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Homboy Irrigated Settlement Project

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Volume 2 Physical Planning

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Introduction

The Homboy Scheme is a large and complex development. In addition to extensive civil works the lives of more than 25,000 settlers presently residing at Dujuuma and over 8,000 local residents within the project area will be deeply affected. The physical planning necessary to ensure a smooth yet rapid development, while at the same time, minimising hardship and unnecessary disturbance, has been studied in detail, and our proposals are presented in this volume. Parts 1, 2, 3 and 4 cover the important aspects of villagisation, the relocation of the settlers and the infrastructure necessary to support both the domestic and scheme management requirements. A summary of costs is also included. The Annex describes the main construction works and again costs are included.

The overall planning concept is one of a series of complementary programmes, based upon the civil works construction programme. They are designed to provide:

(a) The bringing into production of irrigated land as soon as in field works are complete and water available.

(b) Sufficient labour to meet the needs of civil works construction, village building, infrastructure and irrigated agriculture.

(c) The timely provision of staff and settler housing.

Part 1
Villagisation

1.1 INTRODUCTION

This section describes the provision of dwellings, social services and engineering infrastructure for 8,850 families, distributed in 10 villages integrated within the general irrigation scheme. Since it is part of a larger study, it makes reference to other related volumes and reports on certain topics to avoid duplication:

(i) Project background and existing site conditions are described in the earlier Reconnaissance Report.

(ii) Demography, social conditions, labour, scheduling, mobilisation, relocation from Dujuuma, training, and implementation are the subjects of the Part 2 of this Volume, Relocation.

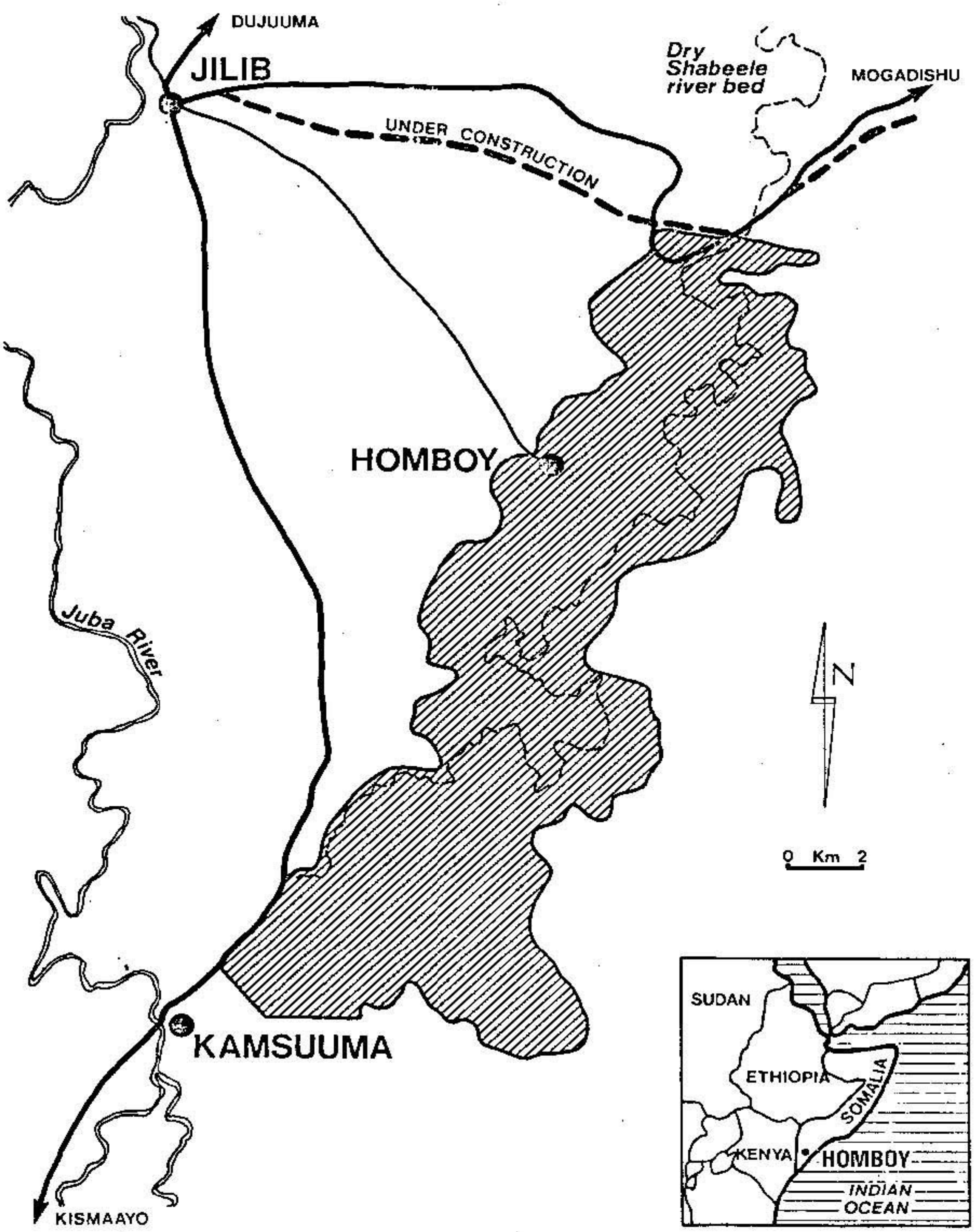
With the exception of two major sources, the USAID report on the pilot project for Kurtunwaare, and the DHV/Dutch report for Sablaale, there is almost no documentation for Somalia of data or policy in the field of community development and housing. Primary data was obtained by visiting the project area, and field offices of Sablaale, Kurtunwaare (where two prototype houses have been built) and the Juba Sugar Plantation. Although recorded data was scarce, the cooperation of government officials, private citizens and consultants was invaluable and essential in assembling whatever data was available from these sources.

1.2 REGIONAL CONTEXT

The site of the irrigation project, illustrated in Figure1.1,follows the dry river bed of the Shabeelle River, forming a triangle with the Mogadishu-Jilib and Jilib-Kismaayu national highways. The Mogadishu-Jilib road, in the process of being upgraded, will provide the project with rapid all weather communications with Jilib, the regional centre. The main all-weather agricultural road which runs along the western border of the project, providing internal access to the site, will create a useful shortcut for traffic destined for Kismayu not wishing to divert through Jilib. The alignment of the project road has been smoothed to facilitate such inter-regional traffic flow, and it is suggested that some cost sharing with the national highway budget should be considered.

During project inception, the first residents will be obliged to obtain some social services in Jilib. Existing facilities are presented below. Plans exist to build a new 300 bed hospital for the region, which may be located either in Jilib or near Homboy (under an independent programme).

1.1 Location of Study Area



Existing Social Services in Jilib (pop. c. 10,000):

District and Municipal Offices	Orientation Centre
Ministry of Agriculture	Post Office and Radio Telephone
Ministry of Finance	Bank
Ministry of Education	Police Headquarters
Ministry of Health	Rest House
Anti-Malaria Office	Hotels (3)
Veterinarian's Office	Petrol Station
Crash Programme Office	State Insurance Office
Labour Inspector's Officer	ONAT (State heavy vehicle rental and rice mill)
Primary Schools	ADC (State grain stores)
Intermediate Schools	Markets (3- meat, milk and vegetables/fruit)
Secondary Schools	Bus Station
Hospital (25 bed)	Private corn mills (5) sim sim mills (7)
Main Mosques (2)	

The existing village of Homboy was chosen as the most appropriate site for the project's main village as despite its off-centre location the advantages behind its selection were considered to be overwhelming:

First, Homboy is the service centre of an extensive hinterland of nomadic groups who travel to Homboy rather than Jilib for trading purposes. Secondly, Homboy has an efficient leadership which has been consolidating nearby villages so that services can be more easily provided. For these two reasons Homboy is already a natural growth centre for the region, and its selection would not only enable these services to continue but also diminish the risk of choosing an unviable location. Thirdly, the only area of beach remnant soil sufficiently large to accommodate the main village functions is located 0.5 km from Homboy.

Finally, however, the greatest advantage of Homboy lies in its ability to provide support and guidance to the first groups of settlers arriving from Dujuuma, who are likely to be nomads unversed in the skills of farming and construction and unfamiliar with local conditions. If the presence of Homboy is not thus exploited, an equivalent reception centre will have to be built in any event, and the mobilisation period for training programmes will be correspondingly extended.

1.3 COMMUNITY PLAN AND SITE SELECTION

Given the constraints of agricultural management and village size, it was decided to establish a village hierarchy consisting of one main village, Homboy, accommodating central services, and nine other villages which would be self-sufficient in most daily activities. Homboy itself would not be much larger than these villages in population, as it too would be an agricultural village commanding a normal irrigation block and requiring only a small additional population to maintain central services.

Criteria used in site selection were:

(i) Walking distance from village to fields was not to exceed 3 kilometres for the majority of villagers.

(ii) Length of roads and numbers of bridges were to be minimised.

(iii) Use of irrigated land for roads and villages was to be avoided.

(iv) Villages were to be located wher ever possible on soils of good bearing capacity.

The determinants behind the site selection criteria are as follows:

(i) Villages located on the Marine Plain outside the eastern bounds of the project will require a bridge costing roughly SoSh 150 - 210,000.

(ii) Areas with Marine Plain Soils, Beach Remnant Soils, and unirrigable alluvial soils (ie. hummocks etc) have almost no opportunity cost. Irrigated alluvial soils used for housing purposes would have a very high opportunity cost; the capital cost of irrigation would still have to be paid although crop income would be forgone.

(iii) Marine Plain Soils are of the grey expansive variety notorious for their unstable bearing qualities. During the rainy season they swell up and over a number of years can severely crack permanent structures and entirely destroy lightweight construction. Assuming the cost of a reinforced grade beam and augered pile foundation to be 3,000 shillings per dwelling, the net additional cost of foundations in these soils would increase the cost of the improved Arish housing alternative by roughly 35 per cent. Alluvial soils are considered to be next best from among the available choices, and Beach Remnant Soils relatively the best, although even these are not likely to be ideal for construction. Nevertheless it is noted that local villages such as Homboy tend to locate quite deliberately on these Beach Remnant Soils because in relative terms they drain well and do not swell excessively.

Three alternative concepts for the community plan are illustrated in Figure 1.2:

(a) A central line of villages paralleling the main supply canal.

(b) A line of villages along a main road running down the western border of the scheme.

(c) Villages on both sides of the scheme, with a main western road and spur roads serving villages on the eastern side.

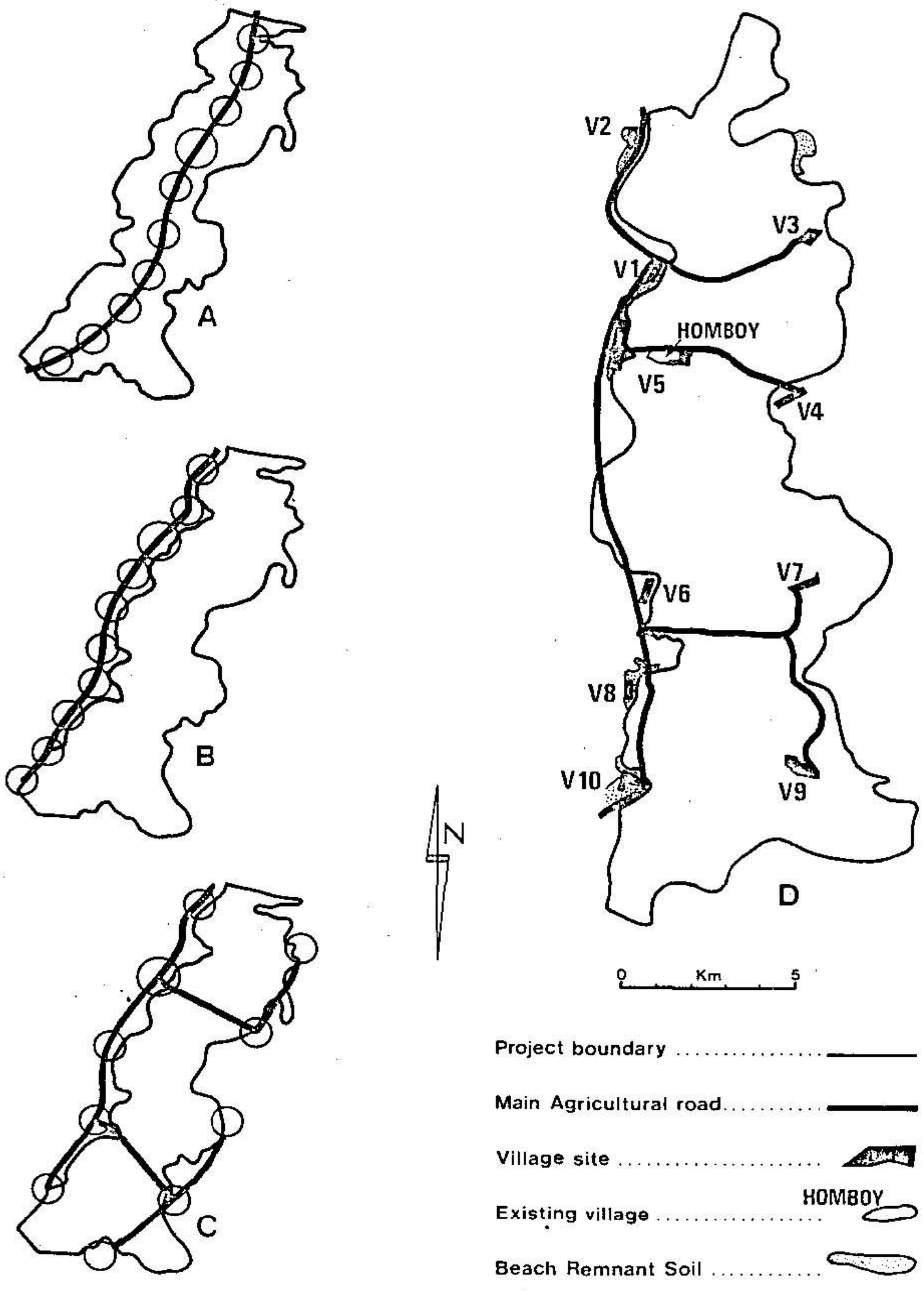
A fourth alternative, involving the same location of villages as in (c) but with a peripheral road surrounding the scheme, was disregarded as having no special advantages over (c) but much greater length of roads.

The three alternative community concept plans were evaluated using the site selection criteria described earlier:

Alternative (a) was eliminated because it would consume 250 ha of irrigated land and placed all villages on the soil of only second best foundation capacity (alluvium).

Alternative (b) had one major fault in increasing walking distance to an unacceptable 6 km, and also had too many villages on the western border to accommodate all on Beach Remnant Soils.

1.2 Community Plan



Alternative (c) presented difficulties where the eastern villages had either to be built on marine plain soils, with a bridge, or on alluvial soils consuming irrigated land. However, when it was determined that 3 of the 4 eastern villages could be located on sites which could not in any event be brought under the command of irrigation (ie. they had no opportunity cost and would not require bridges) this concept plan was adopted as the preferable alternative.

Drawing 2d illustrates how the community plan was designed in detail and integrated within the irrigation layouts using the preferred concept plan as a framework. The final plan has an all weather road running down the western border of the scheme providing access to villages 1, 2, 5, 6, 8 and 10, two all weather spur roads serving villages 3 and 4, and one spur serving villages 7 and 9.

General specifications for the villages are as follows:

Village	Dwellings	Area (ha) Min[1]	Area (ha) Max[2]	Soil	Form
1	600	21.3	28.6	Beach Remnant	Linear
2	825	29.3	39.3	Beach Remnant	Linear
3	700	28.2	33.4	Alluvium	Rectangular
4	925	32.8	44.1	Marine Plain	Linear
5	1,025	41.3	48.8	Beach Remnant	(existing)
6	800	28.4	38.4	Marine Plain	Linear
7	1,125	39.9	53.6	Alluvium	Linear
8	575	20.4	27.4	Beach Remnant	Linear
9	1,525	54.1	72.7	Alluvium	Irregular
10	750	26.6	35.7	Beach Remnant	Irregular
Totals	**8,850**	**322.3**	**422.0**		

Notes: 1 based on Udud design as illustrated in Figure 6(a).
2 based on Udud design as illustrated in Figure 6(b).

The three villages within the irrigated scheme are located on sites which cannot be brought under the command of the irrigation scheme economically. Two villages are unavoidably located on Marine Plain Soils and will require special foundations, and one located on the eastern Marine Plain will require a bridge.

1.4 THE MAIN VILLAGE OF HOMBOY

Discussions with officials and villagers at Homboy indicate that residents wish to remain in their present location, but would prefer new houses to an upgrading programme even if this causes some disruption to their lives. As the existing houses are of temporary construction this approach is recommended.

Table 1.1, based upon interviews with Homboy officials and site inspection summarises existing services within the village, their present condition, and shortfalls in provision according to this report's recommendations for village services presented in Table 1.3. There is little engineering infrastructure in Homboy at present: 4 wells, no all-weather roads or drainage, and no electricity. Most villagers must use the bush for hygenic purposes; only a few homes have privvies.

Figure 1.3 is a sketch map of existing conditions in Homboy, showing approximate locations of crops, vacant land, residential uses and major social services.

1.3 Homboy : Existing conditions

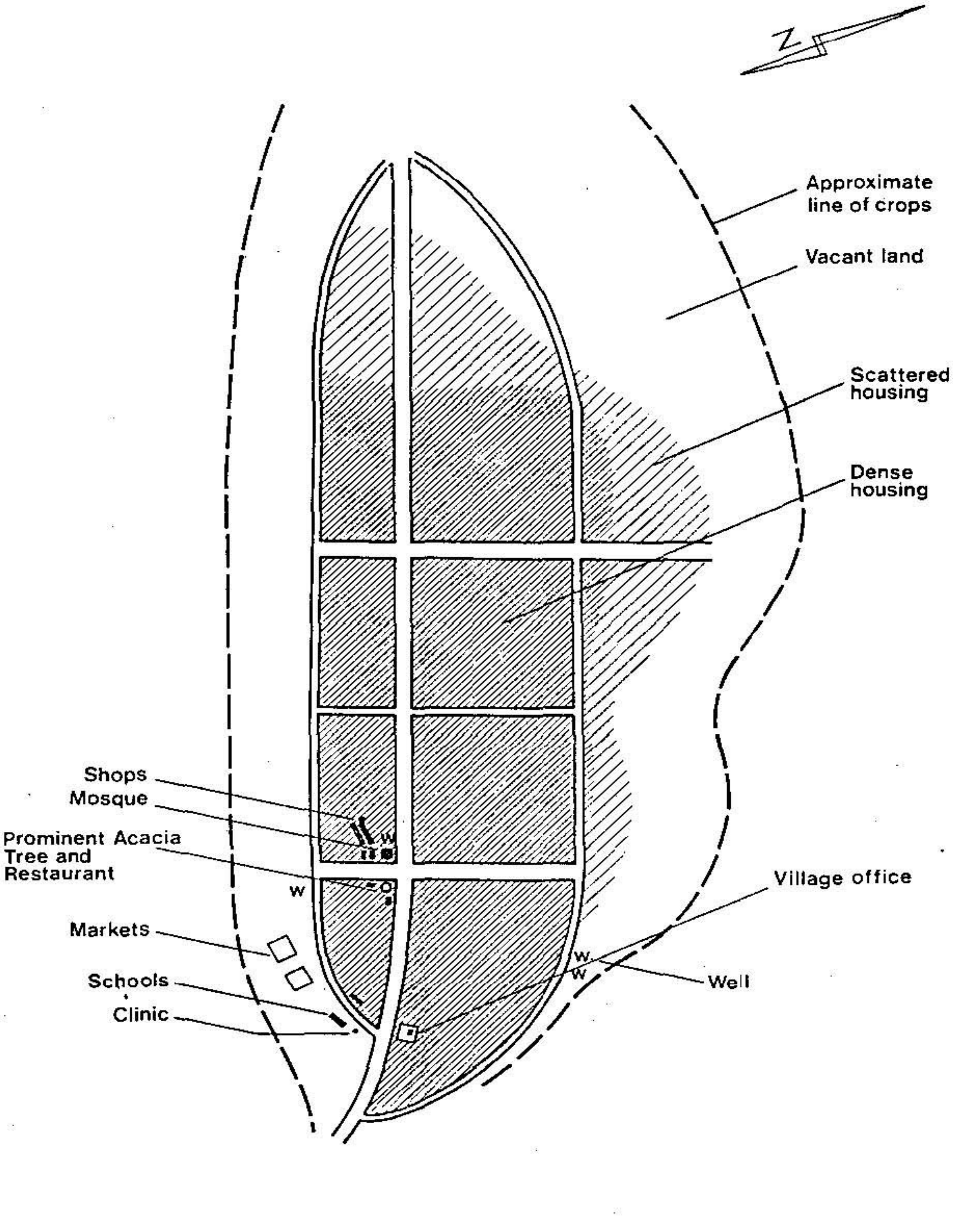


TABLE 1.1 HOMBOY: EXISTING AND REQUIRED SOCIAL SERVICES FOR VILLAGE SUPPORT

Land Use	Existing	Condition	Building Area Required (m^2)	Building Area Shortfall (m^2)	Comments
Administration	1 office	Permanent structure good condition	100	100	Rebuild entire administration block on same site
Police	1 office	- na -	incl. above	-	To be included in new administration block
Primary School Intermediate School	5 classrooms 1 classroom	Permanent structures good condition	750	360	Retain existing, make addi-on same site 4 classrooms @ 65 m^2 plus support
Clinic	2 rooms	Permanent structure good condition	75	55	Retain existing, make additions on same site 4 rooms @ 10m^2 plus support
Mosques	2	Permanent structure acceptable condition	135	-	
Meat Market Veg. Market	1 1	Permanent structure good condition	- na -	200	Rebuild entirely on same site when justified by volume of trade
Restaurants	5	- na -	-	-	
Shops	12	- na -	50	-	
Maize Stores (ADC)	1	- na -			
Staff Housing	- na -	- na -	240	240	8 plots in residential area

* Does not include services required for the entire project which are to be located in the nearby main village precinct. To avoid duplication Homboy village should share the use of the following services in the main area: orientation centre, sports facilities, machine parking.

The schedule for Homboy outlined in the Part 2 Relocation requires that approximately 300 houses be built in Homboy for settlers from Dujuuma. Figure 1.4 presents data from the engineering surveys indicating that the 17 m contour is the nominal limit of both existing built up areas and Beach Remnant Soils. This corresponds roughly with the approximate line of crops shown in Figure 1.3. It is therefore concluded that space for approximately 400 new houses on 220 m^2 plots is available to the north of Homboy, or 330 houses if only the rectangular block shown in Figure 1.4 is developed.

Table 1.2 describes the social services required in the main village centre, and Figure 1.4 presents the concept plan for Homboy's future development. A block of new housing will be developed in the north of Homboy for new settlers from Dujuuma and any few Homboy residents who might be displaced by new development. Existing and upgraded commercial facilities will reinforce Homboy's present function as a trading centre. Direct links to the adjacent all weather agricultural roads will improve access to this regional market area while keeping traffic out of the residential sections. This same area is also suitable for the new primary and intermediate educational facilities as it will be located equidistant to new housing in Homboy and New Aminow, and the existing housing in New Amino itself.

The main village precinct is divided into four zones of compatible uses: a special uses zone, containing secondary school, vocational school and hospital (if it is decided to locate this facility in Homboy) whose common requirements are good access, separation from inhabited areas and room for expansion; a public and administrative zone, also with good access and room for expansion; a residential zone near New Aminow for staff and teachers; and a utility zone containing machine parking and agricultural uses which must be separated from other areas because of noise and traffic nuisance. This is illustrated in Part 4, Infrastructure, Figure 4-5. This zone can expand in two directions, preferably northward on the continuous strip of beach remnant soil reaching all the way to village 2 and the new Mogadishu-Jilib highway, providing good access, ample land and separation from residential areas. In general the main village precinct provides good access to major services without creating congestion within the existing village of Homboy.

1.5 VILLAGE DESIGN

Criteria for village design were:

(i) Accommodate the administrative hierarchy of Beel, Bulsho, Birjeex, Udud and Xubin containing 400, 200, 100, 50 and 10 families respectively through the grouping of houses around common spaces.

(ii) Provide adequate and properly zoned space for social services and engineering infrastructure.

(iii) Organise circulation to emphasise pedestrian access while ensuring that no house is further than 100 m from a vehicular road, and preventing through traffic from the main agricultural roads.

1.4 Homboy Concept Plan

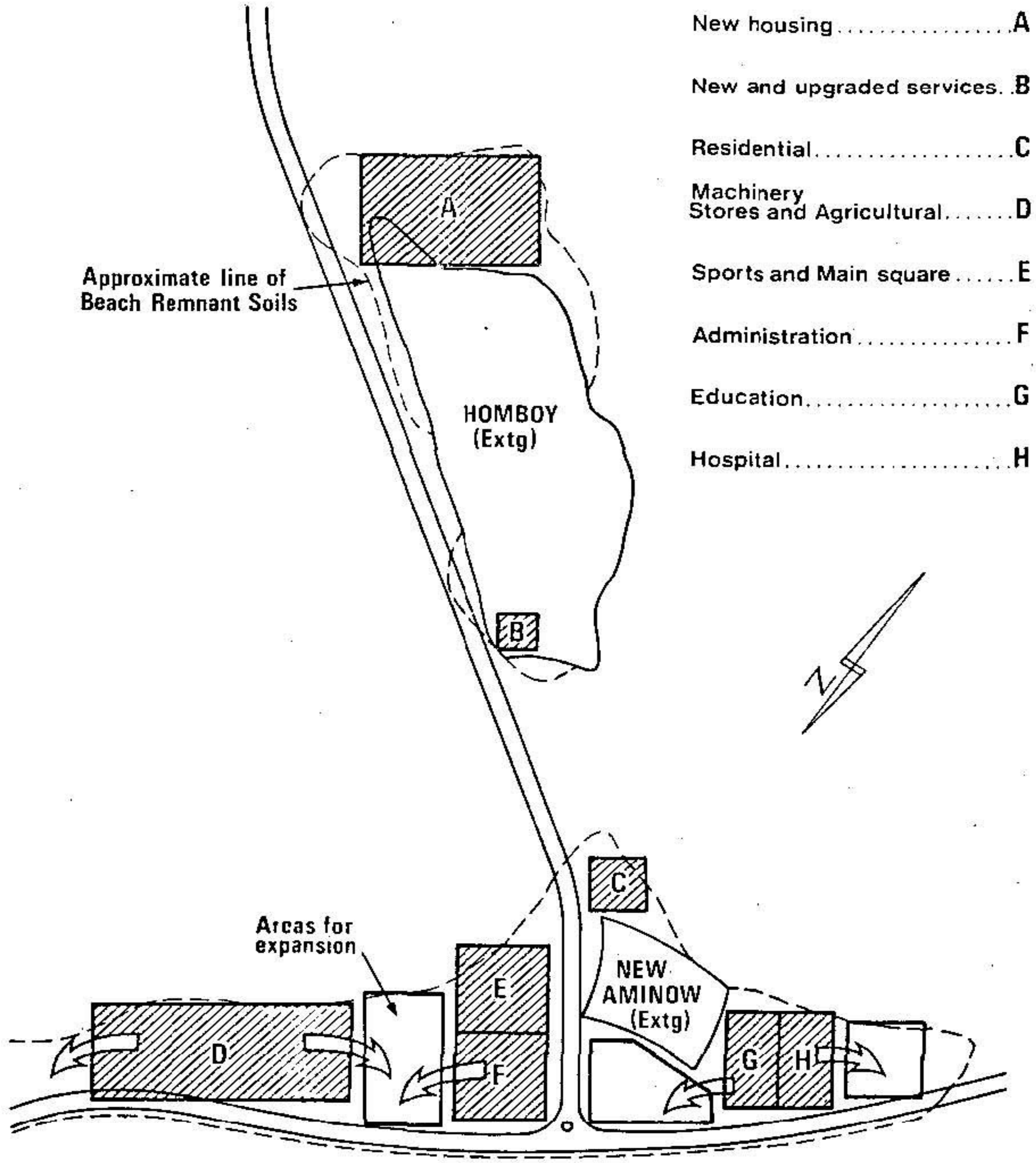


TABLE 1.2 HOMBOY: SPACE REQUIREMENTS OF SOCIAL SERVICES REQUIRED FOR PROJECT SUPPORT

Land Use	Zone	Area (m^2)	Zone (m^2)
Main square	I	10,000	
Administration, post office & guesthouse	I	11,250	
Orientation centre	I	9,600	
Police headquarters	I	4,800	
Sports area	I	45,000	
Zone I Sub Total			**80,650**
Workshop, garage and machine parking	II	75,375	
Stores	II	22,500	
Fire station	II	16,000	
Petrol station	II	3,600	
Zone II Sub Total			**117,475**
Hospital	III	20,000	
Secondary school	III	8,000	
Vocational training school	III	18,400	
Zone III Sub Total			**46,400**
Staff housing	IV	14,400	
Zone IV Sub Total			**14,400**
Total			**258,925**

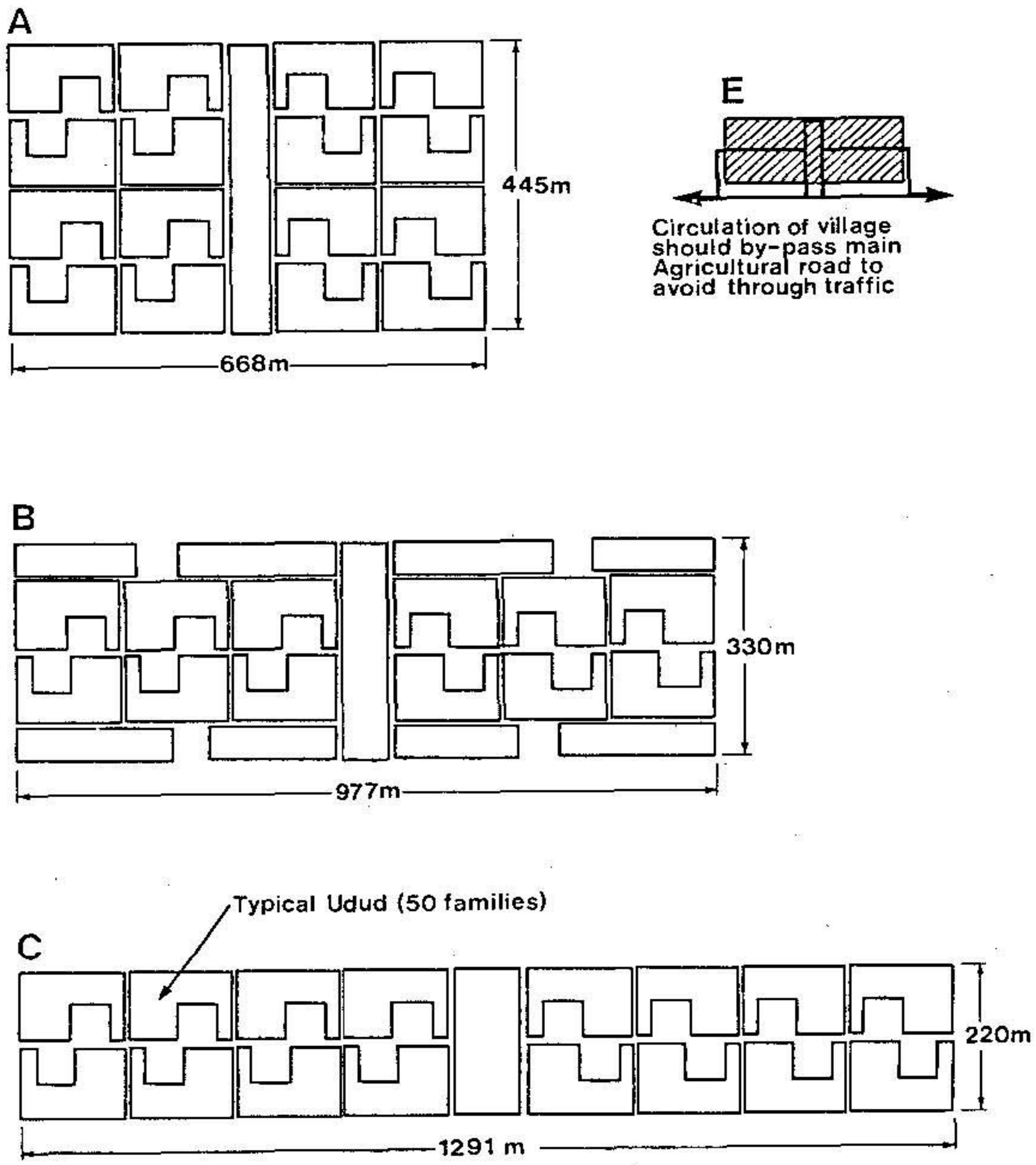
(iv) Subdivide in a simple and repetitive fashion and plan within a modular framework to permit replicability.

