BASES

I1 AREA REQUIREMENT STANDARDS

a) Parking Lots

Lorry	- 10 feet by 20	= 200	square feet
Car	- 16 feet by 8	= 128	square feet
Bicycle	- 6 feet by 1.5	= 9	square feet

b) Office Space User (Gross Area)

Clerks and executive group	- 12 feet by 10 = 120 square feet
Typist	- 6 feet by 10 = 60 square feet
Toilets, lobbies and stores, stairways etc.	- 20 per cent of gross floor area of office building

c) Road Reserves and Open Space - 33 per cent of the built over area

d) Housing - Government Quarters (gross floor area)

Class II - 2 800 square feet per unit
Class III - 1 400 square feet per unit
Class IV - 1 300 square feet per unit

I2 COSTS

a) Parking Lots

1 Car Parking Lot with Shed (Paved)	- $530 or $4.15 per square foot
1 Car Parking Lot with no Shed (Unpaved)	- $190 or $1.50 per square foot

b) Road access constructed to gravel road Standard for use of light vehicles - $1.50 per square foot

c) Government Buildings - Concrete - Ranging from $13 to $20 per square foot depending on location and type of building

d) Furniture - Office

1 Table	- $80 per unit
1 Chair	- $20 per unit

e) Office Equipment

Typewriter (18 inches)	- $ 400 per unit
Safe	- $ 600 per unit
Table Calculator	- $ 200 per unit
Duplicating Machine	- $ 1 200 per unit
Filing Cabinet	- $ 600 per unit
Air Conditioner	- $ 1 100 per unit
Air Conditioning Plant	- $50 000 per unit

f) Vehicles

Land Rover	- $15 000 per unit
Land Rover (Firefly) Fire Engine	- $36 000 per unit
Heavy Motor Cycle	- 2 500 per unit

g) Quarters

Class II	- $60 000 per unit
Class III	- $35 000 per unit
Class IV	- $20 000 per unit

h) Miscellaneous items

Flag pole for Government Office	- $500 per unit
Fencing	- $ 8 per linear foot
Contingencies	- Calculated at 3 per cent to 5 per cent of total building cost
Maintenance of buildings	- Calculated at 2 per cent of investment cost

Note: Transport and equipment costs are assumed to be free of customs duty and sales tax.

I.3 AGE GROUP PROPORTIONS PER THOUSAND POPULATION

I.3.1 Proportion of 6 to 11 Age Group Per Thousand

Planning Unit	Sub Unit	Age group 6-11	Total population	Age group 6-11/1 000 population
Baram	Bakong Marudi Long Lama	1 065 1 848 1 949	5 923 9 912 11 985	180 186 163
Total		4 862	27 820	(175)
Bintulu	Bintulu/ Similajau Kemena	2 381 2 629	13 332 14 441	165 182
Total		5 010	27 773	(180)
Miri	Miri North Sibuti Niah Suai	5 902 1 793 1 947	35 707 10 424 11 578	165 172 168
Total		9 642	57 709	(167)
Grand Total		19 514	113 302	(172)

Source: 1970 Census, Preliminary Data.

I.3.2 Proportion of 12 to 14 Age Group Per Thousand

Planning Unit	Sub Unit	Age group 12-14	Total population	Age group 12-14/1 000 population
Baram	Bakong Marudi Long Lama	328 813 683	5 923 9 912 11 985	55 82 57
Total		1 824	27 820	(66)
Bintulu	Bintulu/ Similajau Kemena	1 076 860	13 332 14 441	81 60
Total		1 936	27 773	(70)
Miri	Miri North Sibuti Niah Suai	2 934 717 723	35 707 10 424 11 578	82 69 62
Total		4 374	57 709	(76)
Grand Total		8 134	113 302	(72)

Source: 1970 Census, Preliminary Data.

I.3.3 Proportion of 15 to 16 Age Group

Planning Unit	Sub Unit	Age group 15-16	Total population	Age group 15-16/1 000 population
Baram	Bakong Marudi Long Lama	218 489 416	5 923 9 912 11 985	37 49 35
Total		1 123	27 820	(40)
Bintulu	Bintulu/ Similajau Kemena	636 456	13 332 14 441	48 32
Total		1 092	27 773	(39)
Miri	Miri North Sibuti Niah Suai	1 811 418 451	35 707 10 424 11 578	51 40 39
Total		2 680	57 709	(46)
Grand Total		4 895	113 302	(43)

Source: 1970 Census, Preliminary Data.

I.4 DETAILED CLASSIFICATION OF STAFF

I.3.1 District Health Centre

Supervisory Staff

Medical Officer of Health	1
Medical Officer	6
Dental Officer (1 will be the District Dental Officer)	3
Senior Health Inspector	1
Senior Hospital Assistant	1
Health Sister	1
Senior Dispenser	1
Senior Laboratory Technician	1
Malaria Technician	1
General Sister	2
Dental Sister	1

Service Staff

Health Inspector	1
Health Visitor	1
Senior Rural Health Supervisor	1
Rural Health Supervisors	2
Dispensers	2
Radiographers	2
X-ray Developers	2

Service Staff (Cont'd)

Hospital Assistant	2
Dental Mechanic	1
Hospital Assistant (Anaesthesia)	2
Dental Surgery Assistant	3
Senior Assistant Nurse	2
Senior Midwife	2
Laboratory Technician	2
Junior Laboratory Technician	2
Squad Leader	2
Anti-malaria Worker	6
Junior Hospital Assistant	1
Nurse	20
Assistant Nurse	38
Midwife	10
Ward Receptionist	8