The social services required for a village of 800 families are presented inTable 1.3 (provision for larger or smaller villages should be adjusted accordingly).

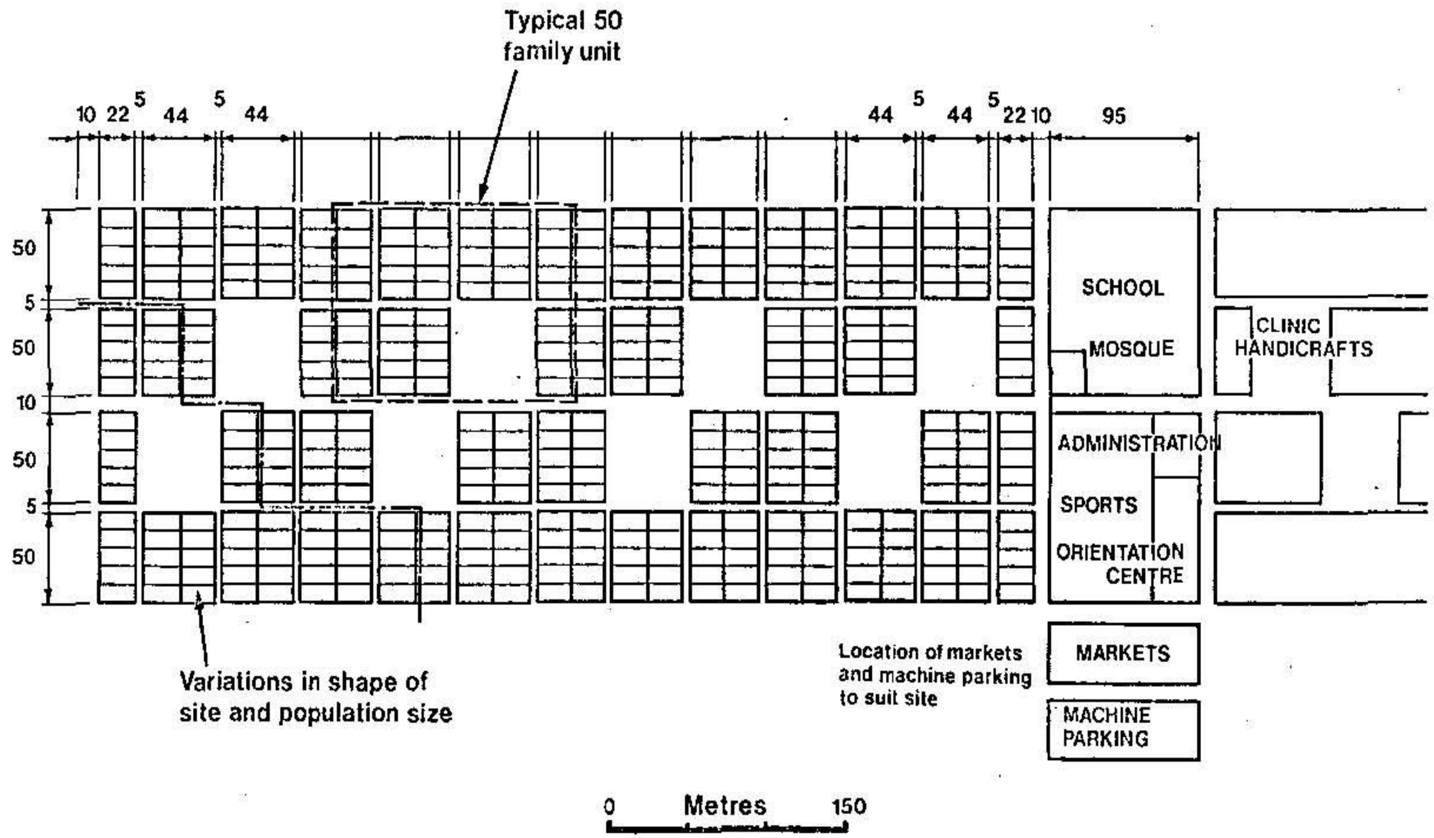
The provision of social services, particularly those leading to personal development, are the most important objectives of the community plan. Since land of low opportunity cost is available, uses requiring only land can be provided freely. Uses which require buildings have been reduced to the minimum, and it is therefore suggested that if savings are required in the total budget, other areas of the community plan such as housing and engineering services should be scrutinised first. The cost analyses accompanying the report use prices reflecting the recommendation that permanent construction be used for all public buildings.

Space organisation of the village centre, as illustrated in Figure 1.5d emphasises the relationship between government, education, recreation and worship. Location of the market and machine parking are only diagrammatic; final placement should depend upon circulation and any chance opportunities presented by site irregularities. Staff and teacher housing should be located adjacent to the residential area of New Aminow. A few public uses can be located in the Udud open space, which will also provide a reserve of space for future services. Housing lots located adjacent to the village centre should be reversed so that houses front on the main square, and this row of houses should be zoned to permit residents to open restaurants and shops.

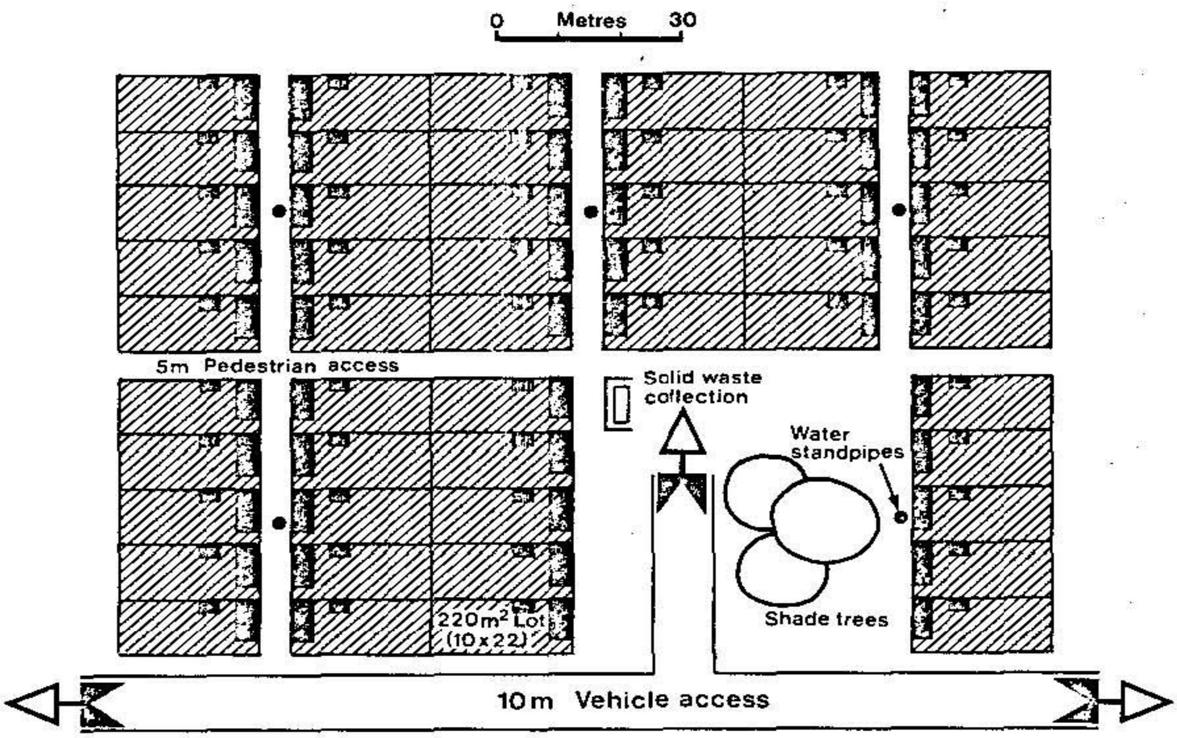
1.5a,b,c,e Village layout



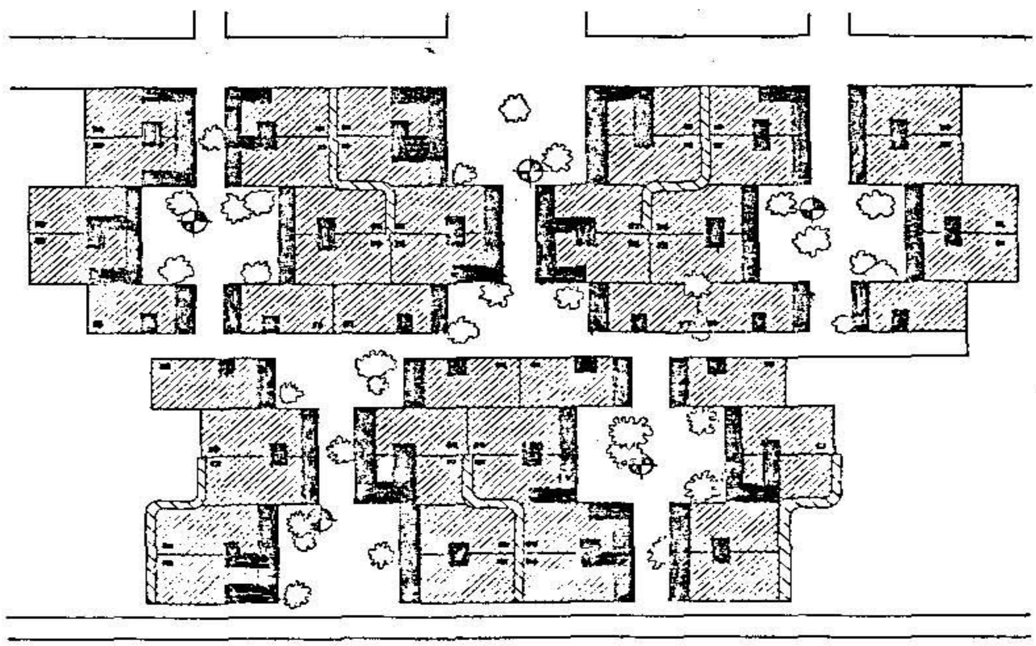
1.5d Village layout (typical Beel 400 families)



1.6a Udud Design (50 families)



1.6b Alternative Udud design



The main objectives of the village plan (Figure 1.5d) are simplicity and modular repetition, necessary to facilitate the adaptation of the prototypical village to different shaped sites and village sizes and simplify surveying in the field, thereby reducing the need for outside assistance during the first design and implementation stages.

The basic units of Udud (a 50 family group) and Beel (a 400 family neighbourhood) can be rearranged in three forms; linear, rectangular and square as illustrated in Figures 1.5a, 5b and 5c respectively. Wherever possible it is recommended that the linear form be adopted as it can substantially reduce walking distance to the fields without increasing them excessively within the village. The walking distance from the most extreme house in example 5a to the village centre is 700 m or roughly 9 minutes, and the majority walk far less. The linear design will also create a lesser apparent scale of development. In the more compact rectangular and square forms, walking distance is diminished accordingly. The rectangular design is created by modifying the shape of the perimeter Ududs into linear form so that the basic circulation scheme does not have to be altered. No house is further than 150 m from vehicular access in the perimeter Ududs only, and 100 m in the remainder of the village. The square design is a straightforward adaptation of the linear design, with slightly lengthier road requirements.

During the final design of villages, site irregularities and different sized populations will require that irregular borders and assymmetrical layouts be adopted. First, the appropriate generalised form should be chosen from Figures 1.5a, b and c. Then Beels, Ududs and Xubins can be added or subtracted to achieve the required population. Boundaries do not have to be regular, as illustrated in Figure 1.5d.

TABLE 1.3 SOCIAL SERVICES SPACE REQUIREMENTS FOR AN 800 FAMILY VILLAGE

Land Use	Site (m^2)	Building (m^2)	Comments
Administration	300	100	Includes police, extension services, etc.
Shop	100	50	
Health Clinic	270	75	
Stores	480	150	
Worship	300	135	
Teachers quarters	na	na	To be located within residential areas.
Orientation centre	1,800	20	Offices and open air assembly.
School	10,000	750	10 classrooms @ 65 m^2 and support.
Staff housing	1,760	240	To be located within residential areas. 8 @ 15 m^2 on 150 m^2 plots.
Sports area	6,500	-	
Workshops	200	50	Handicrafts.
Control kiosk	50	10	
Machine parking	2,500	-	Lengthy separation from residential.
Markets	2,500	200	2 @ 100. Separate from residential.
Total	**26,760**	**1,780**	
Burden per lot		2.25	

Costs for roads and drainage, and housing are included in later sections. Costs for social services are computed on the basis of the derived burden per dwelling of 2.25 m^2 (Table 1.3) and an assumption of 1.00 m^2 per dwelling for central services (Table 1.2). Cost per m^2 is based upon Alternative 1 of the housing analysis: permanent construction of Cinvaram-block and asbestos-cement roofing at SoSh 420/m^2 (Table 1.10).

The design of the Udud (Figure 1.6 a) places five Xubins (groups of 10 families) around a common open space served by the main village road. The assymetrical location of the open space is created by the need to have houses front on public squares to stimulate activity and provide security through overlook. Shade trees should be planted within this area to accommodate the traditional form of village gathering under a prominent tree. A location for one standpipe for every ten families is indicated. This should go on the site of the pathway with a drain and have a gravel soakaway. An alternative Udud design is shown at Figure 1.6(b) which allows more open spaces but a greater degree of privacy. The implication of total area required per village is shown in Section 1.3.

1.6 ENGINEERING INFRASTRUCTURE

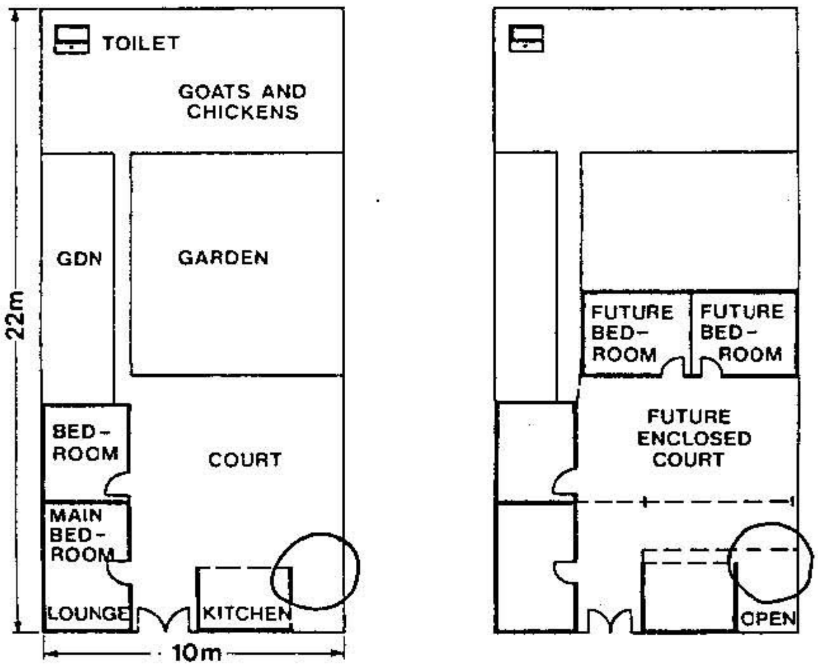
The levels of service for roads and drainage, water and electricity were determined by considering a range of alternatives for distribution only, as water and electrical supply were beyond the scope of villagisation study and the main agricultural roads linking villages were included in the irrigation works. Part 3 covers infrastructure in detail and roads are detailed in Volume 2 Annex .

The disposal of solid waste in this, a rural context, was not considered a problem of major dimensions. The rate of generation is low, since use of packaging is not widespread and that which does exist is usually carefully recycled: for example, packing tins are flattened as wall cladding, plastic sheet is used for waterproofing and wooden crates are made into furniture. Kitchen wastes are fed to the goats and can also be used to improve the functioning of the composting privvies. Any waste material that burns can be used as kitchen fuel. It is suggested, therefore, that for what little solid waste remains concrete collection bins be constructed in the corner of the Udud open space (Figure 1.6a) and the refuse trucked away to disposal points.

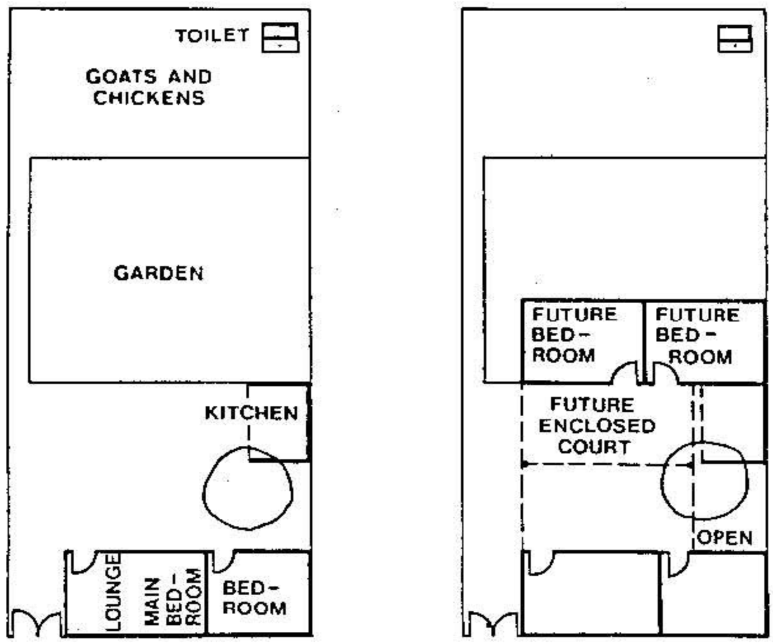
Alternatives for the removal of toilet wastes are quite limited and this study concurs with the two previous pilot schemes which recommend use of the vented composting type privvy. This consists of a vented dry pit partially lined with concrete, a squat plate, and a lightweight, lightproof enclosure. Each pit is used for approximately one year until it is three quarters full, with periodic addition of kitchen ashes and wastes to absorb odour and moisture. The pit is then topped up with earth and allowed to decompose for one

1.7 Alternative Plot Plans

TYPE A



TYPE B



year into an easily handled fertiliser. Odours and fly breeding are prevented by the vent pipe which is painted black and oriented toward the sun to create a draft. A screen inside the pipe traps flys flying toward the light, which eventually die. It is important to keep the enclosure lightproof, paint its interior black, and limit light penetration to a small hole in the door.

When the first pit is filled a new one should be dug and lined, and the lightweight superstructure can thereafter be moved from one pit to the other on an annual basis. Costs of the installation (first pit only) and superstructure are included within housing costs.

Alternatives for roads and drainage, water supply and electricity are as follows.

Roads and Drainage:

(a) Main roads: 10 m right-of-way, unlined drains both sides (one side only on sloping sites) concrete culverts, coral gravel surface.
Footpaths: 5 m right-of-way, unlined drain one side only, compacted earth surface. Drain crossings at individual plot by concrete plant.

(b) Main roads: as above, compacted earth replaces coral gravel surfacing.
Footpaths: as above.

Table 1.4 develops cost for the two alternatives (construction is assumed to be mechanised using spare capacity of project machinery), showing the cost per lot of roads and drainage to be SoSh 681 for Alternative (a) and SoSh 475 for Alternative (b).

Water Distribution:

Four alternatives were considered for water distribution:

(a) Individual Service

(b) One standpipe per 10 families

(c) One standpipe per 25 families

(d) One standpipe per 50 families

Water supply was not included in the cost estimates, but is expected to consist of a separate treatment plant for canal water, pump and storage tank for each village.

The reduction of walking distance to water points and the abundance of water supply take on a special significance in this project as a schistosomiasis risk exists in some parts of the country. Drinking water is therefore not the only consideration; if it is not convenient to carry water to homes or alternatively use communal washing facilities, residents will use the canals for these purposes, which would increase the infection rate if the disease were introduced.

Table 1.5 presents cost estimates for levels of service described above, which show that distribution alone will cost SoSh 1,220 per lot for Alternative (a), SoSh 350 for (b), SoSh 240 for (c) and SoSh 216 for (d). Water tank, pump and motor will add at least SoSh 200 per dwelling in foreign costs, and an allowance must still be made for treatment and engineering works.

TABLE 1.4 COST ESTIMATES OF ROADS AND DRAINAGE ALTERNATIVES FOR AN 800 FAMILY VILLAGE

Roads & Drainage	Unit	Quantity	Rate (SoSh)	Cost (SoSh) Alternative (a)	Alternative (b)
Excavate drains and form subgrade	m^3	1,500	12	18,000	18,000
Excavate foundations for pipe culverts	m^3	155	40	6,200	6,200
Supply, lay and joint spigot and socket concrete pipe and bedding of diameters ranging from 300-600 mm.	lin m	381	800	304,800	304,800
Supply, lay and compact 150 mm coral hardcore	m^3	750	250	187,500	
Pathways and Drainage					
Excavate drains and form grade	m^3	4,250	12	51,000	51,000
Total Cost				567,500	380,000
Cost per lot				710	475

TABLE 1.5COST ESTIMATES OF WATER DISTRIBUTION ALTERNATIVES FOR AN 800 DWELLING VILLAGE

Material	Rate	Alternative A		Alternative B		Alternative C		Alternative D	
	(SoSh)	Qty		Qty	(SoSh)	Qty	(SoSh)	Qty	(SoSh)
100 mm dia UPVC pipe	41	3,230	133,840	2,650	109,816	2,650	109,816	2,650	109,816
50 m dia 6 MS pipe	42	4,600	195,132						
20 km dia 6MS pipe	14	6,400	86,912	2,400	32,592	160	2,170	80	1,092
100 x 100 UPVC tee	560	5	2,800	1	560	1	560	1	560
100 x 50 UPVC tee	525	40	21,000						
100 x 20 UPUC tee	464	70	32,494	80	37,150	32	14,859	16	7,420
50 x 20 6 MS tee	15	730	11,242						
90° bends 100 mm dia	123	6	742	8	980	8	980	8	980
100 mm dia gate valves	1,150	15	17,248	5	5,754	5	5,754	5	5,754
20 mm dia stopcock assemblies	175	800	140,000	80	14,000	32	5,600	16	2,800
Standpipes	140	800	112,000	80	11,200	32	4,480	16	2,240
Miscellaneous fittings			21,000		8,400		5,600		4,200
Washouts	3,500	2	7,000	1	3,500	1	3,500	1	3,500
Total Costs (all foreign)			**781,410**		**223,952**		**153,314**		**138,362**
Labour @ 25%			976,762		279,940		191,643		172,952
Cost per lot			1,220		350		240		216

Electrical Distribution:

Three alternative levels of service were studied for electrical distribution:

(a) Lighting main road, main (longitudinal) pathways, and individual house connections.

(b) Lighting main road and main (longitudinal) pathways.

(c) Lighting main road only.

Spacing of lighting standards is at approximately 30 m centres, house connections are for two lighting fixtures of 100 watts each, and electrical supply is not included.

Table 1.6 presents the cost estimates for the three standards of electrical supply. It is suggested that if only main road lighting is selected it should be wired to Phase 3 standard from the outset to permit future upgrading.

When evaluating these results it should be recalled that while electrical supply will be a necessity in Homboy for administrative uses, machine shops, schools (evening classes) and the hospital, this is not the case in the villages where a small generator serving only school and administrative uses would cost only one tenth of a street lighting scheme (burden per lot SoSh 20).

1.7 HOUSING

While tending their herds nomads live in the Agal, a portable, demountable dwelling in the form of a semi-hemisphere with bowed wooden-stick framework covered by skins, mats, or grass. Recently is has become a widespread practice to cover these materials with a sheet of plastic film. The Agal is a cramped and uncomfortable form of housing with an environment which would rapidly become unhygenic if sites were not being constantly moved.

When taking up residence in the irrigation project, the nomads will enter a transitional way of life bridging the modern and the traditional, the urban and the rural. Examining the dwellings of existing transitional groups will provide a useful guide to the optimal form of housing under such circumstances.

The Mondul is a circular hut found in the south of Somalia with wattle-daub walls and conical thatch roof of about 4 m diameter (12.5 m^2 floor space) used by farmers who practice shifting agriculture around permanent villages such as Homboy. Increasingly the Mondul is being replaced by the Arish, a dwelling of similar construction but having a far more useful rectangular plan. For the wealthier villagers, walls are improved by thickening the mud over the wattle and rendering the exterior with cement plaster, and using galvanised sheet roofing. The Mondul is a traditional dwelling whose shape was perfected over the centuries. It is relatively stable structurally, consisting of a cone resting on a drum. The new Arish, while more commodious in plan, is unstable and begins to twist at the base soon after construction. It is observed that no cross bracing is added to the structure during construction, as the Mondul construction was presumably adapted directly to the Arish without accounting for the difference in stability.

In the village, one to several related families will group together in a single wattle-walled compound organised around a courtyard. Except for nightime and during the rainy season, most of the daily activity including cooking is conducted outdoors. Drawing 8a

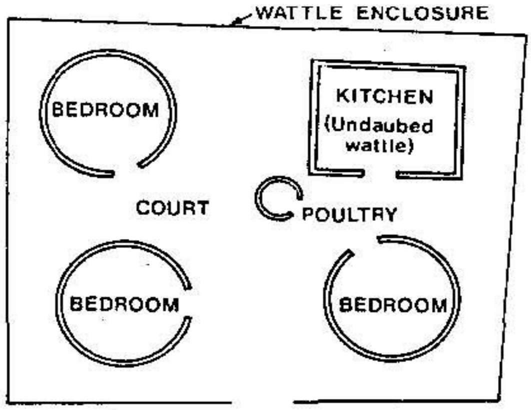
TABLE 1.6COST ESTIMATES OF ELECTRICAL DISTRIBUTION ALTERNATIVES FOR AN 800 FAMILY VILLAGE

Material	Rate* (SoSh)	Unit	Alternative A Qty	Alternative A Cost (SoSh)	Alternative B Qty	Alternative B Cost (SoSh)	Alternative C Qty	Alternative C Cost (SoSh)
Lamp holders	8		1,600	13,440				
100 w lamps	3		1,600	4,480				
Metal clad switches	57		800	46,054				
1.55 mm² 6242Y cable	2	(m)	8,000	16,448				
2.55 mm² 2 core SWA cable	6	(m)	1,600	99,008				
2.5 mm² 2 core glands	7		1,600	11,200				
15 amp connectors	13p/12		800	121				
Weatherproof lockable dist. bds. SPN 12 way	471		96	45,199				
4 mm² 2 core SWA cable	10	(m)	384	3,840				
4 mm² 2 core SWA glands	14		192	768				
Line taps	7	824		5,999				
5 amp SP MCBS	40		800	32,256				
Poles, complete	1,162		177	205,674	177	205,674	33	38,346
80 w fittings	173		177	30,678	177	30,678	33	5,720
80 w control gear	332		177	58,679	177	58,679	33	10.940
Mounting brackets	84		177	14,868	177	14,868	33	2,772
80 w MBF lamps	46		177	8,153	177	8,153	33	1,520
Solar cells	70		177	12,390				
Hard drawn copper cable	4,900	(km)	18.9	92,610	20.9	102,410	3	14.700
Fuse carriers	10		177	1,859	177	1,859	33	347
Hard drawn copper cable	20,860	(km)	5	104,300				
70 mm² 4 core SWA	130		20	2,604				
70 mm² glands	70		1	140				
Clips, mountings etc				2,800				
16 mm² 2 core SWA	272	(m)			20	476	20	476
16 mm² 2 core SWA glands	28				2	56	2	56
Control panel, timestarter, contactor	420				1	420	1	420
Sub total, material costs (all foreign costs)				**815,487**		**423,273**		**74,987**
Labour	35	(days)	9,090	318,150	1,252	43,820	270	9,450
Total Cost				**1,133,637**		**467,093**		**84,437**
Cost per lot				1,417		584		106

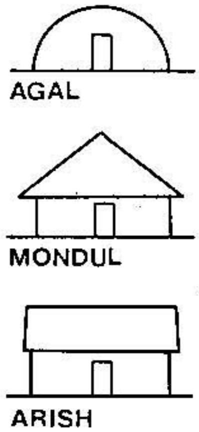
* Cost may not equal exact product of quantity times rate due to rounding of rates.

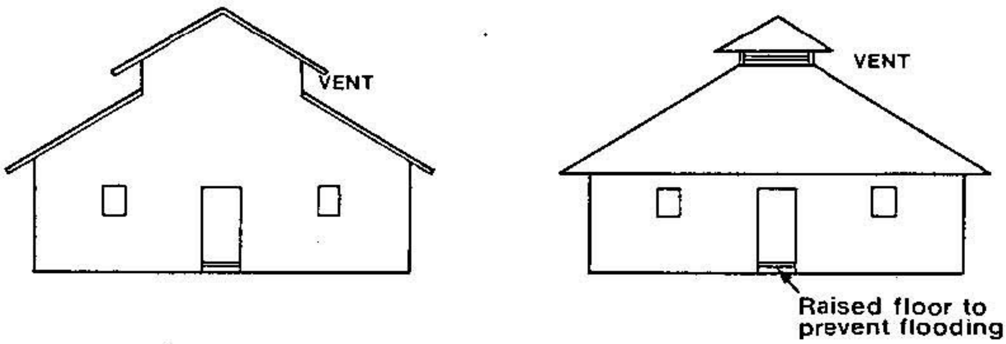
8 Traditional and Transitional Housing Styles

A TYPICAL DWELLING COMPOUND OF SOUTHERN SOMALIA

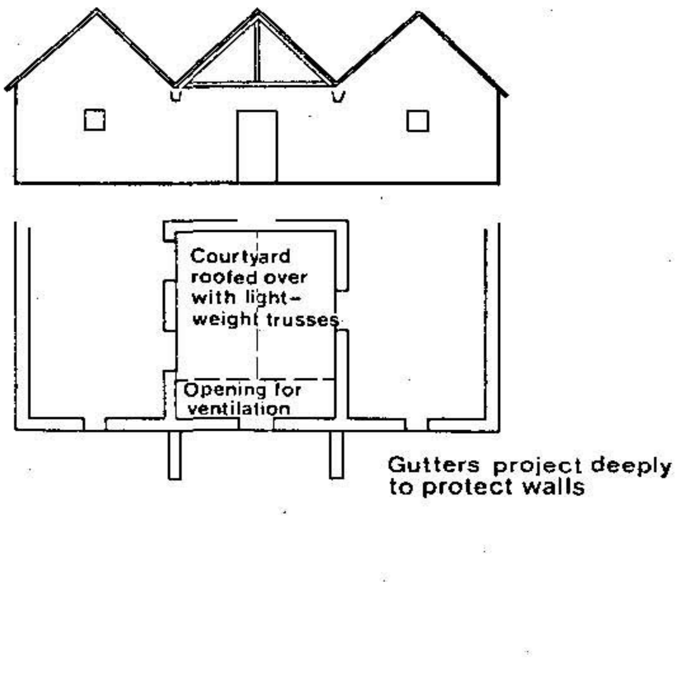


(Single family version)

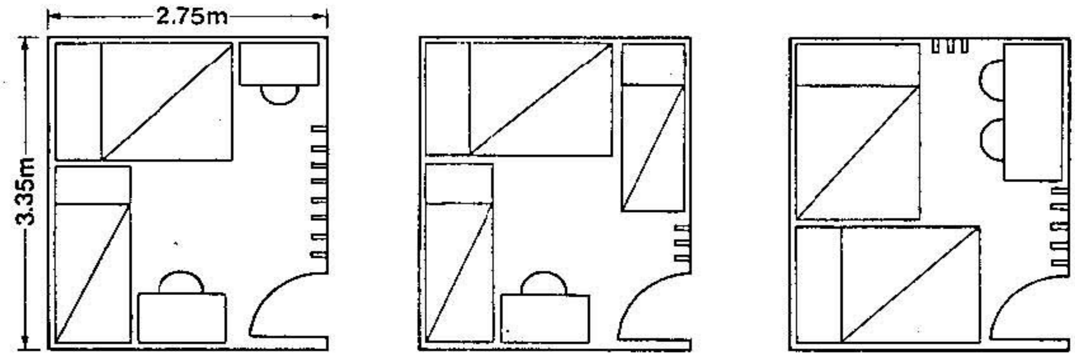




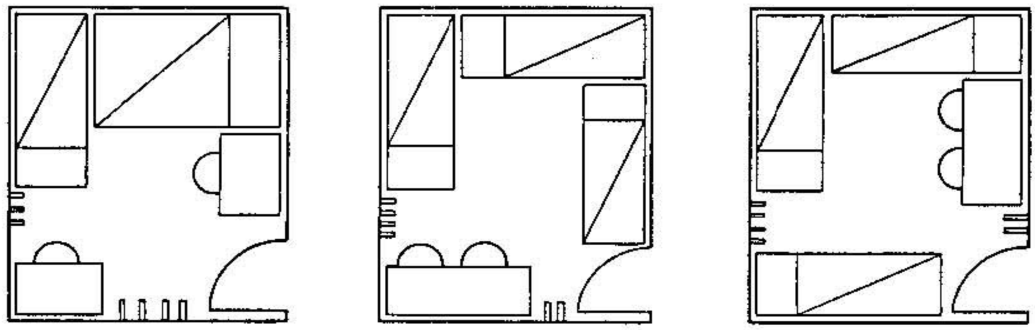
B TRANSITIONAL DWELLING STYLES IN MOGADISHU

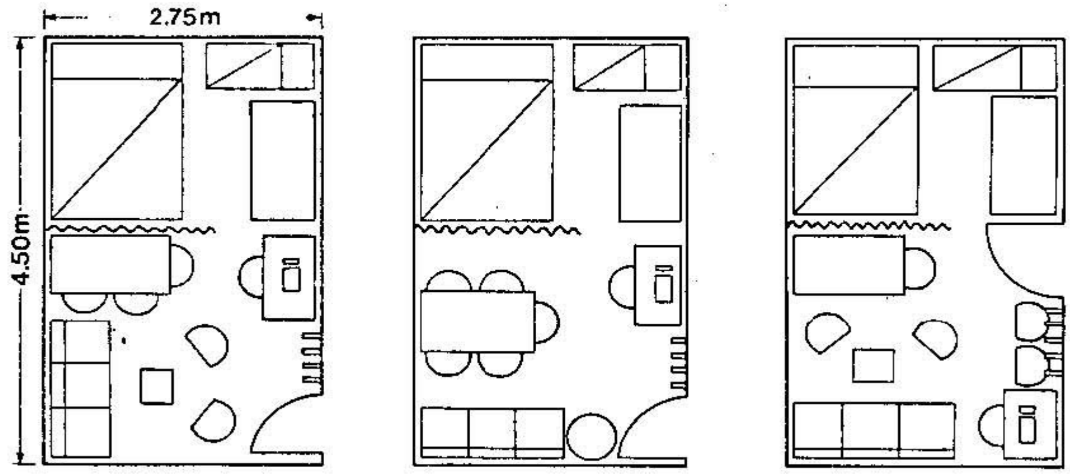


9 Furniture Arrangements



FURNITURE ARRANGEMENTS FOR SMALL BEDROOMS : 3-4 CHILDREN





ALTERNATIVE FURNITURE ARRANGEMENTS FOR MULTI-PURPOSE ROOMS :
2 ADULTS, 1 INFANT, LIVING, DINING, SEWING AND IRONING

presents a typical single family compound visited in Homboy illustrating the custom of providing parents, younger children and older children separate bedroom Monduls, although infants sleep with the parents. The kitchen is a thatched wattle structure which differs from the other structures in the use of undaubed walls for ventilation and sometimes having a rectilinear plan.

The relatively affluent residents of Mogadishu live in modern suburban style houses. Less wealthy urban dwellers live in a courtyard style house (Drawing 8b) which appears in many ways to be the ideal adaptation of modern design styles to Somali traditions and climate. It consists of a courtyard enclosed by two parallel rooms and a front wall with entry. The house is built up in stages until the family can afford to roof over the courtyard (leaving a gap for ventilation) using light wooden trusses and galvanised sheet roofing.

Two other examples are given of alternative forms of ventilating houses employed in more expensive homes in the same neighbourhoods.

The following criteria were adopted for housing:

(i) Housing should be designed to improve upon the basic shortcomings of traditional construction: insect and vermin penetration, inadequate ventilation, leaking roofs, inadequate toilet facilities, and lack of durability.

(ii) Housing costs should be in equilibrium with expenditures on social services and engineering infrastructure.

(iii) Housing should be compatible with available finances and the reasonable expectations of residents of the region. Levels of expenditure should be sustainable over time.

(iv) Housing should be planned to conform to existing cultural traditions. The aim of technological alterations should be to improve the traditional way of life.

Self-help housing was not considered for this project because of the need for nomads to be attracted by the advantages of built housing, and the urgency of contributing their labour to the irrigation project.

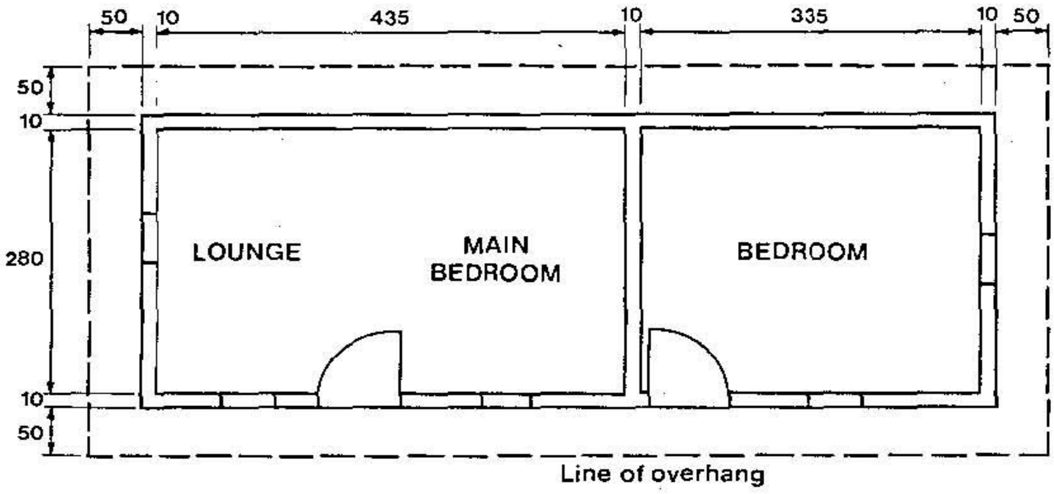
The first stage in house design was to determine the space requirements of a family of five including the option of infants sleeping with parents (Figure 1.9). A traditional form of living room observed in Somalia and other developing countries was included which accommodates the inevitable changes in rural lifestyle introduced by development. It provides a multi-purpose living room for receiving visitors and dining on formal occasions and sewing and ironing, screened off from the parents (and infants) bedroom. An attached bedroom with separate courtyard entry can accommodate up to four persons, but optimally three children would sleep there. Pegs are used for clothes storage, and study desks are illustrated, although these could be replaced by chests and other furniture as required. The kitchen is not furnished, as in dry weather cooking will take place outdoors. Its only function is to provide shelter and storage facilities. A settlement house plan is shown at Figure 1.10.

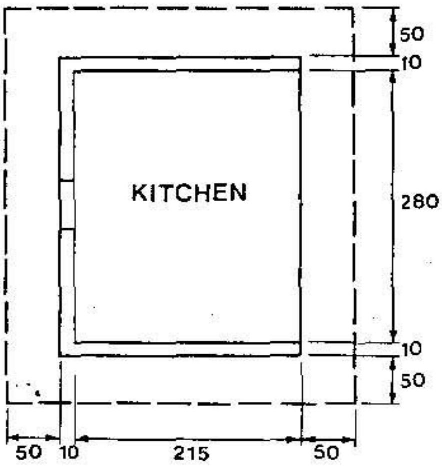
These rooms were arranged around a courtyard (Figure 1.7) in a fashion which confroms to the traditional fashion of Somali outdoor living enhanced by the weather control features of the Mogadishu example.

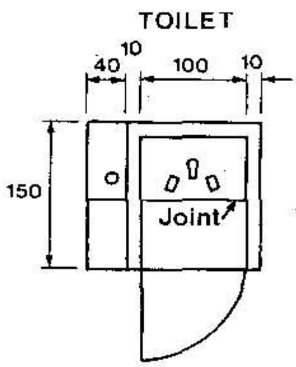
10 Housing plans

Note: Dimensions and overhang vary according to type of construction. Illustrated are improved Arish walls a Thatch Hip roof

All dimensions in centimetres







The main objective in selecting building materials is to provide basic shelter at minimum cost. The principle underlying this goal is the belief that in allocating funds for community development, expenditures in social services and engineering infrastructure will achieve greater results in improving rural conditions than corresponding investments in housing, once the requirements of basic shelter have been met. Criteria for building material selection are:

(a) Reduction of total materials and labour costs

(b) Reduction of foreign costs

(c) Use of available skills in the labour component of housing

(d) Establishing priority in the choice between competing imported materials based upon the likelihood of eventual domestic manufacture.

Alternative housing materials and their properties are described below:

Walls:

(a) Cinvaram (stabilised earth) blocks are permanent if constructed under well monitored conditions; there is a risk of semi-permanence with poor supervision. Large hollow blocks should be used to conserve labour, mortar and materials, although sizes larger than 12 cm x 14 cm x 29 cm are not recommended because of weight. Blocks are made of a lean mix of cement, local clay and sand, reducing foreign and transport costs as compared to concrete block. Cement can be further reduced by substituting locally made lime for cement, although drying time is doubled. Savings in cement and transport may not be realised, or permanence achieved, if the right soil is not present on the site.

(b) Coral is a permanent construction material, popular for coastal construction where transport costs are low. Dressed coral is 20 per cent more expensive than rough coral but will produce substantial saving in mortar consumption.

(c) Wattle-daub in its simplest form is a temporary material. The wood is subject to termite attack and rot, aggravated by erosion of the protective mud surface by rain. Durability is approximately 3 years before major repairs are required. Wattle-daub rendered on the exterior with cement-lime plaster has a life from 6-10 years if carefully maintained. It is reported that villagers in some regions have greatly extended this life by mixing cattle-dung with the mud to prevent cracking, but that nomads were reluctant to adopt this practice as they consider the material offensive. The Improved Arish alternative described in this report would incorporate a more acceptable binder such as chopped straw, wattle cross bracing and special protection from erosion at the base of walls, producing an anticipated durability of 15 years assuming adequate maintenance is provided before every rainy season.

Brick was not considered a suitable alternative for several reasons:

(i) Its foreign costs, represented by fuel, are hidden but nevertheless substantial.

(ii) There is no evidence that delivered sales price would be less than cement block or Cinvaram.

(iii) The factory requires high initial investment which would probably not be recovered.

(iv) Requirements for masonary are very exacting, and under field conditions brick may only be suitable as an infill material, creating the need for an expensive reinforced concrete frame.

Roof:

(a) Asbestos-cement roofing was examined in preference to galvanised metal as it may be in production domestically in a number of years, and has superior thermal qualities.

(b) The thatch and bituminous paper roofing developed and tested by USAID in Kurtunwaare is considered, modified by the Asian practice of incorporating the purlin within the roof thatching units as illustrated in Figure 11b. Use of these prefabricated thatching units will accelerate roof assembly and their preparation could create a cottage industry particularly suitable for female heads of household.

A replacement for dimensioned timber rafters could not be identified and therefore all roofing alternatives will require imported softwood treated with copper-chrome-arsenic or equivalent odourless termite preventative.

Foundation:

A 30 cm wide foundation of rough sand-filled coral blocks extending 50 cm below grade, and 20 cm above grade with cement-lime mortar and topping , is proposed when construction occurs on Beach Remnant oralluvial soils.

Where Marine Plain Soils are unavoidable, a reinforced concrete ring beam with bored piles would be an expensive but reliable alternative. A less expensive solution incorporating a thin, deep ring beam (resembling a wall) will be tested by the Dutch team at Sablaale and could be adopted if proven reliable.

Floor:

(a) Permanent stablised earth floors are made by mixing cement with earth and compacting.

(b) Cinvaram floors use half thickness blocks which should be laid in a thin bed of sand (2.5 cm) and joints filled with a dry cement sand mixture which is then moistened and swept clear. These floors are also permanent.

(c) A compacted clay floor raised 20 cm above grade is the most economical material for flooring. There is some possibility of moisture penetrating during the rainy season.

Doors, Windows and Louvres:

It is proposed that doors, windows and louvres be constructed of treated softwood timber with metal hinges set in timber frames. Doors should have fittings for padlocks and windows should be barred with reinforcing rods. Louvres in walls and roofs should have mosquito netting and hardboard templates held in place by pegs for use during dust storms.

Privvy enclosure:

Privvy enclosures must be lightweight so that they can be moved from one pit to another and inexpensive, since as the size of buildings diminish, the ratio of enclosing surface (walls and roof) to usable floor space increases. Thus the toilet enclosure with 7 per cent of the total floorspace uses 11 per cent of the total wall surface (and would actually use 13 per cent were it not for the fact that one side has a door, for which a fairly substantial allowance in woodwork has been made).

In Alternative 1, an asbestos-cement cabinet is used. Elsewhere a moveable improved Arish enclosure is proposed, resting on a timber base plate. The 7.5 cm thick reinforced concrete squat plate should be cast in two pieces as each piece will weigh roughly 175 kg, requiring the help of neighbours to be moved. Costs of the toilet enclosure are incorporated in the housing costs.

The choice of building materials should be influenced by the ease of upgrading individual components, even if self-help cannot be considered in initial construction phases. For example, thatch roofing on a timber frame can be easily replaced at a later date with asbestos-cement panels; foundations are not as easily changed. Similarly it is a relatively simple task to improve an earthen floor after house construction. Maintenance is also important,particularly with the improved Arish alternative which must be examined before each rainy season for cracks, and then repaired if necessary. Thatch, if used, will also require periodic attention.

Individual building materials cannot be evaluated in isolation; they must be considered in their structural context. For the analysis of building materials, alternative systems were considered:

(1) Cinvaram walls, asbestos roof on timber frame, stabilised earth floor, coral foundation and asbestos privvy enclosure (similar to Sablaale pilot project). Walls must have reinforced ring beams at the eaves for stability.

(2) Cinvaram walls with reinforced concrete ring beam at eaves, thatch and bituminous paper roof on timber frames, cinvaram floor and coral foundation (similar to Kurtum Waarey pilot project). Improved Arish walls for privvy enclosure.

(3) Coral walls with reinforced concrete ring beam at eaves, thatch and bituminous paper roof on timber frame, compacted clay floor and coral foundations. Improved Arish walls for privvy enclosure.

(4) Improved Arish walls, asbestos roof on timber rafters supported by timber frame and pipe columns. Compacted clay floor and coral foundations. Improved Arish walls for privvy enclosure. The intent of this construction was to use a permanent roof with semi-permanent walls which could be easily removed and upgraded.

(5) Improved Arish walls, thatch and bituminous paper roof on timber frame, compacted clay floor and coral foundations. Improved Arish walls for privvy enclosure. Special protection is given to the wall at its base by raising it above ground level, providing an extra layer of protective rendering as a skirting and building 0.5 metre overhangs. Wattle cross bracing adds rigidity.

(6) Bedrooms as in (5). Kitchen undaubed wattle, thatch and bituminous paper roof on wattle rafters, earth floor without foundations. This alternative reflects the fact that the kitchen has less exacting shelter requirements than the bedrooms. The kitchen can be entirely concealed from the street by locating it behind the bedrooms if its appearance does not appear consistent with the higher quality construction.

(7) Wattle daub for all structures. These would be improved with straw binder in the mud, wattle cross bracing, and bituminous paper in the roof, but otherwise identical to the existing vernacular construction method.

The following points must be considered to determine the ideal orientation for dwellings in the project.

(i) Somalia has a compound climate with 2 wet and 2 dry seasons. Criteria for optimal design in each season may conflict.

(ii) Accurate data for the micro-climate of the study area is unavailable. Additionally the micro-climate may change because of land clearance and irrigation.

(iii) A single orientation of lot and house would put rigid constraints on the adaptability of the prototypical village to a variety of sites.

(iv) Residents are likely to have their own set of priorities and can frequently be observed to permanently seal any opening which cannot be made secure from intrusion, insect proof and glareproof.

A flexible approach is therefore proposed which may resolve, at a small cost, all of these conflicting crieteria.

(a) The door must be strong and lockable.

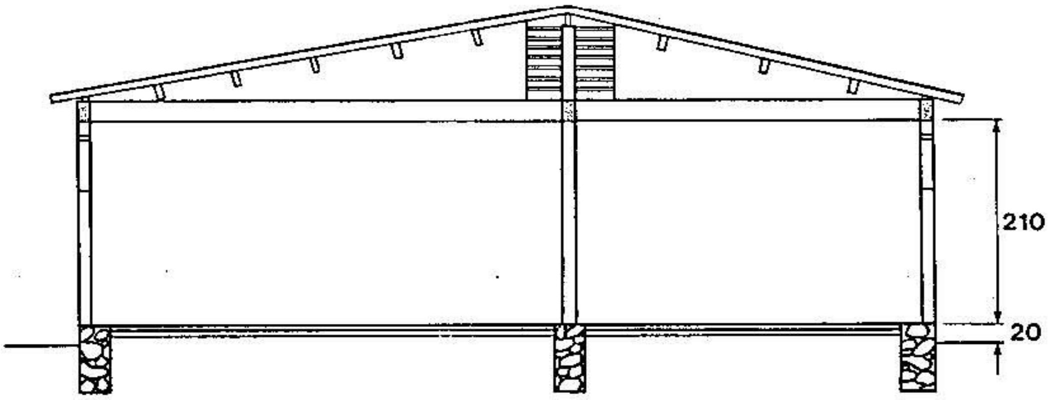
(b) Windows must be small, high, barred, and closeable.

(c) Ventilation louvres and openings must be small and high enough to keep out intruders, and protected by mosquito netting. A thin hardboard, chipboard or masonite template held in place by pegs should be furnished for all ventilation louvres so that they can be temporarily closed during dust storms.

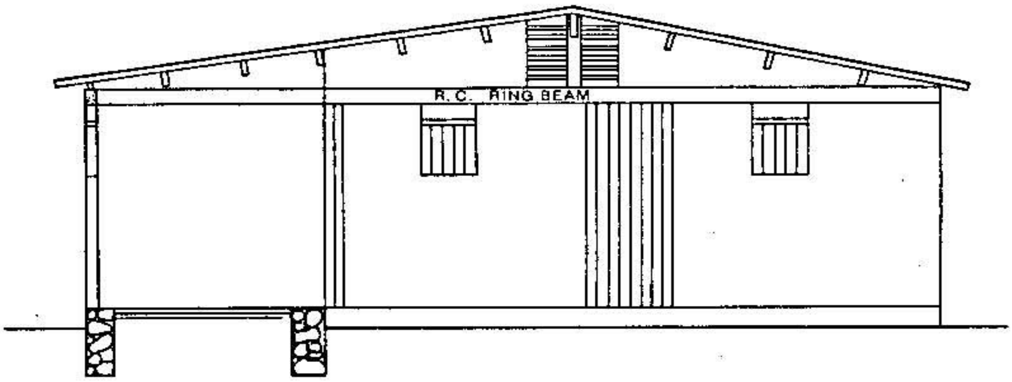
(d) Roofs should be ventilated at their highest point (see Figure 1.8).The opening should be louvred to exclude rain and intruders, have mosquito netting, and removeable templates for dust storms.

Figures 1.11a and 1.11b illustrate housing alternatives 2 and 5 respectively but can be combined to describe any of the other alternatives. Table 1.7 presents an analysis of costs broken down into foreign costs, local costs, and labour by building component, while Table 1.8 presents the bill of materials for each alternative, and Table 1.9, unit costs and labour assumptions.

1.11a Sections and Elevations

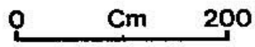


SECTION THROUGH BEDROOMS

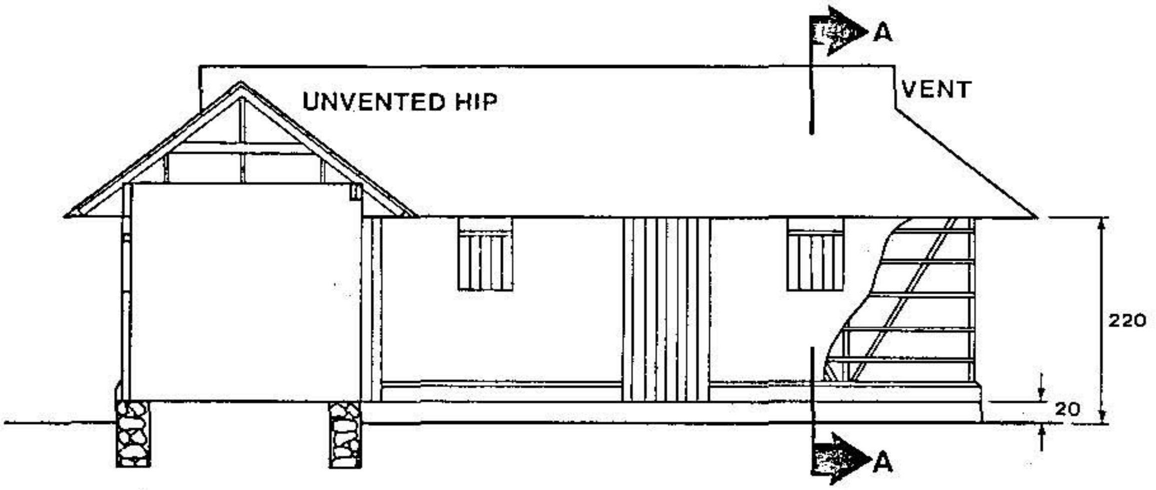


SECTION THROUGH KITCHEN

Note: Materials illustrated are Cinvaram walls, Asbestos cement roof and Coral foundations



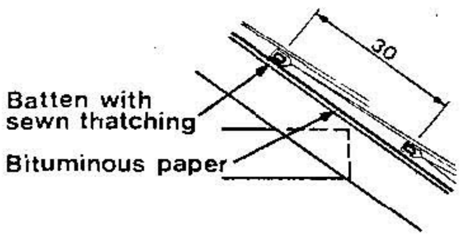
1.11b Sections and Elevations

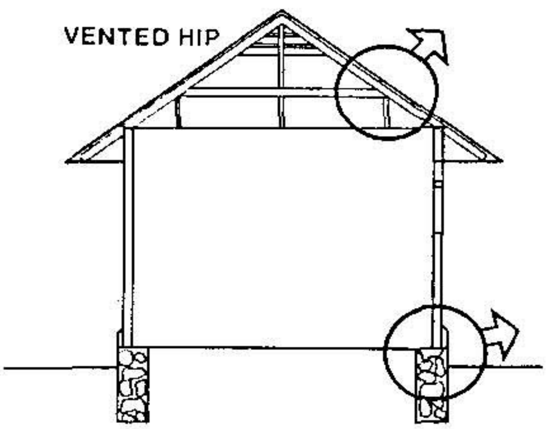


SECTION THROUGH KITCHEN

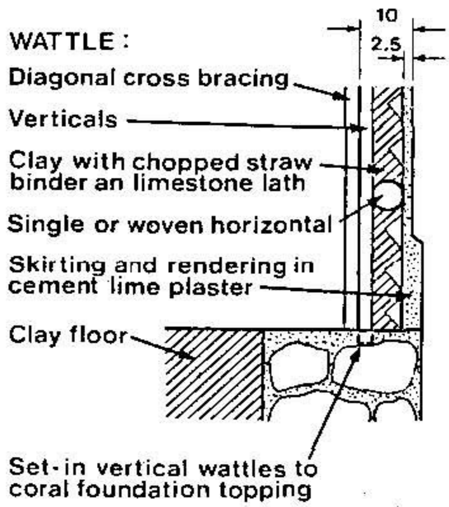
0 Cm 200

Illustration of main vertical and diagonal wattle members introduced for cross bracing. Minor verticals and horizontals omitted for clarity





SECTION THROUGH BEDROOM A-A



ROOF AND WALL DETAILS

Note: Materials illustrated are improved
Arish walls, Thatch roof and Coral foundations

TABLE 1.7 COST BREAKDOWN OF HOUSING ALTERNATIVES BY BUILDING COMPONENT

Type	Walls		Roof		Floor		Foundation		D/W/L[1]		Fittings[2]		Total	
	(hrs)	(SoSh)	(hrs)	(SoSh)	(hrs)	(SoSh)	(hrs)	(SoSh)	(hrs)	(SoSh)	(hrs)	(SoSh)	(hrs)	(SoSh)
1.											(hrs)			
Foreign Materials		1,475		4,299		357		256		760		756		7,903
Local Materials		476				16		712						1,204
Labour Hours	898		136		21		169		48				1,272	
Labour Cost		2,072		340		32		248		150				2,842
Sub Total		**4,023**		**4,639**		**405**		**1,216**		**910**		**756**		**11,949**
Total Cost[3]														**13,143**
2.														
Foreign Materials		1,488		932		182		256		760		713		4,331
Local Materials		499		160		91		712						1,462
Labour Hours	900		277		147		169		48				1,541	
Labour Cost		2068		566		290		248		150				3,322
Sub Total		**4,055**		**1,658**		**563**		**1,216**		**910**		**713**		**9,115**
Total Cost[3]														**10,027**
3.														
Foreign Materials		1,259		932		33		256		760		560		3,800
Local Materials		1,533		160		9		712						2,414
Labour Hours	582		277		7		169		48				1,083	
Labour Cost		1,557		566		21		248		150				2,562
Sub Total		**4,349**		**1,658**		**63**		**1,216**		**910**		**560**		**8,776**
Total Cost[3]														**9,654**
4.														
Foreign Materials		1,972		4,338		33		256		760		603		7,962
Local Materials		407				9		712						1,128
Labour Hours	478		185		7		169		48				887	
Labour Cost		1,054		478		21		248		150				1,951
Sub Total		**3,433**		**4,816**		**63**		**1,216**		**910**		**603**		**11,041**
Total Cost[3]														**12,145**
5.														
Foreign Materials		472		932		33		256		760		560		3,013
Local Materials		414		160		9		712						1,295
Labour Hours	469		277		7		169		48				970	
Labour Cost		1,010		566		21		248		150				1,995
Sub Total		**1,896**		**1,658**		**63**		**1,216**		**910**		**560**		**6,303**
Total Cost[3]														**6,933**
6.														
Foreign Materials		354		699		33		192		760		560		2,598
Local Materials		310		120		9		534						973
Labour Hours	352		277		7		127		48				811	
Labour Cost		756		425		21		186		150				1,538
Sub Total		**1,420**		**1,244**		**63**		**912**		**910**		**560**		**5,109**
Total Cost[3]														**5,622**
7.														
Foreign Materials				228		33		95				60		416
Local Material		160		160		9		32						361
Labour Hours	242		259		7		60						568	
Labour Cost		634		503		21		88						1,246
Sub Total		**794**		**891**		**63**		**215**				**60**		**2,023**
Total Cost[3]														**2,225**

[1] Doors, Windows and louvres

[2] Labour included elsewhere

[3] Includes 10 per cent allowance for contingency and supervision. All costs include transportation

TABLE 1.8 BILL OF MATERIALS AND LABOUR FOR HOUSING ALTERNATIVES

Material	Unit	Quantity Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt. 5	Alt. 6	Alt. 7
A: Foreign Material								
Cement	(m^3)	1.42	1.30	1.02	0.55	0.56	0.42	0.09
Iron	(kg)	38.8	38.8	38.8	33.2	3.0	3.0	3.0
Asbestos	(m^2)	71.55			58.20			
Bituminous Paper	(m^2)		99	99		99	99	114
Wood	(m^3)	0.79	0.78	0.78	1.18	0.78	0.68	
Fittings	(SoSh)	756	713	560	603	560	560	
B: Local Materials								
Lime	(m^3)	1.27	1.37	1.69	1.04	1.06	0.78	
Sand	(m^3)	7.14	8.23	4.05	2.79	2.83	2.13	0.35
Clay	(m^3)[1]	2.51	3.07	0.31	3.21	3.33	2.49	[3]
Limestone Gravel	(m^3)	0.57	0.64	0.70	0.86	0.38	0.67	0.06
Coral, dressed	(m^3)			11.30				
Coral, rough	(m^3)	5.63	5.63	5.63	5.63	5.63	4.22	
Wattle	(L)[2]		0.1	0.1	1.0	1.0	1.0	1.0
Thatch	(L)[2]		1.0	1.0		1.0	1.0	1.0
Labour								
Skilled	(hrs)	577	634	585	396	359	305	230
Semi-skilled	(hrs)	473	544	358	364	380	307	168
Unskilled	(hrs)	221	363	140	127	231	199	170
		1,271	1,541	1,083	887	970	811	568

[1] Local clay, no cost
[2] Transportation and labour cost only per load (L)
[3] Nominal amount

1.8 CONCLUSIONS

The target household income for the project is So. Sh. 3,000 per annum. Since there is insufficient known data or policy to correlate this to available finances the choice of development packages from the options listed in Table 1.10 has been based upon budgetary assumptions.