Clerical Staff

Senior Clerk	1
Clerk	3
Clerk/Typist	2
Typist	2
Office Boy	2

Other Non-Technical Staff

Ambulance Driver (2 ambulances - 24 hours coverage)	7
Driver	4
Boatman/Driver	4
Senior Attendant	2
Attendant: (60)	
Ward	23
Porterage	6
Operating Theatre, X-ray, and Laboratory	3
Clinic Area	6
Kitchen	4
Laundry	6
Nurses' Hostel	8
Relief	4
Chief Cook	1
Cook:	9
Muslim	4
Non-Muslim	4
Relief	1
Seamstresses	2
Telephone Operator	4
Electrician	1
Mechanic	1
Gardener	2

I.3.2 Health Sub-Centre

Senior Hospital Assistant - supervisory staff	1
Dental Nurse - supervisory staff	1

Health Inspector	- supervisory staff	1
Public Health Nurse	- supervisory staff	1
Hospital Assistant	- service staff	1
Junior Hospital Assistant	- service staff	1
Rural Health Supervisor (Senior Grade)	- service staff	1
Rural Health Supervisor (Time Scale)	- service staff	1
Senior Midwife	- service staff	1
Midwife	- service staff	
Junior Laboratory Technician	- service staff	1
Clerical Assistant	- service staff	1
Sanitary Labourer	- service staff	1
Attendant	- domestic staff	2
Boatman/Vehicle Driver	- domestic staff	3

I.4.2 Community Health Centre

Junior Hospital Assistant	2
Midwife	2
Rural Health Supervisor	1
Sanitary Labourer	1
Attendant	2
Driver/Boatman	2

I.5 REFERENCES

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APPENDIX II

APPENDIX II

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APPENDIX III

APPENDIX III

III.1 WATER CONSUMPTION CALCULATIONS

A. MIRI

Sales: (million galls)	1972 whole year		1973 1.1 to 31.8 (243 days)	
Domestic	186.6		140.6	
Domestic/Commercial	17.4		13.8	
Others	60.0		73.5	
Total sales	264.0		227.9	
Total output	381.2		304.8	
Sales as % of output	69%		75%	
Consumption per head: Population served*	Domestic (ghd)	Total (ghd)	Domestic (ghd)	Total (ghd)
assume 21 000	24	34	-	-
assume 25 000	20	29	23	37
assume 28 000	-	-	21	33
mean	22	32	22	35

* The actual population served can be assumed to lie between the two figures given. PWD estimate 21 000 for 1971.

B. KUCHING

Sales: (million galls/month)	1970		1971	
Domestic	70.7		75.1	
deduct large users	8.1		8.3	
add 2/3 of Domestic/Commercial	8.4		8.6	
assumed true domestic users	71.0		75.4	
Total consumption	137.8		148.2	
No. of Consumers				
Domestic	9 437		10 165	
deduct large users	157		164	
add 2/3 of Domestic/Commercial	850		931	
assumed true domestic users	10 130		10 932	
assumed average household*	8.9		8.9	
domestic population served by meters	90 157		97 294	
Total population served	say 120 000		130 000	
Consumption per head	Domestic (ghd)	Total (ghd)	Domestic (ghd)	Total (ghd)
population served by meters	26	50	25	50
Total population served	-	38	-	37

* Household size estimated from KMC figures in 1970 Census: population 64 750, divided by number of living quarters 7 271. This relationship assumed to apply to whole KWB area.

III.2 ELECTRICITY TARIFFS*

CLASS II

Applicable to: Siburan, Beratok, Tapah, Lundu, Bau, Serian, Betong, Simanggang, Sarikei, Binatang, Kanowit, Kapit, Mukah, Miri, Bintulu, Marudi and Limbang.

A. Lighting and Fans

35 cents per unit
Minimum charge $2.00 per month

Private dwelling premises having no outlet sockets and using energy for lighting and fans only.

B. Combined Domestic

for lighting, fans, cooking, heating, refrigeration, air-conditioning etc. (i.e. all domestic uses)

First 30 units per month: 35 cents per unit
Next 30 units per month: 22 cents per unit
Above 60 units per month: 14 cents per unit

Minimum charge $6.00 per month.

C. Commercial

electricity used in business premises including shops, factories, offices, hospitals, clubs, schools, broadcasting, telecommunications etc.

for lighting and fans, air-conditioning, cooking, heating, refrigeration, water heating, domestic appliances, medical apparatus and small motors etc.

First 50 units per month: 30 cents per unit
Next 4 950 units per month: 16 cents per unit
Above 5 000 units per month: 14 cents per unit

Minimum charge $6.00 per month

D. Industrial

electricity used for industrial purposes and manufacturing processes including lighting and fans

First 1 500 units per month: 16 cents per unit
Next 3 500 units per month: 13 cents per unit
Above 5 000 units per month: 11 cents per unit

For industrial premises where the total wattage of lamps installed exceeds 20 per cent total wattage of all electrical equipment installed tariff charges will be as for commercial premises.

The Corporation reserves the right to restrict use in cases of emergency.

Minimum charge $6.00 per month.

E. Cinemas and Theatres

First 1 000 units per month: 35 cents per unit
Next 1 500 units per month: 17 cents per unit
Next 3 500 units per month: 14 cents per unit
Above 6 000 units per month: 11 cents per unit

E. Cinemas and Theatres (Cont'd)

Minimum charge $6.00 per month

F. Street Lighting

Inclusive of all maintenance charges: 33 cents per unit

Minimum charge $6.00 per month

G. Forces Tariff

Applicable to Security Forces installations with single point bulk metering for all electricity consumption

First	1 000 units per month:	35 cents per unit
Next	50 000 units per month:	17 cents per unit
Above	51 000 units per month:	14 cents per unit

Minimum charge $6.00 per month

* This is an abbreviated extract from SESCO "Schedule of Tariffs for the Supply of Electrical Energy" dated February 1970.

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