The total community development cost per dwelling of the Sablaale and Kurtunwaare pilot projects excluding expatriate expense is in the region of So. Sh. 18,500 per dwelling. This is a multiple of over six times annual income, which would require massive subsidy and is clearly unsustainable in the long run. In the absence of any supporting data, it might be hypothesised that a multiple from 1-2 times would be more appropriate for this project.

The special circumstances of the project, making self-help construction infeasible, might possibly justify a subsidy above this multiple. Assuming that the budget for total development cost does not exceed SoSh 9,250 (three times income) even with subsidy, the following choices have been made between the available options presented in Table 1.10.

TABLE 1.9 UNIT COSTS AND LABOUR ASSUMPTIONS

Material	Quantity	Rate (Som. Sh)	
Cement	(m^3)	1,350	
Iron	(kg)	4.6	
Lime	(m^3)	140	
Asbestos-cement roofing	(m^2)	50	
Bituminous paper	(m^2)	2	
Wood	(m^3)	2,200	
Sand	(m^3)	120	
Clay	(m^3)		
Gravel	(m^3)	122	
Coral: rough	(m^3)	250	
Coral: dressed	(m^3)	270	
Wattle	truckload	160	
Thatch	truckload	160	
Labour			
Skilled	(day)	25	(plumbers and electricians 35/day)
Semi-skilled	(day)	15	
Unskilled	(day)	10	

Labour assumptions (hours)

	Quantity	Skilled	Semi-skilled	Unskilled
Footings: excavate, construct, apply mortar topping	(m)	2.0	2.0	1.2
Cinvaram walls: mfr. blocks, masonary, form and pour r.c. beam	(m^2)	5.5	4.6	2.4
Coral: masonary, form and pour beams	(m^2)	5.5	3.0	
Improved wattle: gather, erect, clay daub and render	(m^2)	2.0	3.0	1.2
Wattle: gather, erect and clay daub	(m^2)	2.0	1.0	0.2
Asbestos roof: carpentry, apply roofing	(m^2)	1.2	1.2	
Improved Thatch Roof: carpentry, gather and form thatch, apply roofing	(m^2)	1.4	1.4	1.6
Thatch roof: gather and form thatch apply roofing	(m^2)	1.2	1.2	1.6
Stabilised Floor: mix and compact	(m^2)		0.5	0.5
Cinva-ram Floor: mfr blocks and lay	(m^2)	2.0	2.6	2.4

(i) Housing, Alternative 6 or 7 depending upon available resources. Alternative 6 would provide a complete house consisting of two bedrooms of improved Arish construction with some permanent components for upgrading and a wattle-daub kitchen. Alternative 7 would provide a complete house in wattle-daub.

(ii) Social Services, Option (a). Full social services in permanent construction.

(iii) Water, Option (b), one standpipe per 10 families, maximum walking distance 20 m., complete reticulation permitting future individual service at connection cost only.

(iv) Roads and drains, Option (b), fully drained main roads with compacted surface. Will not flood but will require regrading after wet seasons. Drained clay surface pathways. Surfacing of main road can be upgraded at later date.

(v) Electricity, Option (c), lighting and power for main road and community services only.

Choosing housing Alternative 6, the total development cost would be SoSh 8,023 per dwelling, with a balance of SoSh 1,227 in the (theoretical) budget for water supply, electrical supply and agricultural buildings.

If it is intended to limit expenditure to a 1-2 times multiple of income, then between SoSh 3,000-6,000 would be available for all community costs. In keeping with the assumption that investment in social services and engineering infrastructure will contribute more to rural development than housing expenditures above the requirements of basic shelter, alternative 7 would be chosen for the housing at a cost of SoSh 2,225 (of which 61 per cent is labour cost at the assumed rates) and all other components would remain the same, yielding a total cost of SoSh 4,626 (excluding water supply, electrical supply and agricultural buildings).

TABLE 1.10 TOTAL ALTERNATIVE DEVELOPMENT COSTS PER HOUSE[1]

Alternative	House	Soc. Serv.	Water	Roads & Drainage	Electricity
1	13,143	1,470	1,220	681	1,417
2	10,027	-	350	475	584
3	9,654	-	240	-	106
4	12,145	-	216	-	-
5	6,933	-	-	-	-
6	5,622	-	-	-	-
7	2,225	-	-	-	-

Note:

1 *Does not include agricultural buildings, water supply, treatment and storage, and electical supply.*

1.9 UNRESOLVED ISSUES

The study team has attempted to ensure that local materials contained in the bill of materials are actually available in the quantities specified. Reeds for thatching grow in wide expanses along the borders of the Juba River and on flooded lands which should not be difficult to harvest if labour and transport are available. Since the region is sparsely populated there would be little competition or traditional rights-of-use to consider. There are also several substitutes for reeds, such as dried grass and palm leaves.

Wattle in large quantities will be available from the study area which will be progressively cleared as the agricultural blocks are opened up and villages constructed. Although perhaps 25 per cent of the land has already been cleared for shifting agriculture, the remainder consists of relatively dense bush, and 11,000 ha of clearance should provide sufficient wattle for 9,000 dwellings; if they do not, wattle can be sought in the nearby reaches of the dry Shabeelle flood plain.

The availability of large quantities of locally produced building lime has not been confirmed. In the cost estimates lime is listed as a local cost, but is priced at foreign cost levels as a safeguard against the necessity of its importation.

Of greater concern, however, is the volume of firewood which will be consumed each year for cooking, which may overshadow the amount needed for construction. Biogas generation will be able to furnish some of this energy, and the present research being conducted by the SDA should be pursued vigorously. Nevertheless either severe deterioration of the environment or hardship for the project residents is likely to result as fuel foragers progressively strip the natural cover in an ever increasing radius around the project. This will be exacerbated by the periodic need to repair existing wattle structures.

It is understood that resources are available from UN Habitat to further pursue the issue of innovative construction techniques using local materials. Hopefully their attention can be directed to review in greater detail the recommendations of this report concerning use of local materials, and their availability, and additionally examine the possibility of adapting the Sudanese method of sun dried mud brick construction to Somali conditions as this does not require any wattle. It might also come under their terms of reference to investigate different fuel options.

Finally, it is noted that the recommendation of this report should be supplemented with a careful monitoring of the ongoing pilot projects at Kurtunwaare and Sablaale, particularly with regard to the performance of foundations in swelling soils and the composting toilet.

Part 2
Relocation

2.1 INTRODUCTION

The relocation study examines the population resource and is designed to match the movement of population into the area with the labour requirements necessary to complete the development. It is planned to resettle the Dujuuma population in an orderly manner ensuring that permanent accommodation is immediately available on their arrival and to time this arrival closely with the completion of irrigation engineering works. However, it is also central to the development concept that the labour required to construct housing and engineering infrastructure be recruited from the settlers. Very careful relocation scheduling is therefore required to balance relocation with labour requirement.

The relocation study examines separately the main facets of the population from these different points of view namely:

(a) Resettlement of Dujuuma families to coincide with completion of the development blocks.

(b) Labour requirements of the various project activities.

(c) An analysis of the available demographic data to allow projections to be made of both total population and available labour.

From these studies it is shown that the desired objectives can be achieved. Schedules are drawn up of the required population movement. The various population projections show that towards the end of the development there might well be insufficient families to fill villages 8, 9 and 10 completely but this will not affect the earlier movements. The implications will be available in plenty of time to allow contingency planning.

2.1.1 General Considerations

Phasing the resettlement of people from Dujuuma to Homboy means finding answers to two kinds of questions, these concern:

(a) The availability of labour in relation to the work to be done.

(b) The size of the population to be resettled.

The tasks of constructing an irrigation system, the infrastructure for the villages, the social services and the houses, make heavy demands on labour. Of these, the construction of the villages is the most serious constraint in the resettlement programme. It is important however, that when people are moved from Dujuuma to Homboy they should be properly settled and not put in temporary accommodation as this would soon lead to disillusionment and population loss. From the various possible housing alternatives the Villagisation Report selects two types of construction that are feasible in the circumstances. Figures 2.1 and 2.2 show the relocation programme with both these alternatives. The main objectives of the resettlement programme are:

- to bring the fields under cultivation as soon as the irrigation in field works are completed and thereby:
- achieve economic viability and self-sufficiency as soon as possible;
- to establish a successful and financially attractive scheme which will encourage former settlers to return to the settlement and others from outside to join it;
- to reverse the trend of migration away from the settlement to seek employment elsewhere;
- to ensure full employment for the settlers from the start in order to raise morale and counteract discouragement and indolence resulting from years of enforced idleness and lack of purpose;
- to create a model scheme which is flexible enough for instance, to absorb new settlers in case another drought occurs.

The transfer of families and the construction of the villages are geared to the progress of the engineering work. The present size of the population is not decisive for the success of the scheme, on the contrary, it is the success of the scheme that is most likely to affect the size of the population. It is most important to plan the implementation of the scheme thoroughly and to have all the skilled labour ready at the required time, to avoid delays. The first training programme will have to start in July 1980 and the second in July 1981 (see Figure 2.1). The engineering work is scheduled as shown in Table 2.1.

TABLE 2.1 SCHEDULE OF COMPLETION OF ENGINEERING WORKS

Block 1	Completion	June 1982
Block 2	Completion	October 1982
Block 3	Completion	December 1982
Block 4	Completion	December 1983
Block 5	Completion	June 1984
Block 6	Completion	October 1984
Block 7	Completion	December 1984
Block 8	Completion	October 1985
Block 9	Completion	December 1985
Block 10	Completion	July 1986

Both programmes with Housing Alternatives 6 and 7 assume that the local population in Homboy will be attracted to join the scheme.

2.1.2 Participation of Local Inhabitants

The participation of the original inhabitants is vital not only because the construction

2.1 Resettlement Programme-Housing Alternative 7

	July 1980	January 1981	July 1981	January 1982	July 1982	January 1983	July 1983	January 1984	July 1984	January 1985	July 1985	January 1986	July 1986
Labour for engineering work	-	372 unskilled 23 skilled 3??	372 unskilled 23 skilled 399	427 unskilled 26 skilled 533	533	533	533	533	533	533	533	533	-
Farm labour	-	-	-	-	792 (Block 1)	792 (Block 1) 1,??? (Block 2) 72? (Block 3) 2,6??	2,805 (Blocks 1 2 3)	1,??? (Block 4) 1,??? (Block 2) 9?? (Block 3) 1,??? (Block 4) 4,???	1,??? (Block 1) 1,650 (Block 2) 1,??? (Block 3) 1,221 (Block 4) 1,??? (Block 5) 6,???	4,??? (Blocks 1 2 3) 1,72? (Block 4) 1,??? (Block 5) 1,??? (Block 6) 1,??? (Block 7) 9,3??	[illegible] 9,???	[illegible] 1?,???	[illegible] 15,???
Labour for village community buildings	Start training 44 skilled 36 semi-skilled labour	-	-	100 (Village 1)	100 (Village 2)	100 (Village 3)	100 (Village 4)	100 (Village 5)	100 (Village 6)	100 (Village 7)	100 (Village 8)	100 (Village 9)	100 (Village 10)
Labour for central village community buildings	-	Start training 44 skilled 36 semi-skilled labour		-	100	100	100	100	100	100	-		-
Labour for infrastructure	9	9	15	40	62	57	48	111	16	44	40	42	-
Labour for housing construction	150 houses (Hambay refill) 50	150 houses (Hambay refill) 90	(300 houses Village 1) 180	300 houses (Village 1) = 180 6?? houses (Village 2) = 220 Total 400	425 (Village 2) =2?? 700 (Village 3) =4?? Total 625	925 houses (Village 4) = 374	725 houses (Village 5) =406	8?? houses (Village 6) =440 1,125 houses (Village 7) =6?? 1,1??	575 houses (Village 8) 366	800 houses (Village 9) 440	725 houses (Village ?) 4?5	750 houses (Village 1?) 4?5	
Total labour requirement	99	498	592	1,073	2,212	4,109	4,402	6,913	7,306	10,582	11,???	14,5?3	15,5??
Number of families* resettled	-	150 (in Hambay refill)	300 (in Hambay Refill)	300 (Hambay refill) 300 (Village 1)	300 (Hambay refill) 600 (Village 1) 400 (Village 2) 1,300	300 (Hambay refill) 600 (Village 1) 825 (Village 2) 700 (Village 3) 2,425	300 (Hambay refill) 600 (Village 1) 825 (Village 2) 700 (Village 3) 925 (Village 4) 3,350	300 (Hambay refill) 600 (Village 1) 825 (Village 2) 700 (Village 3) 925 (Village 4) 725 (Village 5) 3,475 + 600 integrated into the scheme in Hambay	600 (Village 1) 825 (Village 2) 700 (Village 3) 925 (Village 4) 1,025 (Village 5) 800 (Village 6) 1,125 (Village 7) 5,??0 (including 600 Hambay families)	600 (Village 1) 825 (Village 2) 700 (Village 3) 925 (Village 4) 1,025 (Village 5) 800 (Village 6) 1,125 (Village 7) 417 (Village 8) 6,117 (including 600 Hambay families)			
Labour available from [illegible] population*	-	355	540	1,0?0	1,170	4,630	7,035	7,992 + 1,500 integrated Hambay population	13,560 +1,500 integrated Hambay population	15,169 +1,500 integrated Hambay population	16,2?? +1,500 integrated Hambay population	1?,??? +1,500 integrated Hambay population	1?,??? +1,500 integrated Hambay population
Labour shortfall (labour to be recruited from Hambay)	99	143	52			-	-	-	-	3,022 minimum population requirement work ???	-	-	-
Surplus labour	-	-	-	1	250	681 (maximum)	2,616 (maximum)	1,077 (maximum)	3,7?? (maximum) 3,??? (minimum)	6,887 (maximum population) (minimum ??? ???)	6,??? (maximum)	3,??? (maximum)	3,128
Number of families left in [illegible]	-	-	-	-	-	5,432	2,497	2,372	447				
Shortfall of families to fill up area	-	-	-	-	-	-					800	1,??5	2,715

Note: * Population figures based on the ??? Population Assumption (???)

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Resettlement Programme - Housing Alternative 6

	July 1980	January 1981	July 1981	January 1982	July 1982	January 1983
[illegible]		372 unskilled 27 skilled 399	399	497 unskilled 36 skilled 533	533	533
					792 (Block 1)	792 Block 1 1,059 Block 2 9[illegible] Block 3 2,805
[illegible] building	Start training 44 skilled 36 semi-skilled		100 (Village 1)	100 (Village 2)	100 (Village 3)	100 (Village 4)
Fuel [illegible]		Start training 44 skilled 36 semi-skilled	-	100	100	100
[illegible]ucture	21	21	57	86	8	77
	248 houses (Humboy refill) 216	258 houses (Village 1) 216	312 houses (Village 1) = 258 351 houses (Village 2) = 2[illegible] 576	441 houses (Village 2) = 360 672 houses (Village 3) = 504 864	28 houses (Village 3) = 35	924 houses (Village 4) = 720
[illegible]ed	237	636	1,132	1,683	1,818	4,330
[illegible]s		253 (Humboy refill)	288 houses Humboy refill 288 houses (Village 1)	288 Humboy refill 600 (Village 1) 384 (Village 2) 1,272	285 Humboy refill 600 (Village 1) 875 (Village 2) 2,365	785 Humboy refill 600 (Village 1) 825 (Village 2) 700 (Village 3) 2,413
[illegible] resettled [illegible]n*		504	1,036	2,353	4,531	4,826
[illegible]	237	132	96			494
				670	2,350	
[illegible]left						
[illegible]s to						

	July 1983	January 1984	July 1984	January 1985	July 1985	January 1986	July 1986
[illegible]	533	533	533	533	533	533	-
	2,805 Blocks 1-2-3	2,805 Blocks 1-2-3 1,221 Block 4 4,026	5,471 Blocks 1-4 1,353 Block 5 6,824	6,824 Blocks 1-5 1,056 Block 6 1,485 Block 7 9,365	9,934 Blocks 1-7	10,6[illegible] Blocks 1-7 752 Block 8 2,013 Block 9 13,463	14,[illegible] Blocks [illegible] 9[illegible] Block 10 15,762
[illegible] building	100 (Village 5)	100 (Village 6)	100 (Village 7)	-	100 (Village 8)	100 (Village 9)	100 (Village 10)
Fuel [illegible]	100	100	100	-	-	-	-
[illegible]ucture	57	57	44	7	72	151	-
	737 houses (Village 5) = 576	768 houses (Village 6) = 576	32 houses (Village 6) = 72 1,056 houses (Village 7) = 792 864	69 houses (Village 7) =72	375 houses (Village 8) =432 384 houses (Village 9) =288 720	1,141 houses (Village 9) = 936 750 houses (Village 10) = 576 1,512	-
[illegible]ed	4,171	3,800	8,507	9,977	11,419	15,259	1[illegible],872
[illegible]s	788 Humboy refill 600 (Village 1) 825 (Village 2) 700 (Village 3) 925 (Village 4) 3,338	600 (Village 1) 825 (Village 2) 700 (Village 3) 925 (Village 4) 425 (Village 5) 3,475 + 600 Humboy families integrated into the scheme in Village 5	600 (Village 1) 825 (Village 2) 700 (Village 3) 925 (Village 4) 425 (Village 5) 768 (Village 6) 4,243 + 600 Humboy families	600 (Village 1) 825 (Village 2) 700 (Village 3) 925 (Village 4) 425 (Village 5) 800 (Village 6) 1,056 (Village 7) 5,331 + 600 Humboy families	600 (Village 1) 825 (Village 2) 700 (Village 3) 925 (Village 4) 425 (Village 5) 800 (Village 6) 1,125 (Village 7) 5,400 + 600 Humboy families integrated	600 (Village 1) 825 (Village 2) 700 (Village 3) 925 (Village 4) 425 (Village 5) 800 (Village 6) 1,125 (Village 7) 432 (Village 8) 5,847	
[illegible] resettled [illegible]n*	7,009	7,992 + 1,500 from Humboy families	10,627 + 1,500 from Humboy families	13,860 + 1,500 Humboy families	13,500 + 1,500 integrated Humboy labour	16,914 + 1,500 integrated Humboy labour	[illegible]
[illegible]	2,838	3,692	3,600		2,325 minimum population maximum work load		
				5,383	3,581 (maximum) population minimum work load	2,124 maximum population minimum work load	
[illegible]left				584	447		
[illegible]s to						720	2,272

[illegible]gures based on the Main Population Assumption (Assumption A).

programme makes heavy demands on labour but also, and perhaps primarily, because through their experience of farming, they can give vital assistance in making a success of the agricultural programme and in helping achieve self-sufficiency. In Dujuuma the failure of agriculture was attributed entirely to unfavourable physical conditions. However, in the other two agricultural settlements development has also been slow. At Kurtun Waarey, the total irrigated area amounted to 830 ha in the summer of 1979 (120 ha rice, 600 ha maize, 30 ha bananas, 80 ha beans). The corresponding figure for Sablaale was 800 hectares. In both cases the target of 3,000 hectares of irrigated and 3,000 hectares of dryland farming was to be achieved by the end of 1979. The difficulties of creating an agricultural settlement scheme from practically nothing are obvious. Homboy is in the fortunate position of having a substantial and fairly successful farming community, therefore every effort should be made to attract the local people to join the scheme.

2.1.3 Schedule

The programme drawn up for relocation for housing alternatives 6 and 7 have been worked out with a reasonable safety margin to accommodate unforeseen delays. The most important consideration is to ensure that sufficient labour is available for farming activities as the fields become available for irrigation. The lower requirement for agricultural labour during the first three seasons of operation on each block, when a simplified cropping pattern is used, has been taken into account. In both programmes, however, the figures of total farm labour requirements are also included to give an upper margin; many labourers are likely to be women, especially in the first 2-3 years and they may not be able to work even half-time. The two figures on the Resettlement Programme schedules indicate the 'safe path' with regard to farm labour. Both Housing Alternatives 6 and 7 would be impossible to start without the participation of local Homboy labour. This participation has been reduced as far as possible, both in numbers and in respect to the length of involvement, since ultimately, it will depend upon Government policy to what extent they will be involved in the scheme.

Even the most optimistic population projection indicates that the Dujuuma population together with the 600 Homboy families will be sufficient to fill eight villages out of the ten, and only seven villages if the Homboy families do not join the scheme. Barring another influx of refugees, however, it is unlikely that the population figure will stand as high as indicated in the Main Projection.

In January 1981, 27 highly skilled labour are required (plant operators, craftsmen, mechanics) for the engineering work. As there will not be time for training only people who have had sufficient experience in this work can be employed. Some local men from Homboy will probably have worked on other projects (for instance, the Jubba Sugar Project). In addition, in July 1980, a training programme must start for 44 skilled and 36 semi-skilled labour, who will build the community buildings in each village; these are permanent constructions and labour, versed in local construction only, must be trained for at least a year on site. In January 1981 another group of 44 skilled and 36 semi-skilled labourers will start training; their task will be to build the central village community buildings. Their training period will also be one year. All these skilled and semi-skilled labour should be retained throughout the construction period to avoid delays occasioned by the training of new men.

The house building programme both in the case of Alternative 6 and Alternative 7 require only 'local skills' and it should not be difficult to find sufficient people among the Dujuuma population. However, the first group of houses will be built before any resettlement from Dujuuma to Homboy has taken place, and will involve the Homboy people.

2.1.4 Population Assumptions

The attitude of the settlers during the next five years and migration trends could affect future population numbers. Several possibilities exist:

(a) Population will not decline by out-migration beyond the 1979 level and all families are willing to move to Homboy.

(b) Population will not decline by out-migration beyond the 1979 level but not all families are willing to move to Homboy. According to Mr. Farah Abi Gule, the commissioner in Dujuuma, about 1,000 families will not move.

(c) Population will decline at the 1978-79 rate but all families are willing to move to Homboy.

(d) Population will decline at the 1978-79 rate and about 1,000 families are not willing to move to Homboy.

The various alternatives will not affect the resettlement programme in any significant way until July 1985, by which time the trend in the movement and attitude of the population will be clear and the programme can be adjusted accordingly.

2.1.5 Housing Alternative 7 - Figure 1

Dujumma families will be resettled - starting in January 1981 - as shown in Table 2.2.

TABLE 2.2 SCHEDULE OF RESETTLEMENT OF DUJUUMA FAMILIES HOUSING ALTERNATIVE 7

	No. of Families	Location
January 1981	150)	Homboy infill
	150)	
January 1982	300	Village 1
July 1982	700	Villages 1-2
January 1983	1,125	Villages 2-3
July 1983	925	Village 4
January 1984	125	Village 5
July 1984	1,925	Villages 6-7
January 1985	447	Village 8
Total	5,847	

In July 1984 according to Population Assumption A (see Section 2.2.4) all villages from 1-7 will be full and only 447 families will remain at Dujuuma. In the case of Population Assumption B, however, Village 7 will be short of 553 families, whereas using Population Assumption C, the shortfall would be 162 families. If Population Assumption D applies, Village 7 will have no population and Village 6 will be short of 37 families.

By January 1985 all Dujuuma families will have been resettled (assuming the maximum number of projected population). In the cases of Population Assumptions B, C and D there will be a shortfall of people by July 1984. At present it is impossible to decide with any degree of certainty which population assumption will correspond most closely to the actual situation, or indeed whether there may not be an absolute increase in the numbers of settlers, by migration of families or individuals back to the settlement.

In any case, cultivation of fields in Blocks 1-6 will not be affected even by the most pessimistic Population Assumption (D). As far as the labour force is concerned the most optimistic population assumption (A) will ensure enough hands for the cultivation of all fields up to July 1986 and the building of villages 8-10, provided that fields in each block have simple cropping patterns for the first three seasons (one year and a half). It is, of course, quite likely that young people, who constitute the rapidly increasing surplus of labour force, will marry at an earlier age than is customary (in our assumption all men are married by 22½ and all women are married by 20 and have children - see Section 3.2). If this is so, the number of families will increase at a much higher rate than projected and will fill up Village 8 and perhaps even Village 9, causing corresponding changes in the assumed shortfall of families (see last line of Figure 2.1).

On the other hand, a number of young people may leave the settlement in order that they may continue their education beyond the age of 15, in secondary schools, vocational schools or training colleges, some may go to university and others may seek employment elsewhere. This will affect the potential labour force as well as the number of future families.

With housing Alternative (7), the surplus labour is sufficiently large by 1983 for the development not to be held up. Between 1980 and 1983, however, the support of local Homboy population is essential for creating the conditions in which this surplus margin can come about.

2.1.6 Housing Alternative (6) - Figure 2

With this type of construction Dujuuma families will be resettled - starting in January 1981 - as shown in Table 2.3.

TABLE 2.3 SCHEDULE OF RESETTLEMENT OF DUJUUMA FAMILIES. HOUSING ALTERNATIVE 6

	No. of Families	Location
January 1981	288	Homboy infill
July 1981	288	Village 1
January 1982	312	Village 1
	384	Village 2
July 1982	441	Village 2
	672	Village 3
January 1983	28	Village 3
July 1983	925	Village 4
January 1984	137	Village 5 at the same time 600 Homboy families will be integrated into the scheme and settled in new houses in Village 5.
July 1984	768	Village 6
January 1985	32	Village 6
	1,056	Village 7
July 1985	69	Village 7
January 1986	447	Village 8

By January 1986 the resettlement of all Dujuuma families will have been completed, and the shortfall of families remains the same as in the previous section (2.1.5).

2.2 TRANSPORTATION

Transportation of settlers from Dujuuma to Homboy presents no real problem and is scheduled to take place during June/July and December/January when road conditions should be reasonably good. The plan assumes that 20 trucks will be available from SDA and that each truck can transport 3 families each trip and that under favourable conditions two round trips/day/truck can be made thereby transporting 120 families/day. Should this prove impracticable the families can still be transported within the period at only one round-trip per day. The time required to transport various numbers of families on these assumptions is shown below in Table 2.4.

TABLE 2.4 TRANSPORTATION OF DUJUUMA FAMILIES

	Number of Families				
	300	400	600	800	1,000
At 1 round trip/day	5.0 days	6.6 days	10.0 days	13.3 days	16.6 days
At 2 round trips/day	2.5 days	3.3 days	5.0 days	6.6 days	8.3 days

2.3 LABOUR REQUIREMENTS

2.3.1 Fixed Labour Requirements

The two groups of fixed labour requirements are the engineering work for the irrigation, and the labour for agriculture.

The schedule for the engineering work represents the basis that determines all other planning.

2.3.2 Labour for Engineering Work

For the first year, July 1981-July 1982, only 75 per cent of the total labour force will be used. From then on the full labour force will be required. Labour requirements are:

Plant operators	112
Craftsmen	49
Mechanics	20
Labourers	397
Ancillary workers (guards, cooks, etc.)	100
181 skilled	497 unskilled labour

The standard of skills required here is so high that, among the local Homboy population, there are unlikely to be more than 20 per cent sufficiently experienced to qualify for employment. Therefore for skilled labour, the programme includes only 20 per cent of the requirement, but all unskilled labour will come from the local population (either Homboy or Dujuuma).

2.3.3 Farm Labour

The engineering plan schedules a programme of construction for the ten blocks of irrigated land. Each block has a village for the people who cultivate the land in that block, the size of which is therefore determined by the net irrigable area of land.

Where part of a block is ready for irrigation before the completion date of the entire block, no specific provision has been made to ensure that labour is available for immediate cultivation. By June 1982 there will be sufficient surplus labour available to meet this requirement and the rate of the house construction has been speeded up with this in mind. Table 2.5 shows the planned rate of agricultural development for which labour will be available.

TABLE 2.5 SCHEDULE OF COMPLETION DATES AND SIZES OF BLOCKS

	Completion Date		Area (ha)
Block 1	June	1982	600
Block 2	October	1982	825
Block 3	December	1982	700
Block 4	December	1983	925
Block 5	June	1984	1,025
Block 6	October	1984	800
Block 7	December	1984	1,125
Block 8	October	1985	575
Block 9	December	1985	1,525
Block 10	June	1986	750

The agricultural plan provides simplified cropping patterns for the first three seasons of cultivation in each block as this will reduce the labour requirements considerably. In the period of simplified cropping pattern the labour requirement for 100 hectares will be as follows:

TABLE 2.6 DAILY LABOUR REQUIREMENTS PER 100 HA USING SIMPLIFIED CROPPING PATTERNS - IN HALF-MONTHLY MEANS

Jan		Feb		Mar		Apr		May		June		July		Aug		Sept		Oct		Nov		Dec	
10	54	14	-	-	-	-	35	45	50	75	43	24	15	44	8	15	18	62	133	144	81	38	43

The maximum labour requirement in the simplified cropping pattern is 133, i.e. about 66 per cent of the assumed two labourers per hectare specified for the normal cropping pattern. The farm labour requirements were based on this 66 per cent figure. In the resettlement planning (Figures 2.1 and 2.2), apart from the labour requirements of the simplified cropping pattern, the full (2/ha) requirements are also indicated as the upper limit. Whereas in planning the villages the number of families is decisive, for labour figures the number of families is not a reliable guide. About 54 per cent of Dujuuma families are estimated to be without a head of household (see Table 2.16 Population Projections), although in the course of years this percentage will be gradually tilted in favour of families with a head of household. As young people in the yearly age groups from 9 years upwards enter the potential labour force at the age of 15 years, the ratio will change. In 1980 the potential labour force will exceed by 2,150 the number of potential labour calculated on the basis of families (2,423 with head of household present, i.e. 2 labourers per family, and 2,644 with the head of household absent, i.e. one labourer per family). Again, there are 'old' families that require housing but will not be able to participate in the labour force.

2.3.4 Variable Labour Requirements

The labour requirements for the categories listed below depend on what standard of construction is recommended and chosen for social services facilities and housing. The villagisation report considers alternatives for housing and recommends standards to be followed in the construction of villages. There are four kinds of constructions to be analysed from the point of view of labour requirements:

(i) Social services buildings in each village.

(ii) Central village community buildings.

(iii) Housing in the villages.

(iv) Infrastructure (roads, water supply, electricity).

In (i) and (ii) the recommended type of construction is Alternative (1): Cinvaram walls, asbestos roof on timber frame, stabilised floor, coral foundation.

For (iii) various options are offered but only Alternatives 6 and 7 are recommended as feasible in the circumstances. Recommendations for (iv) are clearly spelt out and are used in the estimation of labour requirements.

2.3.5 Village Community Buildings

The time and labour requirements for the community buildings in each village are calculated on the basis of the 'Social Services requirements for an 800 family village' as given in Table 3 of the Villagisation Report (variations in smaller or larger villages will be small and will mainly affect school buildings). All buildings are permanent constructions, type Alternative (1) irrespective whether the housing type selected is Alternative 6 or 7. They can be built at a steady rate of 2 centres per year, the first to be ready by July 1982. The total area of the buildings is estimated at 1,780 m². In order to calculate labour requirements, figures for housing Alternative (1) have been used, based on the Villagisation Report. It is calculated that the total area of permanent buildings is equivalent to 62 houses. Work should start on 8 equal sites at about the same time. A calculation of labour requirements is shown at Tables 2.7 and 2.8.

TABLE 2.7 TIME REQUIREMENTS FOR ONE HOUSE ALTERNATIVE 1

			Labour	
	Days	Skilled	Semi-skilled	Unskilled
Footings excavation	0.6	-	-	8
Footings foundation	2	4	4	-
Walls	11	4	4	-
Beams	0.5	8	8	-
Rafters	1.5	2	2	-
Roof	2	4	4	-
Floor	1.3	4	4	-

Time required is 17.6 days assuming that the floor will be done simultaneously with the roof.

Labour requirements

Foundation	4 masons	2 assistants
Walls	(same)	
Beam	4 carpenters	4 assistants
	4 concreters	4 assistants
Rafters	(same as carpenters as above)	
Roof	4 roofers	4 assistants
Floor	(same masons/assistants as above)	

As the carpenters and roofers work 2 days out of 17.6 days they can be easily employed at 8 sites, provided that the starting date is staggered by two days.

Site 1 day x; Site 2 day x + 2, etc.

Concreters are needed for x/32 of the time but this saving cannot be realised. The same goes for the unskilled labourers. Their number cannot, however, be reduced without lengthening the total construction time.

TABLE 2.8 TOTAL LABOUR REQUIREMENTS FOR THE 8 SITES

Skilled	Semi-skilled	Unskilled
32 masons	16 assistants	8 labourers
4 carpenters	4 assistants	
4 concreters	4 assistants	
4 roofers	4 assistants	
44	**28**	**8**

To this must be added the work for the preparation of cinvaram blocks. Total requirement: 139,000 blocks.

1 team (2 operators-ssk, 3 labourers-unsk) can make 250 blocks a day. In 145 days 36,250 blocks. 4 teams can manufacture the requisite number of blocks. Manufacture of blocks must start about one month before required (drying time).

Labour: 8 Semi-skilled 12 Unskilled

Total labour requirement throughout the period of construction

44 skilled 36 semi-skilled 20 unskilled

If this labour is not available allowance must be made for a training period. One team required for the training of 44 skilled and 36 semi-skilled labour on 8 sites for the centre of Village 1:

8 fully trained masons
1 fully trained carpenter
1 fully trained concreter
1 fully trained roofer
2 fully trained cinvaram operators

In these circumstances the community buildings for Village 1 will take about 4 times longer than the above estimate i.e. work must start 2 years prior to completion date, in July 1980.

2.3.6 Central Village Community Buildings - Social Services for Project Support

Work on the main village precinct is more flexible in respect of timing as initially the scheme can function on the facilities of Homboy village. It is therefore assumed that all the buildings will not be completed until the middle of 1985 and the construction will not commence until the middle of 1982. The size of the construction work is about 6 times that of the community buildings in one village (see Table 1.2 in the Villagisation Report). Labour requirements are estimated on the basis of permanent construction Alternative 1.

44 skilled labour (32 masons, 4 carpenters, 4 concreters, 4 roofers)
36 semi-skilled labour (16 assistant masons, 4 assistant carpenters, 4 assistant roofers, 4 assistant concreters, 8 cinvaram operators).
20 unskilled labour.

As in the case of the village community buildings, work will start on eight sites, or construction units, which will save labour at the same rate as described in the estimate for the village community centres. For training, the same assumptions apply as for the village community buildings.

2.3.7 Housing

Alternative 7

The first type of construction considered is Alternative 7 in the Villagisation Report. 'Wattle daub for all structures including privy enclosures. These would be improved with straw binder in the mud, wattle cross bracing and bituminous paper in the roof, but otherwise identical to existing vernacular construction method'.

All labour and time estimates are based on calculation underlying cost and labour assumptions in the Villagisation Report (see Tables 1.7, 1.8 and 1.9 in the Villagisation Report).

Types of activities involved in the construction:

Sequential activities	Independent activities
Erecting walls	Gathering wattle
Fixing rafters	Gathering thatch material
Roofing	Preparation of thatch panels for roof

The first column represents work that must be done in this sequence and the time required for the completion of each stage cannot be reduced beyond a certain point. Examination of the construction methods indicates that 4 wattlers and 2 assistants, 4 roofers and 4 assistants, 2 carpenters and 2 assistants are the maximum number that can work on one house simultaneously without their getting in one another's way. Calculations of labour costs in the Villagisation Report are also based on these assumptions.

Time and labour requirements for one house:

Sequential activities

4 wattlers (skilled) and 2 assistants (semi-skilled) can erect the walls of one house in . . . . 4.7 days

2 carpenters (skilled) and 2 assistants (semi-skilled) can fix the rafters in . . . . 0.75 days

4 roofers (skilled) and 4 assistants (semi-skilled) can complete the roof in . . . . 2 days

7.45 days

Independent activities

Independent activities represent work not so strictly tied to the rate of construction; the number of people working can be increased according to need, as stock-piling is possible.

1 labourer (unskilled) can gather sufficient wattle for one house in . . . . 2 days

1 labourer (unskilled) can gather enough material for thatch roofing in . . . . 7 hours

1 thatcher can prepare thatch panels for one house in. . . . . 12 days

Total 15 days

2 labourers can complete the gathering of wattle and thatching in . . . . 1.5 days

2 thatchers can finish thatch panels in. . . . . 6 days

For maximum time saving two labourers can gather the material and make thatch panels in the same amount of time as takes to construct a house. Starting work one week earlier they can finish all the work in time. In our estimate, however, we shall assume two separate teams.

Construction of 300 houses in half a year (145 working days).

The teams outlined above can build 19 houses within this period of time. In order to complete 300 houses construction of 16 houses must start at the same time.

The detailed labour requirements of sequential and independent activities are shown in Appendix A but the totals are summarised below in Table 2.9.

TABLE 2.9 SUMMARISED TOTALS OF LABOUR REQUIREMENTS

	Skilled	Semi-skilled	Unskilled	Total
300 houses	68	44	64	176
400 houses	102	66	84	252
500 houses	120	72	110	302

Atlernative 6

'Improved Arish walls, thatch a bituminous paper roof on timber frame, compacted clay floor and coral foundations. Improved arish for toilet enclosure. Kitchen undaubed wattle thatch and bituminous paper roof of wattle rafters, earth floor without foundations'.

All labour and time estimates are based on calculations underlying cost and labour assumptions in the Villagisation Report. (See Tables 1.7, 1.8 and 1.9 in the Villagisation Report).

Types of activities involved in the construction work:

Sequential Activities	Separate Activities
Foundation	Gathering wattle
Erecting walls	Gathering material for thatch panels
	Preparation of thatch panels for roof
Rendering	
Fixing rafters	
Roofing	

Sequential activities represent the actual time constraint in construction. As in the case of Alternative 7 the teams working on one house cannot be increased beyond a certain point otherwise efficiency will decline.

The detailed labour requirements for the construction of one house are given in Appendix A together with details of how the various groups of labour can be combined to build different numbers of houses. Table 2.10 shows the overall totals of labour required.

TABLE 2.10 OVERALL TOTALS OF LABOUR REQUIRED

	Skilled	Semi-skilled	Unskilled	Total
300 houses	136	83	88	307
400 houses	187	104	94	385
500 houses	242	140	110	492

Optimum labour savings can be achieved through staggered starting dates if houses are built in multiples of 8 at the same time. Table 2.11 shows the labour requirements assuming that the houses are build with maximum labour saving.

In the calculations for Figure 1.2 all estimates of labour were based on the above maximum labour saving factors.

TABLE 2.11 LABOUR REQUIREMENTS WITH MAXIMUM LABOUR SAVING

Number of Houses	Labour
96	72
192	144
288	216
384	288
480	360
576	432
672	504
768	576
864	648
960	720
1,056	792

2.3.8 Infrastructure

Labour for infrastructure is estimated in the Villagisation Report to be 10 per cent of the labour required for housing. The numbers are the same for Alternatives 6 and 7; all unskilled.

2.4 POPULATION PROJECTIONS

2.4.1 Available Data

In trying to estimate future population of Dujuuma, several problems arose. Census figures are not available and many kinds of data are missing. Much of the accessible data are conflicting and of poor quality, there are considerable divergences between alternative estimates and anomalous sex ratios. In addition, the available figures do not conform to conventional (five-year) age groupings and there are no data available of yearly age groups for estimating the number of people entering the labour force, as children reach the age of 15.

Also, the projections in this case are sensitive to non-demographic aspects, such as climate (rainfall) and economic attractiveness of alternative work. Therefore projections had to be made of a situation which is inherently unstable. Male departures will probably continue as long as alternative sources of income and survival are available, female departures will vary with the scale of food handouts, the economic position of departed husbands and the permanence of their departure. Conversely, population would grow if another drought occurred.

2.4.2 Source

The sources of available data were figures from the Settlement Development Agency and those of the Mogadishu Office of the World Food Programme (the quantity of the food assistance is based on these figures). The system of recording age and sex composition has changed since the first assessment of the numbers of refugees by SDA in August 1975. The first count shows only two age categories: children (up to 14) and adults (15+) without sex groupings. The second count took place in autumn 1976. According to SDA files the population was 41,473 in November 1976 whereas WFP, at the time of the first food distribution, recorded a total of 47,554. The higher WFP figures in this case contrast with all subsequent WFP figures, which are otherwise consistently lower than those obtained from SDA in Mogadishu or in Dujuuma.

2.4.3 Trends Since 1975

The populations of Dujuuma as well as the other two agricultural settlements (Sablaale and Kurtun Waarey) have been declining since the emergency resettlement in 1975 at a more or less steady rate except for two periods when sudden decrease was experienced at all three locations. The first of these occurred within the first year, the second in 1978. The first wave of migration away from the settlements was in all probability a natural reaction of people who could not accept a settled existence and, on recovering from the shock of near starvation, returned to their pastoral existence.

The second sudden drop in the numbers of settlers is more problematic. One reason may have been that abundant rainfall and its effect on the vegetation improved the prospects of renewing livestock. Another explanation offered was the introduction of a stricter method of population counts. In the latter case the autumn 1978 figures would not indicate a sudden drop but register the result of a fairly rapid but steady decline that took place in the two preceding years. Two other explanations have also been suggested by Government officials, a period of intense drafting into the army and the introduction of restrictions in granting exit visas to people seeking work abroad. This issue unfortunately cannot be settled without an extensive survey among those who left the settlements.

The decline of population had, in any case, slowed down by later 1978 and has since remained at a moderate level, showing a tendency to level off. Table 2.12 shows the population figures for Dujuuma from 1977-1979.

2.4.4 General Approach

In estimating future population it is, in the circumstances, best to establish a probable lower and upper limit over the next six years. In the Main Projection (stating the upper limit) the mid-1979 figures (see Table 2.12) are held steady, without any further migration away from the settlement. In the Alternative Projection the population is assumed to decline at the rate as from mid-1978 to mid-1979.

The figures in Table 2.13 were established on the basis of the available population estimates, and as they were frequently conflicting, adjustments were made correcting anomalous sex ratios in one source by referring to the other and to past figures. Comparisons were made with similar settlements in Sablaale and Kurtun Waarey. For fertility/mortality assumptions we used the United Nations' data on Somalia published this year (The World Population situation in 1977. UN New York, 1979) comparing these with such figures as were obtainable at Dujuuma and the other two settlements. The UN figures give :

Death rate	per 1,000 population	21.7
Crude birth rate	per 1,000 population	47.2
Life expectancy at birth		
infant mortality		180/1,000

Data obtained from the three agricultural settlements show much lower birth and death rates (in Dujuuma birth rate 25.3; death rate 5.6) but much of the difference can be accounted for by a complete absence of data on infant mortality.

2.4.5 Main Projection

From the point of view of the Homboy Irrigation Scheme the relevant demographic data are the potential labour force and the number of families. Total population figures do

TABLE 2.12 DUJUUMA POPULATION 1977-1979

	0-5			6-14			15-30			31-45			46-60			61+			Total		
	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total
1977[1] March	2,773	2,430	5,203	10,306	7,765	18,071	4,847	5,292	10,139	1,781	2,396	4,177	925	968	1,893	298	249	547	20,930	19,100	40,030
	Ratio[4] : 144			Ratio: 133			Ratio: 92			Ratio: 74			Ratio: 96			Ratio: 120					
1978[2] June/July	1,678	1,555	3,233	7,120	5,645	12,765	2,770	3,099	5,869	808	2,908	3,716	560	580	1,140	299	352	651	13,235	14,139	27,374
	Ratio: 108			Ratio: 126			Ratio: 89			Ratio: 28			Ratio: 97			Ratio: 85					
1979[3] June/July	1,490	1,410	2,900	7,090	5,160	12,250	2,610	2,900	5,510	890	2,560	3,450	480	500	980	250	280	530	12,810	12,810	25,620
	Ratio: 106			Ratio: 137			Ratio: 90			Ratio: 35			Ratio: 96			Ratio: 89					
Annual Percentage changes																					
1977-78	-39.5	-36.0	-37.9	-31.0	-27.3	-29.4	-42.9	-41.4	-42.1	-54.6	+21.4	-11.0	-39.5	-41.0	-40.0	+0.3	+41.0	+19.0	-36.8	-26.0	-31.6
1978-79	-11.2	-9.3	-10.3	-0.4	-8.6	-4.0	-5.8	-6.4	-6.1	+10.1	-12.0	-7.2	-14.3	-13.8	-14.0	-16.3	-20.4	-18.6	-3.2	-9.4	-6.4

Notes:

1 *WFP figures (No data available at Dujuuma)*

2 *Figures from Dujuuma records*

3 *Figures from Dujuuma adjusted on the basis of information from the SDA and WFP*

4 *Sex ratio: number of males per 100 females*

TABLE 2.13 MID-1979 POPULATION ESTIMATES - Dujuuma

	0-5	6-14	15-30	31-45	46-60	61+	Total
M	1,490	7,090	2,610	890	480	250	12,810
F	1,410	5,160	2,900	2,560	500	280	12,810
Total	2,900	12,250	5,510	3,450	980	530	25,620
Per cent	11.3	47.8	21.5	13.5	3.8	2.1	-

not provide any idea either of feasibility of the alternative housing schemes or of the extent to which the villages have to (or can) be developed by 1986. The total population figures as in Table 2.14 were interpolated in order to establish estimates of 5 year (conventional) age groups. Table 2.15 shows the growth of population in each five year period between the ages 15-59 (both economically active and fertile age groups).

In estimating the potential labour force up to 1986 (Table 2.16) it was assumed that all available people would work on the project: neither employment elsewhere nor nomadic herding would be allowed. There is no allowance made for school attendance in the 15-19 age group. Unmarried girls are assumed to be able to participate fully in the labour force. Participation for women in the 20-59 age group was put at 75 per cent on account of periods away from work during pregnancy, after childbirth (they are exempt from work for 2 years after giving birth to a child at all three settlements).

In order to establish a coherent system, estimates of the number of families in each successive year were extrapolated from the population figures in Table 2.16 assuming that the average age of marriage in the settlements is between 20-25 for men and 17½-22½ for women (information obtained from the settlements). It was assumed, therefore, that all men over the age of 22½ are married and are heads of household and that all women over the age of 20 are married. Families with head of household equal the number of men over 22½ but under 60. Families without head of household present equal the number of women over 20 less the number of families with head of household present. A separate category was established for old families (over 60) as these may have to be housed but may not form part of the economically active population.

As Table 2.21 shows the number of available labour per family will be steadily rising as the under 15 yearly cohorts enter the working population.

2.4.6 Alternative Projection

The alternative projection was worked out on the assumption that migration away from Dujuuma is going to continue as from mid-1979 to mid-1986 with respect to the relevant age groups. Exact predictions are impossible, since even if the reasons for past trends had been established by an extensive survey of the settlers that have left, it would not be certain that future trends would conform. Continued delay in the resettlement scheme may increase outmigration, abundant rains one year may also contribute to it; new job opportunities in the area would certainly be an incentive for men to leave, especially if the salaries earned elsewhere are higher than those in the settlement (this would apply even when the construction of the Homboy scheme is already under way). On the other hand, another drought may reverse the trend drastically. Droughts of varying severity have occurred in Somalia on average every five years since 1919 (Jeremy Swift: Pastoral Development in Somalia. In Desertification, ed. Michael Glantz).

There are no definite indications that the trend of migration away from the settlements has been reversed, and certainly not in Dujuuma. According to WFP figures the population in Dujuuma dropped from 25,203 to 24,972 between December 1978 and May 1979. Figures obtained from SDA, on the other hand, show an increase of population from 25,203 to 26,290. Fortnightly migration figures available at SDA for mid-July 1978 show that 116 persons arrived at the settlement and 283 left it; for mid-July 1979 the number of arrivals was 227 while the numbers leaving 405. This indicates a much higher rate of movement in general and a slight increase in net outmigration.

In Sablaale net outmigration for the same period was 128 in mid-1978 and 615 in mid-1979.

In Kurtun Waarey net outmigration increased from 44 in mid-1978 to 203 in mid-1979, yet, according to both WFP and SDA figures the settlement showed a net increase of population between December 1978 and June 1979; this may be due to the inclusion of local population (1,139) in the scheme in spring 1979.

2.4.7 Assumptions in the Alternative Projection

For the 15-30 age group the sex ratio was held constant at 92.5 men:100 women since:

(i) males are susceptible to emigration;

(ii) sex ratio was unchanged from 1977 to 1979 despite drop in population;

(iii) women under 20 are not likely to leave.

For the 31-45 age group the sex ratio was held constant at 35 men:100 women (the trend of substantial male emigration was extrapolated, while the number of women varies little in any case.

For the 45-60 age group the sex ratio was held constant at 82 men:100 women.

Figures for the alternative projection are given in Table 2.18 and potential labour force and number of families in Tables 2.19 and 2.20.

2.5 LOCAL POPULATION IN THE HOMBOY AREA

The original local population will play an important part in making a success of the Homboy Scheme. Their experience in farming, their knowledge of the area, the position of Homboy as a meeting place of nomadic population in the region will greatly contribute to making the new settlement a lively and normal functioning place. Also, in contrast to Dujuuma, the local population did not have to go through a period of enforced idleness, with the inevitable result of low morale and a reduced capacity to work.

During our discussions with the local population it seemed that most of them are favourably disposed to joining the scheme if the conditions are reasonable. This was also the opinion of Mr. Abdulkadir Mohammed Kasib, the village head of Homboy, as well as of the inhabitants of several other villages in the area. In one or two places, however, the general opinion was that it would be more favourable for them to stay out.

Detailed census figures are not available for the Homboy region. The Statistical Department of the State Planning Board provided the figure of 693 heads of household for Homboy itself, but had no information about other villages or communities.

Homboy itself consists of 6 communities, for which we were able to obtain population figures from the Village Head.

Iftin	945
Kulmis	1,104
Xaafadh Barka	904
Holwadaag	775
Aminow	574
Bula Geduud	85

Other nearby communities are:

Dayax	250
Goorkha	300
Cumar Muuse	12
Sheek Cabdey Muudey	200
Kooskey	75

Other settlements further away are:

Brutuqam	93
Burgaan	1,497
Cabdihari	104
Xerer Mirsha	65
Xudda Saxalle	110

Other villages in the area without population figures:

Kusle, Dhaytatwake, Deghadey, Ged Subag, Cabdi Maama, Dexasera, Cumar Abooka, Gedgoy.

TABLE 2.14 GROWTH OF POPULATION AGED 15-59 - 1979-1986 MAIN PROJECTION

Year	15-19		20-24		25-29		30-34		35-39		40-44		45-49		50-59		Total	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
1979	1,265	941	713	891	540	890	414	888	293	882	219	850	176	300	313	299	3,933	5,941
1980	1,504	1,015	766	883	565	880	431	879	329	874	232	855	174	409	309	307	4,310	6,102
1981	1,849	6,176	843	880	590	870	450	870	343	865	247	850	175	523	305	321	4,793	6,355
1982	2,358	1,518	924	873	615	870	470	860	358	856	261	843	182	629	301	342	5,469	6,791
1983	3,107	2,044	1,050	877	642	860	491	858	374	847	277	837	189	731	297	362	6,427	7,416
1984	4,178	2,760	1,216	906	679	851	513	847	391	843	274	833	201	796	300	427	7,752	8,263
1985	4,853	3,269	1,446	978	730	843	536	838	407	834	307	826	213	801	295	537	8,787	8,926
1986	5,001	3,568	1,777	1,133	795	840	570	828	425	826	320	817	227	796	295	656	9,400	9,464
Annual Increase	21.7	21.0	13.9	3.5	5.7	-0.8	4.4	-1.0	5.5	-0.9	5.6	-0.6	3.7	15.0	-0.8	11.9	13.3	6.9

TABLE 2.15 POPULATION AGED OVER 15 - 1979 TO 1986 MAIN PROJECTION

	15-19			20-29			30-44			45-59			60 +			Total		
	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total
1979	1,265	941	2,206	1,253	1,781	3,034	926	2,620	3,546	489	599	1,088	277	299	576	4,210	6,240	10,450
1980	1,504	1,015	2,519	1,331	1,763	3,094	992	2,608	3,600	483	716	1,199	289	309	598	4,599	6,411	11,010
1981	1,849	1,176	3,025	1,424	1,750	3,174	1,040	2,585	3,625	480	844	1,324	295	317	612	5,088	6,672	11,760
1982	2,358	1,518	3,876	1,539	1,743	3,282	1,089	2,559	3,648	483	971	1,454	313	326	629	5,772	7,117	12,889
1983	3,107	2,044	5,151	1,692	1,737	3,429	1,142	2,542	3,684	486	1,093	1,579	312	333	645	6,739	7,749	14,448
1984	4,178	2,760	6,938	1,895	1,757	3,652	1,178	2,523	3,701	517	1,223	1,724	323	344	667	8,075	8,607	16,682
1985	4,853	3,269	8,122	2,176	1,821	3,997	1,250	2,498	3,748	508	1,338	1,846	312	327	639	9,099	9,253	18,352
1986	5,001	3,568	8,569	2,572	1,973	4,545	1,305	2,471	3,776	522	1,362	1,884	299	316	615	9,699	9,780	19,479

TABLE 2.16 POTENTIAL LABOUR FORCE - 1979-1986 MAIN PROJECTION

Year	Men 15-59	Women 15-19	Women 20-59[1]	Total
1979	3,933	941	3,750	8,624
1980	4,810	1,015	3,815	9,640
1981	4,793	1,176	3,884	9,853
1982	5,469	1,518	3,955	10,942
1983	6,427	2,044	4,029	12,500
1984	7,752	2,760	4,127	14,639
1985	8,787	3,269	4,243	16,299
1986	9,400	3,568	4,422	17,390

Note:
1 *Assuming 75 per cent participation only.*

TABLE 2.17 NUMBER OF FAMILIES - MAIN PROJECTION

Year	With H of H[1]	Without H of H[1]	Old Families (60+)	Total	Annual Increment
1979	2,312	2,688	299	5,299	-
1980	2,423	2,644	309	5,396	97
1981	2,527	2,652	317	5,496	100
1982	2,649	2,624	326	5,599	103
1983	2,795	2,577	333	5,705	106
1984	2,966	2,537	344	5,847	142
1985	3,211	2,446	327	5,984	137
1986	3,511	2,385	316	6,212	228

TABLE 2.18 POPULATION AGED OVER 15 - 1979-1986 ALTERNATIVE PROJECTION

	15-19			20-29			30-44			45-59			60+			Total		
Year	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total	M	F	Total
1979	1,265	941	2,206	1,253	1,781	3,034	926	2,620	3,546	489	599	1,088	277	299	576	4,210	6,240	10,450
1980	1,329	1,015	2,344	1,241	1,763	3,004	921	2,608	3,529	483	592	1,075	289	309	598	4,263	6,287	10,550
1981	1,472	1,176	2,648	1,235	1,750	2,985	913	2,585	3,498	480	588	1,068	295	317	612	4,395	6,416	10,811
1982	1,788	1,518	3,306	1,229	1,743	2,972	903	2,559	3,462	483	592	1,075	303	326	629	4,706	6,738	11,444
1983	2,271	2,044	4,315	1,227	1,737	2,964	897	2,542	3,439	486	595	1,081	312	333	645	5,193	7,251	12,444
1984	2,934	2,760	5,694	1,244	1,757	3,001	891	2,523	3,414	501	614	1,115	323	344	667	5,893	7,998	13,891
1985	3,413	3,269	6,682	1,296	1,821	3,117	882	2,493	3,375	508	622	1,130	312	327	639	6,411	8,537	14,948
1986	3,708	3,568	7,276	1,418	1,973	3,391	872	2,471	3,343	522	639	1,161	299	311	615	6,819	9,057	15,876

TABLE 2.19 POTENTIAL LABOUR FORCE - ALTERNATIVE PROJECTION

Year	Men 15-69	Women 15-19	Women[1] 20-59	Total	Difference from Main Projection
1979	3,933	941	3,750	8,624	
1980	3,974	1,015	3,722	8,711	929
1981	4,100	1,176	3,692	8,968	885
1982	4,403	1,518	3,670	9,591	1,351
1983	4,881	2,044	3,655	10,580	1,920
1984	5,570	2,760	3,670	12,000	2,639
1985	6,099	3,269	3,702	13,070	3,229
1986	6,520	3,568	3,853	13,941	3,449

Note:
1 *Assuming 75 per cent participation.*

TABLE 2.20 NUMBER OF FAMILIES - ALTERNATIVE PROJECTION

Year	With H of H[1]	Without H of H[1]	Old Families (60+)	Total	Annual Increment	Difference from Main Projection
1979	2,213	2,688	299	5,299	-	-
1980	2,292	2,671	309	5,272	-27	124
1981	2,276	2,647	317	5,240	-32	256
1982	2,266	2,628	326	5,220	-20	379
1983	2,259	2,615	333	5,207	-13	498
1984	2,274	2,620	344	5,238	+31	609
1985	2,295	2,646	327	5,268	+30	716
1986	2,359	2,814	316	5,489	+221	723

Note:
[1] *Head of Household.*

TABLE 2.21 NUMBER OF AVAILABLE LABOUR PER FAMILY

Year	Main Projection	Alternative Projection
1980	1.7	1.6
1981	1.8	1.6
1982	1.9	1.8
1983	2.1	2.0
1984	2.5	2.3
1985	2.7	2.4

APPENDIX 1

HOUSING LABOUR REQUIREMENTS

1.1 ALTERNATIVE 7 LABOUR REQUIREMENTS

As outlined in Section 2.3.7 labour is required for both Sequential activities and Independent activities which are now described in greater detail for the construction of 300 houses in 145 working days. The teams outlined in Section 2.3.7 can build 19 houses in the required time. Therefore, to complete 300 houses construction of 16 must begin at the same time.

Sequential Activities - Labour Requirements

4 roofers with 4 assistants are occupied only 1/4th of the total time (7.5 days). Therefore, one team can complete the work on 4 houses, provided that the starting date of the construction is staggered:

1st house	day x
2nd house	day x +2
3rd house	day x +4
4th house	day x +6

A similar staggering schedule is applied to the second group of 4 houses:

5th house	day x +1
6th house	day x +3
7th house	day x +5
8th house	day x +7

Consequently 2 teams of carpenters (2 carpenters and 2 assistants) whose time input is 1/8th of the total construction time can do the work on 8 houses.

A similar saving for wattlers is less significant but with efficient organisation of the work wattlers' input can be reduced by about 25 per cent.

Total labour force for 16 houses at the same time taking into consideration the 8 days' spread outlined above.

1 team: 4 wattlers, 2 assistants
16 teams: 64 wattlers (sk)
32 assistants (ssk)

	Skilled	Semi-skilled	Unskilled
less 25 per cent	48	24	

Carpenters		Skilled	Semi-skilled	Unskilled
1 team:	2 carpenters (sk 2 assistants (ssk)			
16 teams: 8		4	4	
Roofers				
1 team:	4 roofers (sk 4 assistants (ssk)			
16 teams: 4		16	16	

Labour requirements for independent activities

Gathering material and manufacturing thatch panels

1 team: 4 (unsk) labourers

16 teams: 64 (unsk)

Total		68(men)	44	64(women)

Construction of 400 houses in half a year (145 working days)

One team will build 19 houses in the given period. 21 houses must be started at about the same time if the target is to be met. 20 teams will complete 380 houses.

Labour requirements

As outlined above the construction of 300 houses within 145 days required:

68 skilled 44 semi-skilled 64 unskilled labour

Labour for the reamining 100 houses:

The construction of 6 houses will start at the same time; applying the same principle of staggered starting date, although less efficiently. The time (37 per cent surplus) left over here can be used to carry on construction of the next group of 400 houses.

Wattlers		Skilled	Semi-skilled	Unskilled
1 team:	4 wattlers, 2 assistants			
8 teams:	32 wattlers (sk) 16 assistants (ssk)			
less 25 per cent		24	12	
Carpenters				
1 team:	2 carpenters (sk) 2 assistants (ssk)			
8 teams 8		2	2	
Roofers				
1 team:	4 roofers (sk) 4 assistants (ssk)			
8 teams 4		8	8	

Independent Activities	Skilled	Semi-skilled	Unskilled
Gathering material, manufacturing thatch panels			
1 team: 4 (unsk)			
5 teams:			20
Total	**34**	**22**	**20**
Total for 400 houses	68	44	64 (women)
	34	22	20 (women)
	102	**66**	**84**

Pro-rata surplus of skilled and semi-skilled labour only 12 per cent.

Construction of 500 houses

The construction of 27 houses must start at the same time for 500 to be completed in 145 days.

Labour requirements

For 24 houses to start at about the same time the requirements are, taking into account, the labour saving device of staggered starting dates outlined above.

Wattlers' team	Skilled	Semi-skilled	Unskilled
Wattlers	72		
Assistants		30	
Carpenters' team			
Carpenters	6		
Carpenters' assistants		6	
Roofers' team			
Roofers	24		
Roofers' assistants		24	
Total	102	60	
Independent activities			
Gathering material and making thatch panels			96

For the remaining 3 houses to start at the same time (here there is a wastage of 37.5 per cent).

Wattlers	12		
Wattlers' assistants		6	
Carpenters	2		
Carpenters' assistants		2	
Roofers	4		
Roofers' assistants		4	
Separate activities			12
	120	72	110
	302		

1.2 Alternative 6 - Labour Requirements

Time and labour requirements for one house

Sequential activities				
Footings				
Excavation	8 labourers (unskilled)	4 teams	0.5 days	
Coral foundation	4 masons (skilled)	4 teams		
	4 assistants (semi-sk)		1.5 days	
Walls				
Erecting	4 wattlers (skilled)	4 teams		
	2 assistants (semi-sk)		4.5 days)	overlap possible
Rendering	4 renderers (skilled)	2 teams		to reduce
	2 assistants (semi-sk)		3.0	to 7.2 days
Roof				
Rafters	2 carpenters (skilled)	2 teams		
	2 assistants (semi-sk)		1.5	
Roof	4 roofers (skilled)	4 teams		
	4 assistants (semi-skilled)		1.125	
			Total 12 days	

Independent activities

Same as in Alternative 7.

4 unskilled labour (1 group of 4 labourers can complete the work for 2 houses, provided they start 2 weeks in advance).

Construction of 300 houses in half a year (145 working days).

25 houses must start at about the same time to complete 300 houses in 145 days.

The groups of labour need not be multiplied by 25 as the building programme can be staggered to start at two days' intervals.

Day x, day x +2. . . . . .day x +8	
Unskilled labour for excavation of foundations 3 x 8	24 (unsk)
1 group of 4 teams of masons/assistants can do the work on 8 houses	
Total requirement 3 groups of 4 masons	12 (sk)
4 assistants	12 (ssk)
1 group of 4 wattlers 2 assistants can provide for 2.5 houses	
12 groups of 4 wattlers	48 (sk)
2 assistants	24 (ssk)
can do the work on 25 houses	
1 group of 4 renderers	
2 assistants do the work on 3 houses	32 (sk)
8 groups can provide for 25 houses	16 (ssk)

1 group of	4 carpenters 4 assistants can do the work on 8 houses	
3 groups of	4 carpenters 4 assistants can provide for almost 25 houses	12 (sk) 12 (ssk)
3 groups of	4 roofers 4 assistants can do the work on 25 houses	12 (sk) 12 (ssk)
		116 skilled 75 semi-skilled
+ 10 per cent	**Total**	**136 skilled 83 semi-skilled**

Independent activities

The same principle as for Alternative 7, starting 6 days prior to day x, the first day of the staggered programme requirement.

			64 unskilled
Total for 300 houses	136 skilled	83 semi-skilled	88 unskilled

Construction of 400 houses in 145 days.

Construction of 34 houses must start at about the same time.

4 groups of 8 houses	170 skilled	94 semi-skilled	94 unskilled
+ 10 per cent skilled and semi-skilled			
Total	**187 skilled**	**104 semi-skilled**	**94 unskilled**

Construction of 500 houses in 145 days

Construction of 42 houses must start at the same time.

5 groups of 8 houses			
+ 10 per cent skilled and semi-skilled			
	220 skilled	128 semi-skilled	110 unskilled
Total	**242 skilled**	**140 semi-skilled**	**110 unskilled**

Figures 2.1 and 2.2 outline the development plans showing the various activities and the labour requirements necessary for their undertaking. The primary consideration is to ensure that labour is available to undertake the agricultural development as soon as the irrigation blocks are completed. This in turn specifies the village completion dates and hence the labour required for housing and infrastructure construction. Since the plan is initially to use incoming labour for the house construction programme, the villages are planned to be completed before the irrigation blocks. To ensure that there is sufficient labour available it is essential that the present Homboy population be used in the critical early stages. By 1983 the surplus labour is sufficiently large for the development not to be held up through labour shortage.

The plans require that training programmes begin in 1980 to supply the necessary skilled and semi-skilled labour necessary for the construction of village community buildings, and a further programme be started in January 1981 to train people for the construction of the project control buildings in Homboy. It is recommended that once trained, these people remain with the respective construction programmes until they are completed to ensure the greatest efficiency of labour use.

The house construction labour requirements have been calculated on the basis of using labour teams each of which works on a number of houses at any one time in order to optimise savings which can be derived from staggering the starting times of certain activities.

The figures showing the labour required for engineering work are based on the assumption that all unskilled labour can be drawn from the local population. The high levels of skill required for jobs such as plant operators, craftsmen and mechanics means that it is highly unlikely that any more than 20 per cent of the skilled labour will be found locally and the balance will have to be recruited elsewhere. The labour requirements shown in Figures 2.1 and 2.2 show only that which can be obtained locally.

The final requirement for labour is the farm work after the irrigation works have been completed. It is planned to operate a simplified cropping programme for the first three seasons in each irrigation block as the reduced labour force required enables the surplus to be released for the construction of houses and infrastructure.

In the analysis labour availability is calculated from the number of families resettled in the project area. In the first year of development it is calculated that an average 1.7 people per family will be available to work on the project but this figure rises steadily as children in the younger age groups enter the working population. By 1985 2.7 people per family can be employed.

Part 3
Groundwater

3.1 INTRODUCTION

The main objective of the hydrogeological appraisal was to determine whether the potable water demand of the proposed settlements could be supplied from groundwater sources. Further objectives were to determine the best methods of groundwater abstraction and evaluate the costs of any necessary installations.

The main problem with attaining these objectives has been the weakness of the existing data base. Thus, though some work relevant to the hydrogeology of the region had been done in the past, much of the data appears to have been lost. A particular example of this are the boreholes drilled by the Russians, for which all records seem untraceable. Further, even such scant data as exists has never been systematically analysed and compiled.

The approach of this study has been to collect all the published information, particularly the various development reports, to interview the personnel of various agencies concerned with groundwater work in Somalia and to conduct a field survey to collect geological and hydrogeological data. All this information has been carefully processed and compiled to obtain a regional picture of the groundwater systems. The Project Area itself, for which basically no subsurface data exists, was then viewed within that regional context. The results obtained are not fully conclusive but they are strongly indicative.

3.2 GEOLOGY AND GEOMORPHOLOGY

The Project Area is located at the confluence of the Jubba and Shabeelle flood plains, in the coastal sedimentary basin east of the Great Banta-Gialalassi Fault, which runs along the whole length of Somalia, more or less parallel to the coast and divides the country into two major hydrogeological provinces. The whole region consists essentially of flat lowlands with stabilised coastal dunes forming some more uneven relief in a belt of low hills.

Apparently the southern extremity of the coastal province, which includes the Project Area, is underlain by a great thickness of Tertiary sediments of marine origin. Technital S.p.A. (1975) quoting evidence from deep exploratory oil drillings, report the presence of Tertiary deposits 3,000 to 4,000 metres thick, comprising sandstones and shales with subordinate limestones, sometimes gypsiferous; layers of lignite are common throughout the sequence.

According to Technital S.p.A. this Tertiary succession is overlain by a Quaternary alluvial complex, several hundred metres in thickness. In contrast, Johnson (1978), discussing the groundwater resources of the Jubba Valley, states that no deep alluvials had been identified and that the Lower Jubba region is underlain exclusively by marine sands, marls, clays and gravels. It would seem that this contention is contradicted by evidence from recent drillings, which penetrate gravels, sands and clays of typically fluviatile nature.

The alluvials were presumably deposited by the ancestral Jubba and Shabeelle Rivers. This fluviatile deposition was interrupted at least once by a marine incursion into the area, probably associated with sea level changes during the Pleistocene ice age. This resulted in a period of lagoonal conditions which led to the formation of one of the major geomorphic units of the region, the Marine Plain (Lockwood/FAO, 1968). Subsequent marine recession allowed the resumption of riverain activity with the formation of the present Jubba and Shabeelle flood plains.

The lithological character of the Quaternary strata is not well documented except for the surface deposits which have been mapped by the soil survey. There are some exposures of shallow subsurface formations in sand pits excavated for construction materials; there are also some wells which penetrate deeper into these deposits, but in most cases the lithological information from these was either not collected at all or has been lost since.

The surface deposits over the whole region are mainly clayey, often of swelling montmorillonitic clays. These are virtually impermeable when wet but crack deeply on drying out. There is some evidence that they are often underlain by sand.

A large sand pit near the village of Maqdas showed the following near surface succession:

Depth	Lithology
0 - 1 m	Red lateritic soil.
1 - 3 m	Red fine sand with white calcareous concretions.
3 - 4 m	Grey sandstone, fine grained showing nodular weathering.
4 - 6+ m	Red fine sand with white calcareous concretions.

It appears that the occurrence of the red sand with calcareous concretions is widesoread throughout the region as similar material was seen on spoil heaps of excavated material found adjacent to recently constructed dug wells, both in sandy and clayey soil areas.

Information on deeper lithology is available from one drilling only, located outside the Study Area at the Trans-Jubba Project compound along the main Kismaayo to Jilib road some 6 km south of Kamsuuma. The succession at that site is as follows:

Depth	Lithology
0 - 6 m	Clay, loamy.
6 - 12 m	Loam with very fine sand.
12 - 18 m	Gravel, medium to fine, with medium sand and interbedded marl.

18 - 49 m	Sand, fine to medium, with fragments of crystalline rock; contains inter-bedded layers of calcareous gravel.
49 - 70 m	Gravel, medium to fine, well rounded, calcareous, with fine to medium sand.
70 - 89 m	Clay with sub-angular calcareous gravel and some very fine sand.
89 - 105 m	Clay, grey, with a little calcareous gravel.

It is likely that this sequence is fairly typical of the Project Area, though the various layers can be expected to vary widely in thickness and the depth at which they are found.

It should be mentioned that all the lithological data available relates to areas very close to the Jubba River, whereas the proposed development area (where the proposed settlements will be situated) is located astride the Shabeelle flood plain. Thus it is possible that the alluvial succession there is rather different.

In terms of geomorphology four distinct units have been identified in the region by Lockwood/FAO (1968):

(i) Marine Plain.

(ii) Shabeelle Alluvium.

(iii) Jubba Alluvium.

(iv) Beach Remnants.

The Marine Plain is the most widespread of these. The Shabeelle Alluvium occurs in a wide flood plain with a now mainly abandoned river channel as the present day Shabeelle ends in a swamp upstream of the Project Area, except at times of particularly large floods. The Jubba Alluvium is found in a narrow tract along the present course of the river. The Beach Remnants occur as small isolated, slightly elevated patches of sandy material; these are believed to be remnants of beach ridges and coastal sand dunes.

From the point of view of hydrogeology the geomorphology of the Area may be significant with relation to groundwater salinity. In view of the recent marine history of the region, the best chances of good quality groundwater occurrence are near the present and recent courses of the rivers where the saline marine influence may have been flushed out by seepage from the rivers.

3.3 AQUIFERS

The water table is normally somewhere around five metres below ground level near the Jubba but increases in depth rapidly with distance from the river. In most of the region it is usually at depths of between 15 and 20 metres. It appears that below that depth potentially productive aquifers are found at various levels throughout the Quaternary (? alluvial) profile and are probably also present in the underlying Tertiary sequence.

Dug wells in the Area penetrate about two metres below the water table and usually tap a sandy layer or lens but some may bottom in clay. The productive layer is commonly the sand with calcareous concretion as witnessed by the spoil heaps of newly excavated wells. Water quality evidence suggests that this is a discontinuous series of minor aquifers isolated from each other by clayey material. Nevertheless these aquifers are sufficiently permeable to sustain production by bucket and rope of about 1,000 litres per hour at peak abstraction times. In one case a dug well very close to the river yielded enough water to sustain a pumped discharge of about 5 litres per second (l/s).

Though, as already mentioned, data from deeper, drilled wells is extremely scarce, it appears that further permeable layers of sand and gravel are always found within the top 100 metres or so. Thus all the drilled wells in the region have no problems with sustaining their, admittedly low, production rates. The depths of these wells reportedly vary from some 35 to about 100 metres and the yields are estimated as between 5 and 10 l/s.

Quantitative data on the transmission properties of the aquifers is available at one place only, namely Well No. 20 (see Figure 3.1), where a pumping test has been done. Application of the Logan method to these data gives a transmissivity of 3.3 m^2/hour from a screened section of gravel of 19 metres. This is equivalent to a permeability of about 4.2 m/day, which is more consistent with fine sand than with gravel and suggests that either the aquifer is partially cemented or contains a considerable admixture of very fine material.

Nothing is known about the production capacity of deeper Quaternary and Tertiary aquifers, but they are known to exist.

To summarise it is apparent that potentially productive aquifers occur extensively throughout the profile in the whole region. To obtain discharges of between 5 and 10 l/s, which would certainly satisfy the demands for potable water of individual settlements, drilled depths of well of no more than 100 metres would probably suffice.

3.4 WELLS AND BOREHOLES

All wells and boreholes, that could be found in the region, were visited and all available relevant information from them was collected. The results of this survey are summarised in Table 3.1. The approximate locations of all these wells are given in Figure 3.1.

Eighteen dug wells were inspected. The absolute range of depths is from about 6 to 25 metres, but most of the wells are probably between 17 and 22 metres deep. The penetration below the water table is normally about two metres.

The usual practice is to line the wells with concrete rings about 1.5 m in diameter, though some are left unlined and do not appear to suffer from slumping. The unlined wells are rectangular in cross-section.

In all but two cases, the dug wells are not equipped with any mechanical water lifting devices and water is drawn from them by bucket and rope. The two exceptions are an abandoned well in Jilib, equipped with a broken down windmill pump and a shallow well (6 m) very close to the Jubba river on a banana estate, equipped with a small centrifugal pump, delivering water to an elevated storage tank.

The rates of abstraction by rope and bucket are estimated at no more than 1,000 l/hour at peak and probably less than a tenth of that on average. The well equipped with the centrifugal pump, probably yields about 5 l/s with an operating factor of no more than six hours per day.

3.1 Location of existing wells

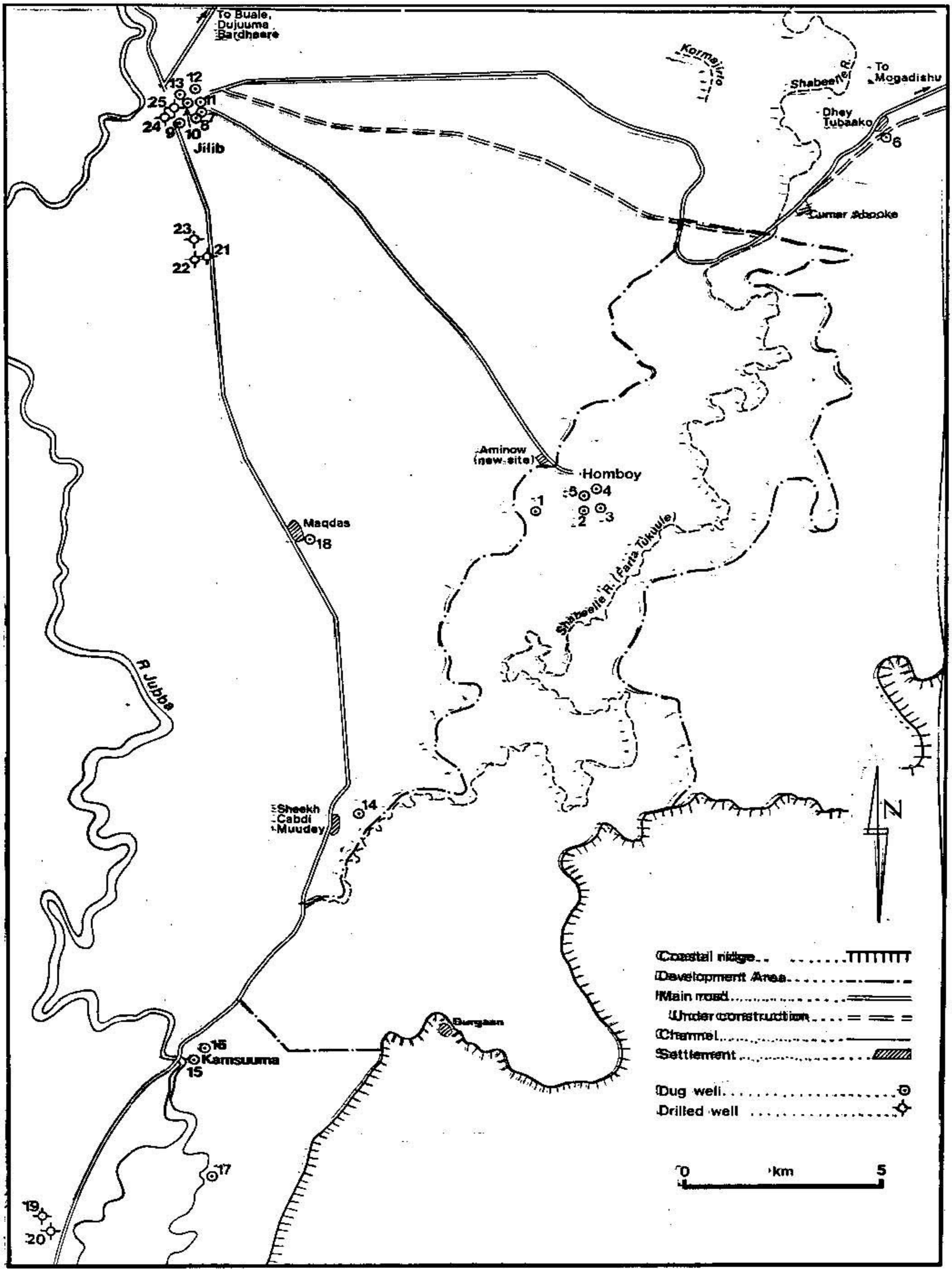


TABLE 3.1 EXISTING WELLS

Well No.	Type	Location	Dia. (m)	Depth (m)	SWL below GL (m)	EC $x10^6$ @ 25°C	Remarks
1	Dug	Aminow	1.50	?	18.70	1,735	Lined with concrete rings.
2	Dug	Homboy	c.2.00	?	18.45	1,814	Unlined.
3	Dug	Homboy	c.2.00	?	18.45	2,811	Unlined.
4	Dug	Homboy	1.50	?	17.90	1,541	Lined with concrete rings.
5	Dug	Homboy	c.1.50	?	22.20*	4,081	Unlined.
6	Dug	Dhey Tubako	1.50	?	21.44	4,234	Lined with concrete rings. Not used for several years.
7	Dug	Jilib	1.50	?	14.22	2,095	Lined with concrete rings.
8	Dug	Jilib	1.50	?	12.70*	1,571	Lined with concrete rings.
9	Dug	Jilib	1.50	14.20	12.02*	3,115	Lined with concrete rings.
10	Dug	Jilib	1.50	?	12.60*	667	Lined with concrete rings.
11	Dug	Jilib	1.50	-	-	-	Old abandoned well, originally equipped with windmill pump, now filled with rubbish.
12	Dug	Jilib	1.50	?	15.10	30,260	Lined with concrete rings. Newly constructed well - abandoned because of high salinity.
13	Dug	Jilib	1.50	?	10.80*	2,581	Lined with concrete rings.
14	Dug	Sheikh Cabdi Mukdey	c.1.50	?	16.30	8,163	Unlined. Abandoned because of high salinity.
15	Dug	Kamsuma	1.50	?	6.50*	740	Lined with concrete rings.
16	Dug	Kamsuma	1.50	?	6.95	3,401	Lined with concrete rings.
17	Dug	Romana Plantation	1.50	6.00	4.45	833	Lined with concrete rings. Equipped with centrifugal pump.
18	Dug	Maqdas	1.50	21.60	18.22	3,249	Lined with concrete rings.
19	Drilled	Trans-Juba Project Compound	0.20	80.00	7.02	1,584	Equipped with shaft driven turbine and diesel motor.
20	Drilled	Trans Juba Project - near main road	0.20	80.00	6.70	1,224	Equipped with submersible pump and diesel generator.
21	Drilled	Fanoole Project - yard	0.30	26.20	15.90	1,678	Abandoned. Depth was measured but well is open and may be filled with spoil.
22	Drilled	Fanoole Project - yard	0.15	?	?	2,064	Pumped by airlift.
23	Drilled	Fanoole Project - yard	0.30	?	14.78	?	Equipped with pump and motor (Russian), but apparently never used.
24	Drilled	Fanoole Project office compound	?	?	?	1,296	Equipped with submersible pump.
25	Drilled	Jilib	0.15	?56.00	-	-	Disused for some years. Closed with a welded cap.
26	Drilled	Marere - Juba Sugar	?	?	?	952	Equipped with shaft driven turbine and diesel motor.

Source: Field Survey.

* *Water level measured after the well had been in use.*

Most of the dug wells in the region have been installed by the local population themselves but with government assistance; this assistance usually consisted of supplying the concrete lining. Some of the wells were constructed more than 30 years ago. It appears however that recently there has been an upsurge in well construction with about half of the wells inspected being installed within the last two years.

The history of drilled wells in the region is much shorter, being limited to the last 10 years or so.

Eight drilled wells were inspected. In most cases no records of their design and construction could be found, so the information obtained is certainly less than full, but it seems that basically two different designs have been used:

(i) Wells constructed by the Russians; percussion drilled and lined with 12 inches (30 cm) diameter casing. It is not known what type of screen was installed and whether gravel packs were used or not.

(ii) Wells constructed by the Water Development Agency (WDA); rotary drilled and lined with 6 inches (15 cm) or 8 inches (20 cm) diameter casing; drilled diameter was usually 12 inches (30 cm). In the case of those wells for which some records are available, it seems that wire-wound screens and gravel filters were used.

The depths of the Russian constructed wells are reportedly between 35 and 70 metres, though the only well actually sounded during this survey was 26.2 m deep (this was an abandoned well, left open and it may have been partially filled with spoil). The length of screen used per well is not known.

The wells constructed by WDA are up to 100 m deep with about 20 m of screening installed opposite the coarsest strata penetrated.

Five of the drilled wells inspected were in working order. One was pumped by airlift, two by line shaft turbines driven by diesel motors and two by submersible pumps (one connected to the Jilib power supply and one equipped with its own diesel generator). In all cases the yield was estimated at between 5 and 10 l/s. In one case only is there any discharge and drawdown available (Well No. 20). That well was test pumped at 18 and 24 m^3/hour (5 and 6.7 l/s) and gave the same specific capacity, for both discharges, of 0.75 l/s/m drawdown.

3.5. WATER QUALITY

3.5.1 Quality Standards

The most authoritative quality standards for drinking supplies are those established by the World Health Organisation (WHO, 1963). These deal with the physical and chemical as well as biological nature of the water and specify desirable and permissible levels of various constituents and characteristics. The list of these is very extensive, but some of the more important limits are listed in Table 3.2.

Apart from the criteria listed in Table 3.2 bacteriological quality is also subject to acceptability limits. These are specified for both raw and treated water and should be determined by standard sampling and analytical procedures. The limits for potable water are expressed in terms of coliform organisms present in 100 millilitres of water. The permissible level for human consumption is 3 coliform organisms per 100 millilitres.

TABLE 3.2 WHO INTERNATIONAL STANDARDS FOR DRINKING WATER

Substance or Characteristic	Maximum Desirable Level	Maximum Permissible Level
Colour	5 colour units	50 colour units
Odour	Unobjectionable	Unobjectionable
Taste	Unobjectiionable	Unobjectionable
Turbidity	5 turbidity units	25 turbidity units
Total Dissolved Solids	500 ppm	1,500 ppm
pH Range	7.0 - 8.5	6.5 - 9.2
Total Hardness as $CaCO_3$	100 ppm	500 ppm
Boron	1 ppm	1 ppm
Calcium as Ca	75 ppm	200 ppm
Chloride as Cl	200 ppm	600 ppm
Copper as Cu	0.05 ppm	1.5 ppm
Iron (total) as Fe	0.1 ppm	1.0 ppm
Lead as Pb	0	0.1 ppm
Magnesium as Mg	30 ppm	150 ppm
Nitrates and Nitrites as N	0	10 ppm
Sulphate as SO_4	200 ppm	400 ppm
Zinc as Zn	5.0 ppm	15 ppm
Phenol	0.001 ppm	0.002 ppm
Anionic Detergents	0.2 ppm	1.0 ppm
Mineral Oil	0.01 ppm	0.3 ppm

Source: World Health Organisation.

It should be mentioned that the criteria in Table 3.2 are generally observed in the developed countries but many developing countries use potable supplies with one or more characteristics outside the permissible limits. This does not appear to do any great damage to public health.

3.5.2 River Water

It is probable that the Jubba river water is the source of much of the groundwater in the region. Therefore a short discussion of the Jubba water quality is relevant.

The quality of the Jubba is generally good, but it does show considerable seasonal variations. The available chemical analyses are listed in Table 3.3 but these do not represent the full range as there are records of dry season flow with about 1,300 ppm of total dissolved solids (EC x 10^6 of 2,000) (Booker-McConnell, 1970).

TABLE 3.3 CHEMICAL ANALYSES OF JUBBA RIVER WATER (SAMPLES COLLECTED NEAR FANOOLE AND JILIB)

Date	EC $x10^6$ @ 25°C	TDS ppm	PH	Ca ppm	Mg ppm	Na ppm	K ppm	CO_3 ppm	HCO_3 ppm	SO_4 ppm	Cl ppm	Fe ppm	F ppm	Total Hardness ppm	SAR
14/8/75	320	250	8.1	67.1	4.7	4.6	2.3	12.0	213.5	4.8	10.6	-	-	-	0.1
15/9/75	340	210	8.2	66.1	3.5	4.1	1.6	3.0	170.2	10.1	30.1	-	-	-	0.1
23/1/76	410	330	7.4	45.1	9.2	25.3	0.4	0.0	115.9	56.7	40.4	-	-	-	0.9
6/3/76	730	500	7.9	62.1	16.8	65.3	4.3	0.0	132.4	86.5	129.8	-	-	-	1.9
13/3/76	870	588	7.1	72.1	22.9	75.4	4.7	0.0	134.2	127.8	150.0	-	-	-	2.0
20/3/76	990	668	7.2	88.2	25.3	84.6	5.1	0.0	134.2	151.3	174.8	-	-	-	2.0
27/3/76	1,120	768	7.4	88.2	29.3	107.0	5.5	0.0	115.9	177.7	219.8	-	-	-	2.5
10/78	210	110	7.8	30.1	4.5	6.7	2.0	0.0	122.0	4.8	2.8	0.55	0.16	100	0.3
10/78	200	120	7.8	28.1	9.5	5.8	2.0	0.0	109.8	8.6	3.9	1.04	0.13	85	0.2

Source: Booker McConnell and Project Analyses.

As can be seen, provided the overall salinity (TDS) of the water is within the WHO limit, the level of the various constituents is satisfactory as well. This is also likely to be true of groundwater.

3.5.3 Groundwater

Groundwater in the shallow aquifer tapped by dug wells reflects the discontinuous nature of that aquifer by exhibiting extreme variation in salinity. Thus within the town of Jilib the electrical conductivity (EC) of shallow well water varies from some 700 to about 30,000 micromhos/cm. Though the latter of these values is a clear indication of marine influence, presumably during the formation of the Marine Plain, there appears to be no direct relation between the water quality in that aquifer and the geomorphic position. Further, once more than a few metres away from the river, there appears to be no relation between water quality and distance from the Jubba.

All but one of the surveyed dug wells tapping the shallow aquifer, produce water of salinity greater than the WHO desirable limit (TDS of 500 ppm is equivalent to EC x 10^6 of about 780). Most of them (10 out of 18) are also outside the permissible limit (equivalent to EC x 10^6 of about 2,300).

Some full analyses of groundwater from shallow wells in the region are shown in Table 3.4. It may be noticed that the EC values listed are slightly different from those given in Table 3.1. The two sets of samples were collected at different times (about seven months apart).

In the case of drilled wells, all those sampled showed salinities (EC) between the WHO desirable and permissible limits (see Table 3.1). However, all these wells are located within two kilometres of the Jubba River and there is some evidence that the salinity of groundwater in the deeper aquifers increases with distance from the river. Thus, the highest salinities sampled were those from two wells in the Fanoole Project yard about four kilometres south of Jilib; of the wells surveyed these were the furthest from the Jubba. Moreover, some recently constructed tubewells, about 6 km west of the Jubba apparently are all more saline (M. Jones, 1979); reportedly, pronounced water quality stratification is found but all the salinities are well outside the WHO permissible limit, though some of the water is suitable for livestock watering. Finally, according to Technital S.p.A., discussing the general hydrogeology, of the Lower Jubba Plain, the shallower aquifers (up to 50 m depths) normally produce water of very high salinities (TDS of 6,000 to 35,000 ppm), whereas the deeper aquifers yield better water (TDS of 2,500 to 5,500 ppm). All of these salinities are too high for potable supplies.

There are no boreholes in this Project's development area, where the proposed settlements will be located. However, accepting the Jubba as the main source of deeper groundwater in the region, high salinities can be expected in most of the area. The complicating factor is that the development area is located on the Shabeelle flood plain, albeit abandoned. Thus the groundwater quality distribution may also be related to that river, and the occurrence of groundwater of acceptable quality, though unlikely, cannot be completely ruled out.

3.5.4. Conclusions

Water quality is the main problem in attempting to supply the proposed settlements with potable supplies from groundwater sources. Review of available quality data leads to the following major conclusions.

TABLE 3.4 CHEMICAL ANALYSES OF SHALLOW WELL WATER

Well No.	Location	EC x10^6 @ 25°C	TDS ppm	pH	Ca ppm	Mg ppm	Na ppm	K ppm	CO_3 ppm	HCO_3 ppm	SO_4 ppm	Cl ppm	Fe ppm	F ppm	Total Hardness ppm	SAR
4	Homboy	1,370	840	7.6	120.6	50.5	86.7	17.2	0.0	247.8	140.2	177.3	0.34	0.50	475	1.7
6	Dhey Tabako	2,400	1,450	7.7	290.6	50.1	63.5	79.0	0.0	1,189.7	74.4	90.1	0.63	0.20	752	0.9
10	Jilib	600	400	8.1	35.1	16.1	77.5	2.0	0.0	183.0	81.7	56.0	0.33	0.70	145	2.7
16	Kamsuma	4,000	3,560	7.9	237.9	248.7	538.7	24.2	0.0	353.9	2,024.9	269.9	0.76	0.64	1,465	5.8
18	Maqdas	3,050	2,010	8.3	16.0	12.2	753.2	13.7	0.0	616.2	263.2	664.9	0.40	1.00	80	34.5
-	Bandar Salmm	1,390	960	8.7	32.5	8.0	258.75	30.5	0.0	518.6	46.1	150.0	0.46	-	155	10.5

Source: Project Analyses.

(i) Potable supplies to the WHO desirable quality standards cannot be obtained from groundwater sources.

(ii) It is most unlikely that shallow dug wells could supply the proposed settlements with water of quality within the permissible WHO limits. However, in view of the highly irregular nature of the shallow aquifer this possibility, though very remote, cannot be completely rejected.

(iii) It is also unlikely that drilled wells could supply the proposed settlements to the permissible WHO standards, but because of the unknown effect of the Shabeelle flood plain on the groundwater system in the area, this option merits further investigation.

3.6 WELL DESIGN AND COSTS

3.6.1 Introduction

Though, as stated above, it is unlikely that potable water of reasonable quality can be supplied to the proposed settlements from groundwater sources, the following brief discussion of well design and costs is given for comparison with alternative water supply schemes. This may assist in deciding whether the groundwater option is worth pursuing further.

The treatment of well design here is necessarily sketchy and highly generalised as the basic data, on which designs are normally based, are not available. Hence an investigatory element is required in any further groundwater work proposed, on which sounder design criteria could be based.

3.6.2 Well Design

Well design is governed largely by economics. The objective of sound well design is to produce a required amount of water, of acceptable quality, over a specified period of time, at the lowest possible cost. This objective is best achieved or at least approached, by adopting design criteria based on generally accepted hydraulic concepts, modified in the light of local practices, observed as having been successful in the past.

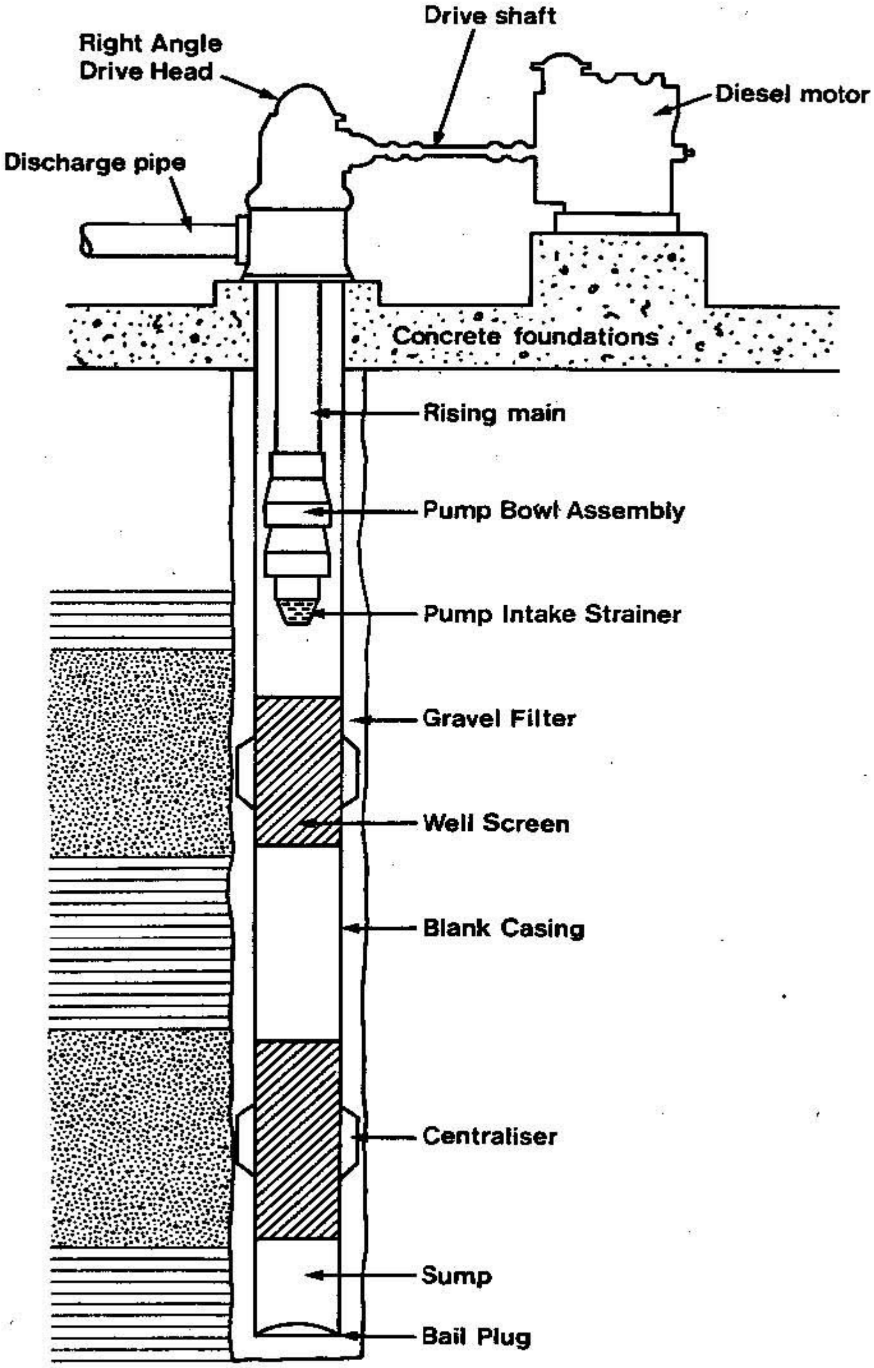
A typical arrangement of a fully equipped well is shown in Figure 3.2, with the various components specified for reference.

Well depth for any required yield depends on the proportion of permeable material in the formation and on the magnitude of the permeability of that material. Thus the effective transmissivity of the producing profile has to be high enough to sustain the required discharge with a reasonable drawdown; further, the amount of screen installed against the productive strata should be long enough to satisfy the screen entrance velocity criterion, which is usually taken as this velocity not exceeding 0.03 m/s.

Screen diameter is partly determined by the same consideration, but it also has to be compatiable with the casing size. The function of the upper part of well casing is ofcourse to accommodate a pump; thus the diameter must be large enough to accept a suitable pump with sufficient annular clearance.

For discharges of 5 to 10 l/s, casing and screen of 0.15 m (6 inches) diameter would

3.2 Typical fully equipped drilled well



be suitable. Judging by the one permeability result available, which is 4.2 m/day for an aquifer described as sand and gravel, some 6 to 12 meters of screen would be required per well for the above discharges and drawdowns not exceeding 20 metres. These dimensions would also satisfy the entrance velocity criterion, provided the area of openings of the screen was greater than 6 per cent.

Thus the drilled depth would be determined by the occurrence of the required thickness of screenable aquifer; it is assumed here that the average depth would be 75 metres. Drilled diameter would have to be large enough to accommodate the casing and screen with a sufficient annular space for an artificial gravel filter, should such be necessary.

In this project, at the present state of knowledge, it would be advisable to plan for wells with gravel packs, as this increases the flexibility of choice regarding which aquifers could be screened in any particular well. A drilled diameter of 0.30 cm (12 inches) would be suitable for 15 cm casing and screen and a reasonable thickness of gravel filter.

With no aquifer grain size analyses available, little useful can be said about the desirable gravel grading and screen slot-size. There appear to be no major problems with sand pumping in any of the existing wells, but it is not known what sizes of slot and gravel were used. It may be that the aquifers are sufficiently well cemented so that the gravel pack grading and screen slot size are not important. However, if a selection has to be made without any additional data becoming available, it is suggested that the gravel should be between 1 and 4 mm and the slot size should be about 1.5 mm.

It seems that mud flush rotary drilling is the quickest and most efficient method of well construction in the area. Installation of casing and screen would be all in one string, followed by gravel pack placement, preferably through tremie pipes. Vigorous development would be required to remove the mudcake formed on the permeable beds during drilling and ensure a good hydraulic connection between the aquifer, gravel and well. This could be achieved by airlifting with strong surging and back-washing.

Assuming static water levels of about 20 metres and drawdowns of similar magnitude, rotary pumps, either turbine or positive displacement (monopump) type would seem the most suitable to obtain the required discharges. Since no electric power is likely to be available, the pumps would probably be powered by diesel motors.

The choice of materials for the various well and pump components is determined largely by the quality of the pumped groundwater. If this quality indicates that corrosion may be a problem then corrosion resistant materials should be used. If no corrosion potential is identified, then cheaper materials such as mild steel may be used. However, corrossivity of water is difficult to evaluate. Thus, often the best indicator for suitable materials is the past history of local wells. Although the history of drilled wells in the region is not very long, no corrosion problems have been reported and it is tentatively concluded that the predominantly mild steel components, used at present, are satisfactory.

3.6.3 Costs

The unit costs of well construction in Somalia are given in Table 3.5. These are based on international contractors estimates, but it is considered that WDA prices would be similar.

TABLE 3.5 UNIT WELL CONSTRUCTION COSTS

Item	Unit	Rate (So.Sh)
Move in and set up all necessary equipment	sum	20,000
Drill 0.3 m dia	lin. m	2,000
Provide & install casing	lin. m	700
Cement casing	lin. m	500
Provide and install screen*	lin. m	800
Provide and place gravel filter	lin. m	50
Develop and test	sum	16,000
Provide and install pump and motor	sum	90,000
Pump house, plinth etc.	sum	30,000

** slotted casing.*
Source: Project Estimates.

These costs apply to the type of well envisaged, that is with casing and screen of 0.15 m diameter and with a pump and motor suitable for delivery of 5 l/s at 40 metres total lift.

Using these unit costs, the capital cost of a fully equipped well, 75 metres deep with 12 metres of screen is estimated at 372,450 So.Sh. Some 70 per cent of this sum would be expensiture in foreign exchange.

In addition to these capital costs of construction, producing the required water supplies would also involve recurrent costs, that is, costs of operation and maintenance (including spares).

Annual cost of spares and maintenance can be taken as 5 per cent of total capital cost, that is 18,622 So.Sh. Fuel costs can be calculated using the following formula.

$$C_f = \frac{3.234 \times 10^{-3} \times Q \times H \times C_D}{E}$$

Where C_f = fuel costs per hour, So.Sh.
Q = discharge rate, l/s
H = total pumping head, metres
E = overall pump and motor efficiency, fraction
C_D = cost of diesel, So.Sh. per litre

Allowing another 15 per cent of this for cost of lubricants and assuming an overall efficiency as 50 per cent, the hourly operating cost, C_o, can be estimated as follows-

$$C_o = 7.438 \times 10^{-3} \times Q \times H \times C_D$$

Thus, taking the cost of diesel as 1.65 So.Sh. per litre, which is the present financial price, the operating cost of a well can be estimated for any discharge and total pumping head. In the case of 5 l/s discharge and 40 metres head, this works out as 2.45 So.Sh. per hour.

The total costs of groundwater abstraction with drilled wells, at various annual operating factors, are summarised in Table 3.6.

TABLE 3.6 COSTS OF GROUNDWATER ABSTRACTION

Well Construction Costs (So.Sh.)	Operating factor (hours/year)	Total Water Pumped (l/year)	Recurrent Costs Maintenance (So.Sh)	Operating (So.Sh.)	Total (So.Sh.
372,450	1,000	18×10^6	18,622	2,450	21,072
-	2,000	36×10^6	18,622	4,900	23,522
-	3,000	54×10^6	18,622	7,350	25,972
-	4,000	72×10^6	18,622	9,800	28,422
-	5,000	90×10^6	18,622	12,250	30,872

Well Depth = 75 m, Discharge = 5 l/s, Total Head = 40 m.

Source: Project Estimates.

3.7 SUMMARY AND RECOMMENDATIONS

The Project Area is located at the confluence of the Jubba and Shabeelle flood plains. The actual area proposed for irrigation development lies wholly on the Shabeelle alluvium.

The whole region is underlain by Tertiary and Quaternary marine and fluviatile strata, which include layers of coarse, clastic, permeable rock. Though little reliable subsurface data are available, it is considered that aquifers, capable of sustaining yields of 5 to 10 l/s, occur within 100 metres of the surface.

There are no boreholes in the proposed development area, but drilled wells are used for water supply to some Government project compounds in the region, particularly those located near the Jubba. In addition there are a number of large diameter, dug wells, which serve as sources of domestic supplies to towns and villages.

Groundwater quality in the region is generally poor to marginal. In terms of WHO drinking water standards, water within the desirable quality limits cannot be obtained from groundwater sources. Further, it is unlikely that even supplies within the much less severe permissible limits can be obtained from wells. However, because of the unknown effect of the Shabeelle flood plain on the groundwater system, it is possible that groundwater quality in the proposed development area departs from the overall regional pattern. Consequently, this problem merits investigation, provided suitable groundwater supplies would be cheaper and easier to obtain than those from surface sources.

With this in mind, the costs of groundwater abstraction by drilled wells were estimated. For a fully equipped well, 75 metres deep, yielding 5 l/s through total lift of 40 metres, the costs would be as follows:

Construction Costs	372,450 So.Sh
Annual Maintenance Costs	18,622 So.Sh
Hourly Operating Costs	2.45 So.Sh.

If these costs compare favourably with those of providing potable supplies from surface sources, then an investigatory drilling programme should be undertaken in the proposed development area. This programme should comprise three exploratory bores, each drilled to 150 metres depth and sampled for water quality.

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J.H. Johnson	1978	"A Conceptual Review of Somalia's Groundwater Resources", FAO, Rome.
M. Jones, UNDP	1979	Personal Communications, Mogadishu.
Lockwood Survey Corporation/FAO	1968	"Agriculture and Water Surveys", FAO Rome.
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Part 4
Infrastructure

4.1 INTRODUCTION

This section deals with the infrastructural requirements of the project. It therefore uses the recommendations made in the Villagisation report (Part 1), the Relocation study (Part 2) and Groundwater (Part 3) studies as a basis, but describes the various components in detail.

In addition, requirements not covered in the above reports are included with the objective of presenting a complete picture of the project's total requirements.

4.2 VILLAGE UTILITY SERVICES

The services covered include the treated water supply and the sanitation proposals for the settlement villages and the project headquarters and the development of electricity generation for communal, project support, administrative and domestic use. A short discussion is also included on bio-gas generators in light of the anticipated future critical shortage of fire-wood and other forms of energy sources.

4.2.1 Water Supply System

The provision of an adequate, reliable and clean water supply for the villages and project headquarters is considered to be of paramount importance to the health and welfare of the project employees. Not only will it help in the prevention of bilharzia but also in the elimination of intestinal diseases, particularly in young children, both of which are propagated by untreated drinking water.

Two possible sources of supply have been considered:

- water pumped from canals;
- groundwater.

Groundwater has the considerable advantage of not normally requiring treatment to make it potable. However, as concluded in the groundwater report, groundwater generally in the area tends to be saline and there is no guarantee that a well drilled at a village site will provide adequate quantities of suitable water.

The alternative of pumping water from canals involves the extra cost of treatment works which must be capable of producing a safe supply of water. There is an additional disadvantage with this system in that the canal system will be shut off during February and March. It will be necessary therefore to hold water in some of the storage reservoirs for release to the village water supplies through this 'closed season'.

Clearly the groundwater alternative could be preferable and experience on the Trans-Jubba Livestock Project and also the Jubba Sugar Project both close to the river indicates that a suitable source may exist. Trial boreholes will be required in the early stages of the project to establish this.

The capital costs given in the Groundwater Report are considerably below that associated with an equivalent system incorporating treatment and delivery of irrigation water. Annual operation and maintenance costs of the two alternatives are not considered to be much different. Thus costs do indicate that trial boreholes should be drilled to investigate whether a suitable source of water exists.

Further investigations should be carried out and precise requirements as to the desired quality of the final water supply should be established.

If groundwater is found in quantity but too saline, a reverse osmosis plant could be provided but such equipment is normally uneconomic compared with a simple water treatment plant.

For the purposes of estimating the costs of a water supply system the irrigation storage reservoirs have been taken as the source of supply. A design has been based on the requirements of such a system. These costs are summarised in Section 4.5.

Individual block village treatment works would, by their nature, be scattered around the project requiring experienced operators at each village. In developing countries it is difficult to obtain the requisite number of operators and mechanics and to maintain the distribution arrangements for fuel and chemicals. Moreover, experience of individual village treatment works on other irrigation schemes has demonstrated that they are seldom properly maintained and operated. A compromise was adopted between a centralised single treatment unit and the individual village treatment works. Figure 4.1 shows the proposed water supply network and positions of treatment works, while Figure 4.2 shows a typical works. It is imperative that the Project Administration pay particular attention to all the logistics associated with a continuous water supply system.

The following standards should be adopted for the treatment works:-

(a) All water supply to be fully treated.

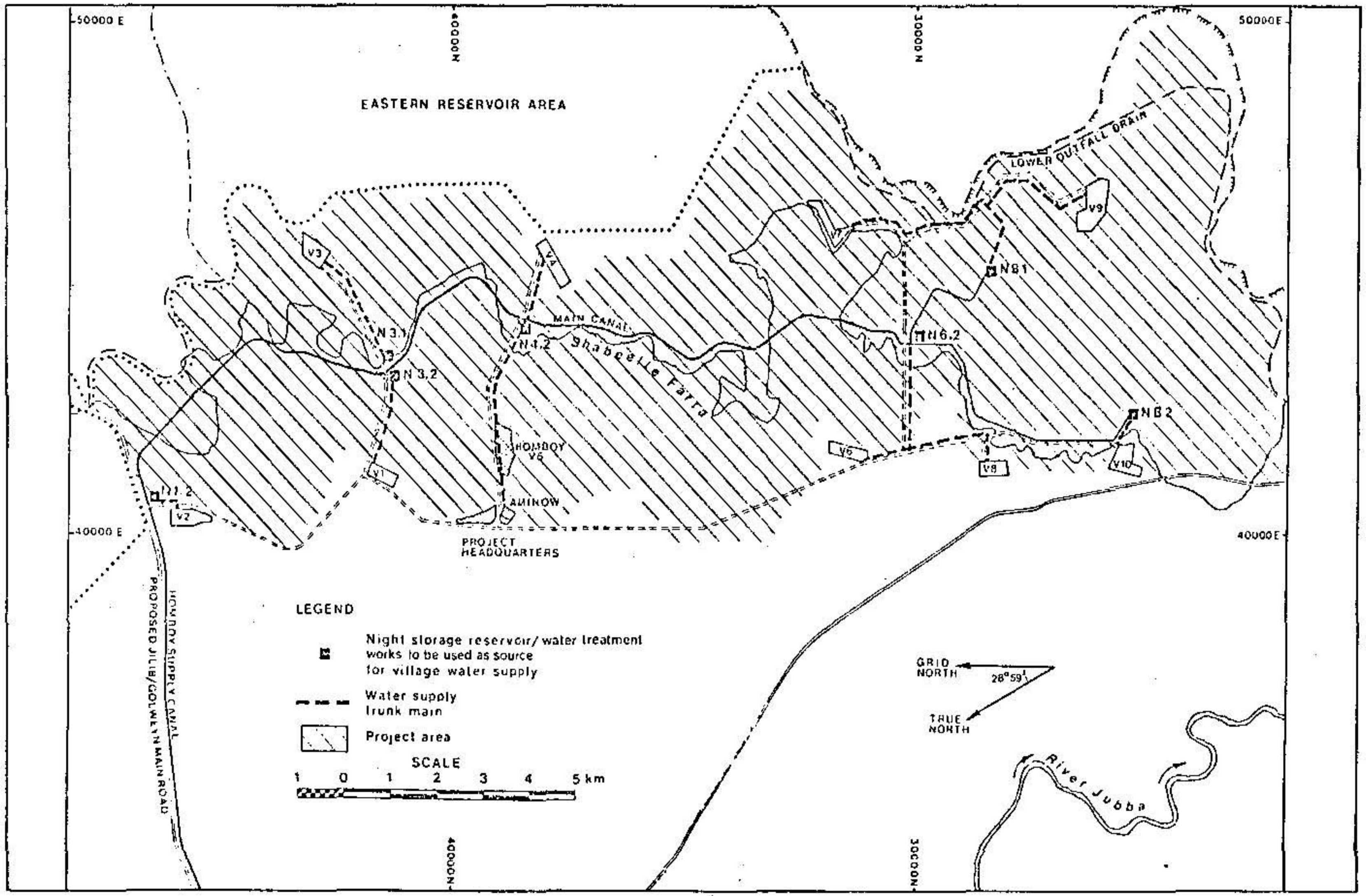
(b) Apart from the sedimentation and filtration treatments the chlorination of the treated water will prevent bilharzia but as an additional precaution treated water will be stored for at least 36 hours.

(c) Stand-pipe density of 1 per ten families. Each stand-pipe location will have a catchment apron to help control the inadvertent misuse of water. An area of at least 2 m in diameter will be surfaced with concrete or brick and graded to drain away from the tank. Channels or other means will prevent the run-off from the area becoming standing pools or creating muddy conditions (see Figure 4.3).

(d) Consumption of water in the villages is based upon 100 litres per head per day. Management staff housing 150 l/h/day.

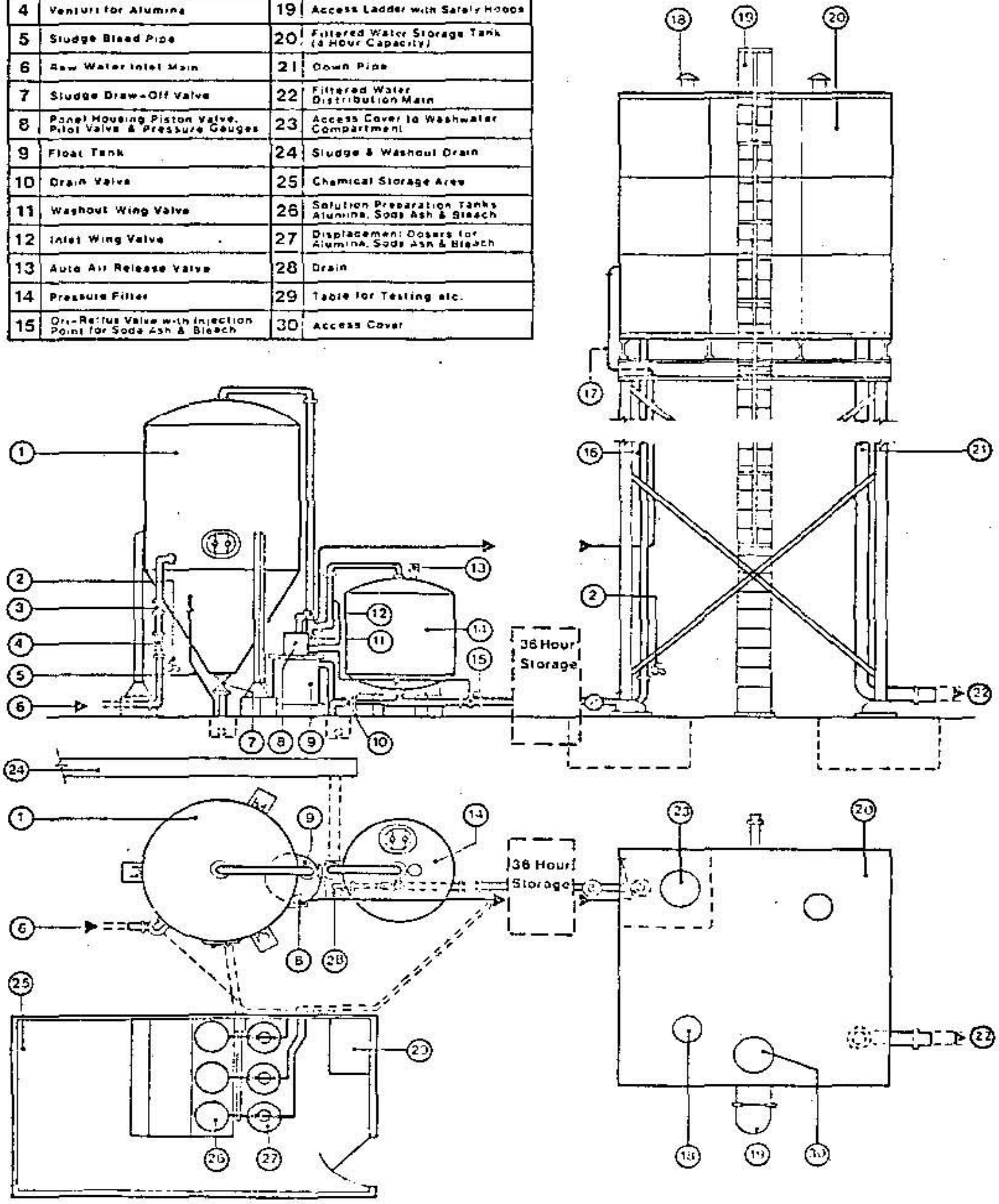
(e) Each treatment works will require a low lift diesel pump to provide raw water

4.1 Water supply network (based on irrigation storage reservoirs)

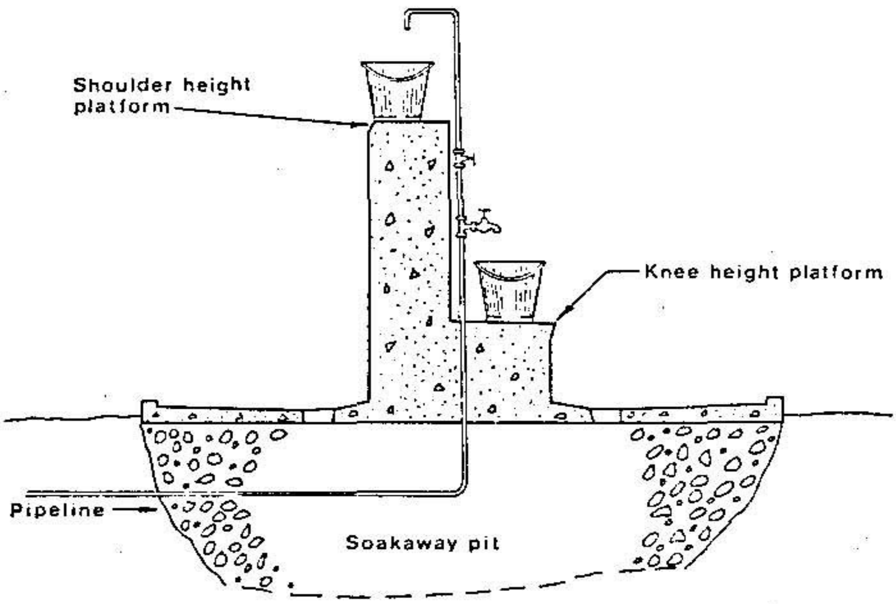


4.2 Typical water treatment plant

1	Settling Tank	16	Rising Main
2	Sampling Cock	17	Water Supply to Piston Valve on Control Panel
3	Inlet Valve	18	Mosquito Proof Ventilators
4	Venturi for Alumina	19	Access Ladder with Safety Hoops
5	Sludge Bleed Pipe	20	Filtered Water Storage Tank (4 Hour Capacity)
6	Raw Water Inlet Main	21	Down Pipe
7	Sludge Draw-Off Valve	22	Filtered Water Distribution Main
8	Panel Housing Piston Valve, Pilot Valve & Pressure Gauges	23	Access Cover to Washwater Compartment
9	Float Tank	24	Sludge & Washout Drain
10	Drain Valve	25	Chemical Storage Area
11	Washout Wing Valve	26	Solution Preparation Tanks Alumina, Soda Ash & Bleach
12	Inlet Wing Valve	27	Displacement Dosers for Alumina, Soda Ash & Bleach
13	Auto Air Release Valve	28	Drain
14	Pressure Filter	29	Table for Testing etc.
15	Non-Reflux Valve with Injection Point for Soda Ash & Bleach	30	Access Cover



4.3 Typical standpipe



NOTE: Where necessary, connect soakaway pit to village drainage system from the irrigation storage reservoirs to the treatment works, a high lift diesel pump to carry clean water from a treated water reservoir containing at least 36 hours storage to a water tower holding 4 hours storage and servicing the villages by gravity. The abstraction from the irrigation reservoirs should be screened and cleaned daily.

(f) All stand-by chemical equipment and emergency stores of chemicals should be retained at the project headquarters.

(g) Potable water supply should be provided to all senior staff housing, offices and workshops both at project headquarters and block village level.

(h) The distribution system would be constructed in PVC pipe which has superior hydraulic characteristics to either concrete or metal piping, and is easier to transport and lay. The water mains would be entrenched in the verges of the project area roads for ease of laying and access for maintenance.

(i) Suitable junctions will be made, and pipes with sealed end caps provided, to sites where future developments (mosques, community centre, abattoir, etc.) are to be carried out.

(j) The reticulation system should be so designed as to permit future modification which could ultimately result in individual supplies.

4.2.2 Sanitation

Various factors have affected the choice of the most appropriate method of sewage disposal for this project.

Capital costs and the shortage of water during periods of the year rule out the adoption of a water-borne sewage system. Such a system would not only appreciably increase the water demand of a village but also require installations, operation and maintenance associated with a high technology system.

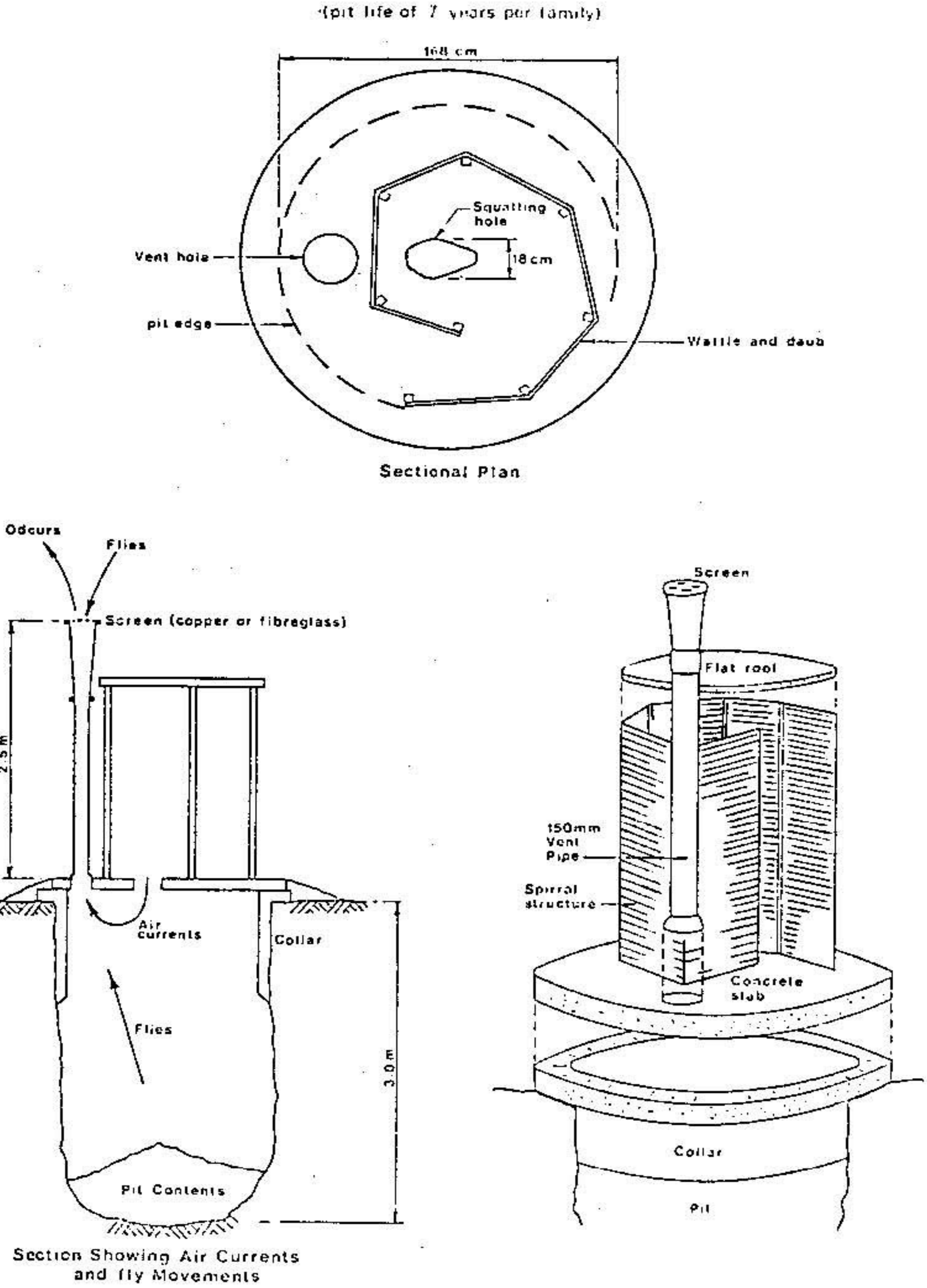
The impermeable nature of the soil added to the poorly predictable response of the water table to the new irrigation system does not normally favour the use of septic tanks and water based privy options. If such a system were built its functionability would depend upon lateral drainage provisions or the timely removal by pumping of the wastes from each individual pit and subsequent disposal in selected areas of each block unit. The latter alternative would be an expensive and difficult operation if provided to every housing unit.

At Kurtun Waarey double vault composting toilets are being employed. In fact most forms of dry composting pit latrines could be employed.

For the Homboy Scheme it is proposed that a vented composting type privy be employed. A possible design is shown in Figure 4.4.

The privy consists of a vented dry pit partially lined with concrete, a squat plate, and a light-weight, light-proof enclosure. Each pit can be used for a period of at least seven years until it is three quarters full, with periodic addition of kitchen ashes and wastes to absorb odour and moisture. The pit is then topped up with earth and allowed to decompose for one year into an easily handled fertiliser. Odours and fly breeding are prevented by the vent pipe which is painted black and oriented toward the sun to create a draft. A screen

4.4 Pit privvy detail



inside the pipe traps flies, flying toward the light, and they eventually die. It is important to keep the enclosure light-proof, paint its interior black, and limit light penetration to a small hole in the door.

When the first pit is filled a new one should be dug and lined, and the light-weight superstructure can thereafter be moved from one pit to another. Either an asbestos cement structure or a movable improved Arish enclosure resting on a timber or concrete base plate is proposed.

The cost estimates for settler housing included in the Villagisation Report allow for the cost of an Arish structure and timber base privy structure. In addition a 7.5 cm thick reinforced concrete squat plate was included, cast in two pieces as each piece will weigh 75 kg requiring the help of neighbours to be moved.

Some effort will have to be made to educate the people in the use of earth closets. The people in the villages should be actively discouraged from indiscriminate use of canals, drains and public areas which would rapidly become health hazards.

For senior staff housing, particularly at the Project Headquarters, offices and workshops, communal/individual septic tanks are proposed. Lateral drains will be constructed radiating from the tanks to counter the loss in effectiveness of the septic tanks owing to the nature of the soils in the area.

4.2.3 Roads and Drainage

Provision should be made in each village to enable storm run-off to be drained from the village and into the adjacent drainage network of the project.

Village drainage channels will be located on both sides of roadways. These street drains will receive surface run-off both from the roads and the adjacent housing areas and therefore must be designed as one common network.

The proposals laid down in the Villagisation Report specify the following:-

Main roads: 10 m right-of-way, unlined drains to be provided on both sides of the road (one side only on sloping sites), compacted earth surface to the roads. Concrete culverts where necessary. Surfacing 150 mm thick.

Footpaths: 5 m right-of-way, unlined drain on one side only, compacted earth surface. Drain crossings at individual plots. Surfacing 50 mm thick.

The network of roads and footpaths is such as to minimise vehicular use, with footpaths providing the principal means of circulation and access to the individual plots.

The main roads which form the basis for the circulation network have a 6 m compacted earth surface which should be suitable for upgrading to a coral surfaced road at a later stage. The roads have been designed to enable full circulation of each 'Bulsho'.

The costs of the roads and footpaths defined by the Villagisation Report were evaluated at So.Sh. 475 per dwelling and have been calculated for the full project in Section 4.5.

In addition it is considered advantageous to provide serviceways between the backs of the dwelling lots. These serviceways would permit the passage of small livestock and the servicing and reconstruction of the composting privies. These passageways should be a minimum 1.5 m wide with a centre drain.

4.2.4 Electricity Supply and Distribution

Electricity will be generated by hydro-power at Fanoole when the proposed dam has been constructed. The estimated maximum power generated will be 6,600 Kw at 35 000V of which 1,500 Kw will be required at the Fanoole Scheme Headquarters. During low flows of the River Jubba, power availability will be reduced to 1,620 Kw which is only sufficient to meet the requirements of the Fanoole Headquarters. If Homboy were connected to the same grid as the Fanoole Scheme, alternative generator provision would have to be made during the low flow period.

Provision of generators have therefore been evaluated and costed. An integrated power supply for the whole project cannot be justified economically. However, electric power is essential for the project headquarters and is very desirable, albeit on a small scale, for the block villages.

If the Baardheere dam is constructed then it may be viable to supply the area with the generated power but the cost of the pylon network has not been included in the present study costs. The pylon network presently being developed by the Fanoole Project crosses the Jilib/Golweyn road at a point 4 km east of Jilib. From this point approximately 60 km of pylon line would be necessary to supply all the Homboy Scheme villages.

A comparison was carried out in the Villagisation Report of three alternative levels of service for electrical distribution within each Block village. The simplest considered entailed the lighting of the main road only for each Block village. Street lighting being spaced at 30 metre centres and each with an 80 W MBF lamp. It is suggested that the electricity supply be wired to Phase 3 standard from the outset to permit future upgrading.

An electricity supply will be a necessity in New Aminow for administrative uses, schools (evening classes) and if built in New Aminow, the hospital, although the latter will probably have a separate power source. The workshop supplied has 110 KVA and 55 KVA generators included to make the workshop a self-contained unit; it is therefore unnecessary for a supply of electricity to be distributed to the workshop.

In Kurtun Waarey schooling at present only takes place during daylight hours but this is only to be expected since the children under instruction are chiefly of the primary school age group. At Aminow, where the secondary school is to be established, an electricity supply will be needed for evening classes.

In the Block villages a small generator serving only the lighting of the administrative building, clinic, community centre and senior staff housing would cost only one fifth of the aforementioned street lighting scheme (So.Sh. 20 per dwelling as opposed to So.Sh. 95). A separate generating unit will be necessary for the pumped water supply.

For the lighting of the buildings, a small generating set would be sufficient, housed in a building located near the community buildings and administrative block.

Generators have been provided in each village to supply the lighting of the main road, lighting of all administrative buildings and management housing and air conditioning of the senior staff houses and project office. These costs are given in Table 4.1, Section 4.5.

4.2.5 Solid Waste

The disposal of solid waste in this, a rural context, was not considered a problem of major dimensions. The rate of generation is low, since use of packaging is not widespread and that which does exist is usually carefully recycled; for example, packing tins are flattened as wall cladding, plastic sheet is used for waterproofing and wooden crates are made into furniture. Kitchen wastes are fed to the goats and can also be used to improve the functioning of the composting privies. Any waste material that burns can be used as kitchen fuel. It is suggested, therefore, that for what little solid waste remains concrete collection bins be constructed in the corner of the Udud open spaces and the refuse trucked away to disposal points.

A large proportion of the solid waste from each dwelling can be added to biogas generation units. At present the SDA in conjunction with the Somali Development Bank are testing biogas generators at Kurtun Waarey. The basic input being used is cattle dung but other selected vegetable wastes could also be added. Biogas generators, it is hoped will play an important role in reducing the reliance on firewood collected from the surrounding bush.

4.2.6 Fuel Source

It has been specified within the contract documents for the construction of the irrigation and drainage system that all the bush cleared from the site should be stock-piled adjacent to the individual block village site to serve as a fuel store and building material source for the first few years of the project.

The Homboy Scheme will not be fully implemented for a number of years and it is important to find an alternative fuel source in this period since the volume of firewood which will be consumed each year may well exceed the amount initially needed for construction. Severe deterioration of the environment or hardships for the project residents are likely to result as fuel foragers progressively strip natural cover in an ever increasing radius around the project. This will be exacerbated by the periodic need to repair existing wattle structures.

Assuming the success of the SDA involvement in biogas generation it will be necessary to increase the volume of animal waste to meet the demand of the digestors and this must be taken into account when considering the involvement of livestock.

As a safeguard against the possible inefficiency or slow development of biogas generators alternative fuel sources must be considered such as paraffin (kerosene), charcoal or fuel wood plantations.

4.2.7 Health

Maintaining the good health of the workers will benefit not only the settlers themselves but will also increase the profitability and functionability of the scheme by increasing the output and enthusiasm of the workforce. Ultimately the whole region would benefit.

Disease can be attacked from two fronts - prevention and cure. Often the former is cheaper, more effective and from the point of view of those affected, preferable. Furthermore there are diseases for which there either is no cure or for which the cure is too expensive to justify its use on a large scale.

For Homboy therefore the emphasis should be on prevention, particularly through education. Nevertheless the following points in the planning of the project have been devised to reduce the occurrence of disease:-

- Provision of a guaranteed supply of potable water.
- Provision of simple but effective toilet facilities away from the housing.
- Training of the settlers in personal hygiene and the use of toilet facilities provided.
- Provision of clinics.
- Establishment of a community services department.
- The avoidance of locating canals and drains within villages.
- Design of housing and villages to promote good ventilation and air circulation and yet reduce the effect of wind-borne dust and its related diseases.

4.3 PROJECT HEADQUARTERS

The Project headquarters is the nerve centre of the project. It is the location where the majority of the senior staff are accommodated together with the project workshops, vehicle parks and training centre.

It is proposed that the project headquarters be located at New Aminow on the western boundary of the scheme having a very close link with the existing village of Homboy.

A summary of the details of existing services within the village of Homboy, their present condition and shortfalls in comparison with the proposed village services as given in the Villagisation Report. The existing village of Homboy will be upgraded to form block village number 5. In the initial period of implementation use will be made of the existing facilities both in Homboy and also at Jilib.

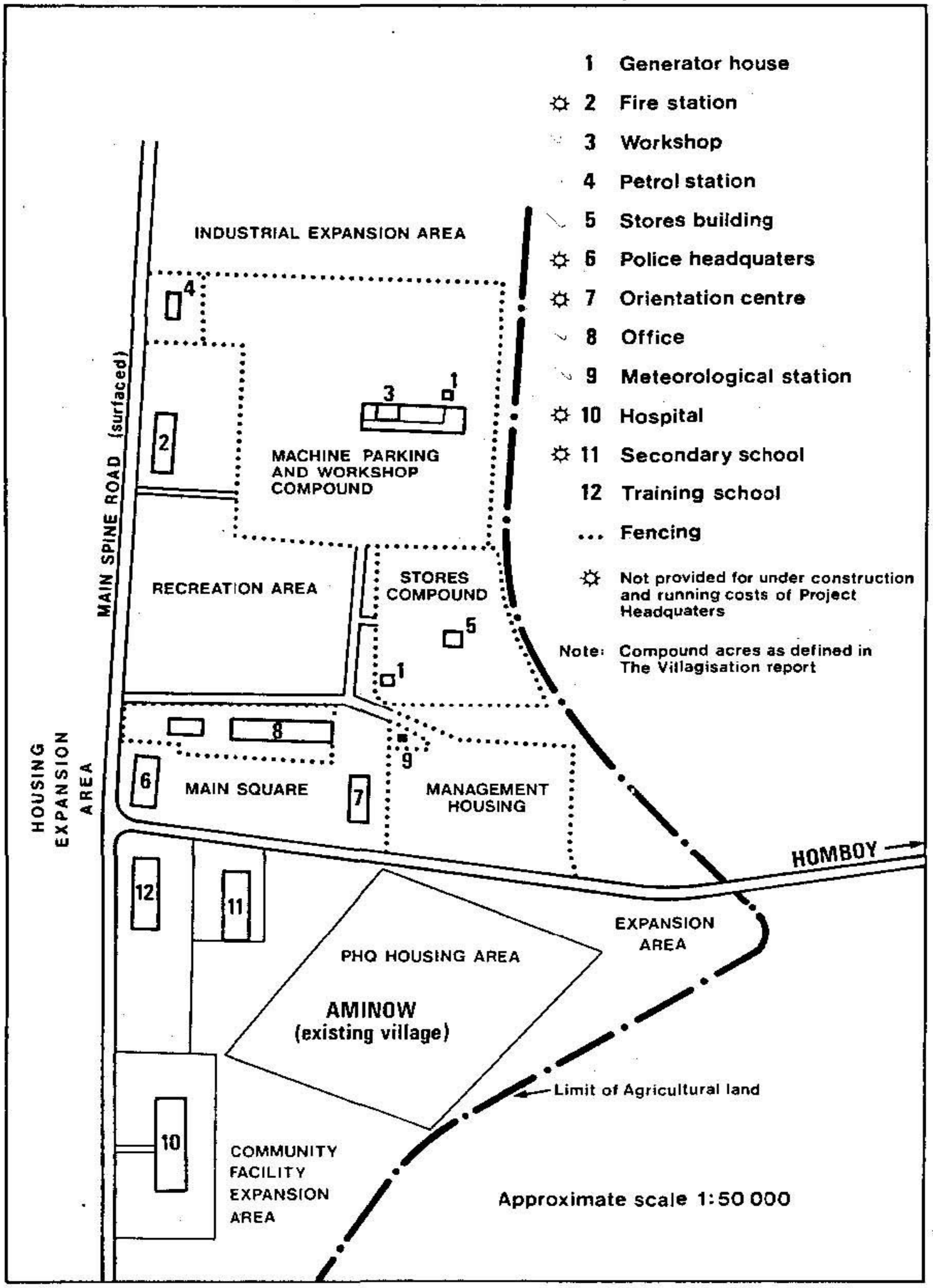
Figure 4.5 is a sketch map of the proposed development of the project headquarters at Aminow. The areas of development associated with each service facility are laid down in Table 1.3 of the Villagisation Report. Plans exist to build a new 300 bed hospital for the region which may be located either in Jilib or near Homboy (under an independent aid programme).

The area of New Aminow village was chosen as the most appropriate site for the project's main centre as despite its off-centre location the advantages of its selection were many, and are discussed in the Villagisation Report.

The building development comprising the project headquarters has been intentionally located on beach remnant soil to minimise foundation problems and consequently reduce construction costs.

Some housing already exists at Aminow, in addition to serving as the location for the project headquarters, the area of Aminow will be used to accommodate any overspill development from Homboy village. Use should be made of the continuous strip of beach

4.5 Proposed development of project headquarters at Aminow



remnant soil either side of the proposed new spine road which passes village 2 before connecting with the Mogadishu-Jilib road.

The proposed project headquarters will house the senior staff responsible for the organisation and management of the Homboy Irrigation Settlement Scheme, however, the degree of centralisation at the project headquarters has been minimised. This entails the block villages and the staff associated with each block being fairly self-sufficient and seldom needing to resort to obtaining assistance from the project headquarters although the project headquarters will be responsible for the operation and maintenance of the scheme as a whole.

The project headquarters facilities and offices are consequently far less extensive and costly than is normally found in projects of this type. It is therefore unlikely that the project headquarters complex will overshadow the identity of nearby Homboy village, either before or after the village has been incorporated in the scheme as village 5. The development configuration of Homboy and Aminow are discussed in the Villagisation Report.

The project headquarters housing all the senior staff must be built to a sufficiently high standard and provided with suitable services for attracting experienced and high calibre personnel. Initially during the implementation stage a large proportion of the project headquarters staff will possibly be expatriates. All senior staff housing should possess in-house electricity, water supply and sewerage system.

Figure 4.6 illustrates the facilities which it is proposed to provide at the project headquarters, those are described below.

4.3.1 Office Block and Meteorological Station

The proposed office has a floor area of 545 m^2 comprising 15 rooms, store, conference room and toilets. The office block will house the proposed management team, SDA staff, supporting staff and also act as a base for the Block Specialists described in the organisation and management section. The office block is located away from the generator house, vehicle park and workshop whilst near the management housing and the orientation centre.

It is recommended that a full meteorological station be established. It will be located in an open area close to the office block and enclosed by a chain link fence.

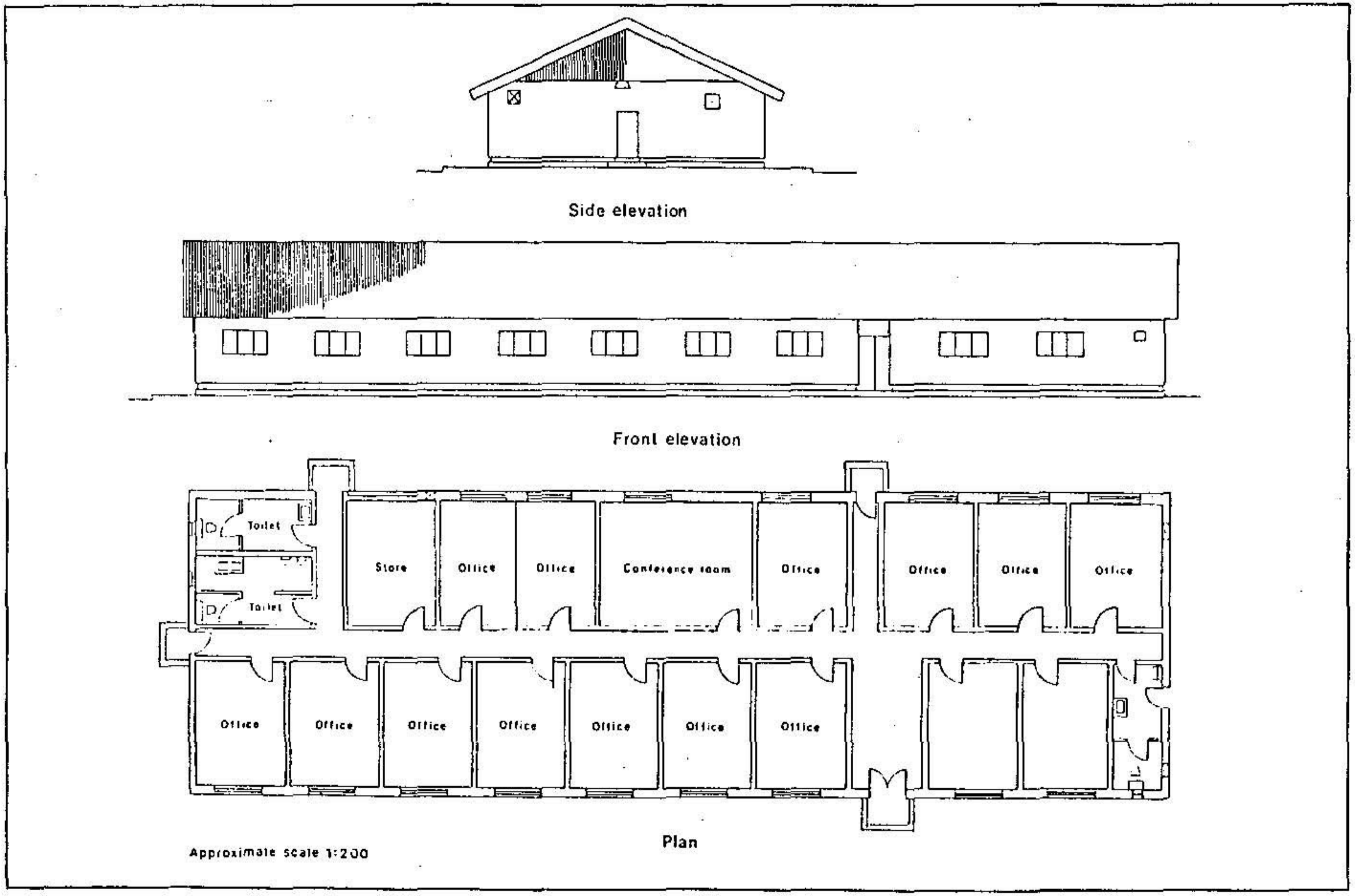
4.3.2 Training Centre

The training centre is located at the junction of the road from Homboy with the spine road adjacent to the secondary school. The training centre (Figure 4.7) has an area of 200 m^2 and comprises two offices, a classroom, two stores and toilets and an outside covered concrete hardstanding area for practical demonstrations. Large equipment will be stored outside for the majority of the year and at the project store during the wet seasons. Smaller equipment will be stored in the training centre stores.

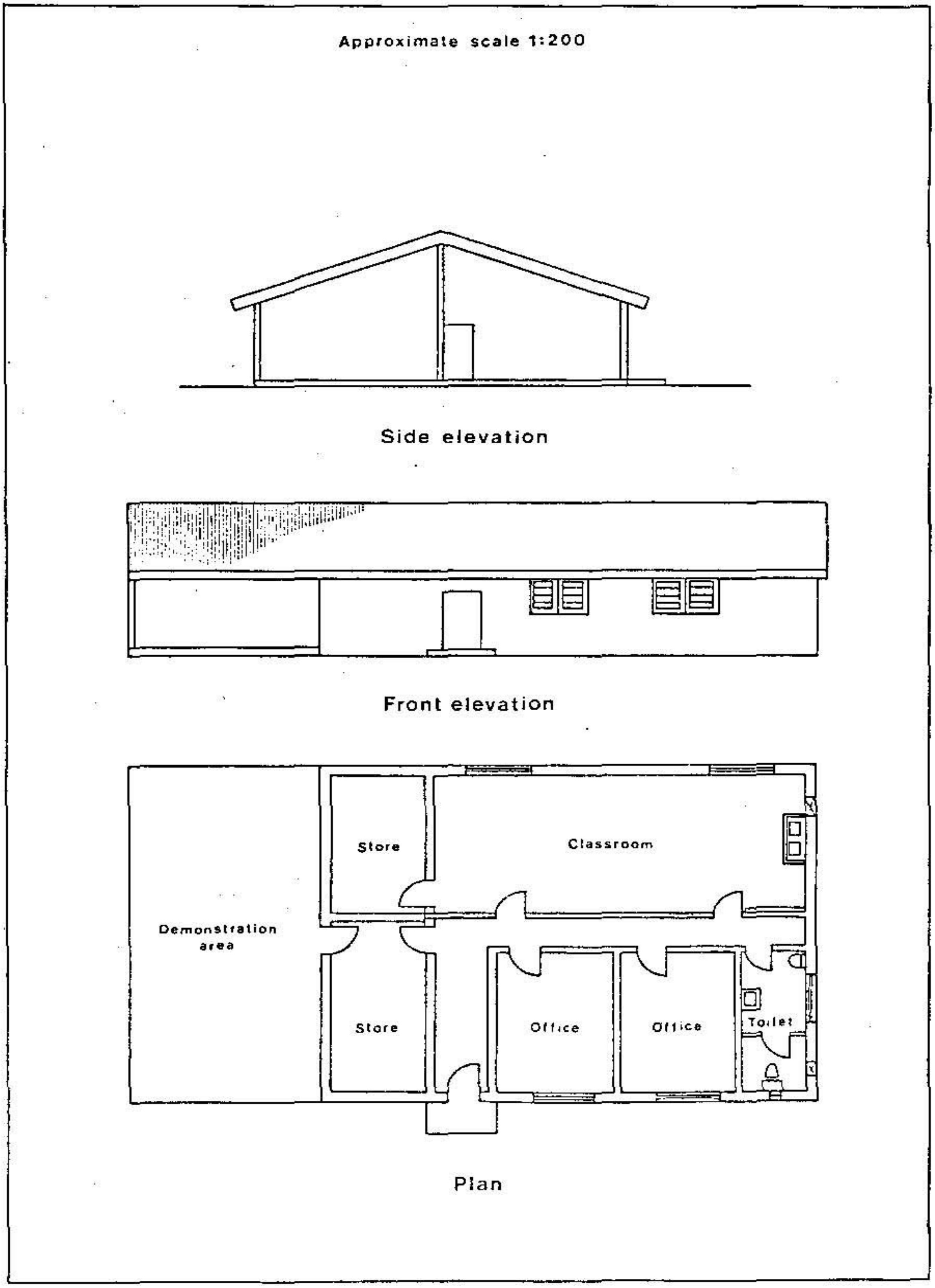
4.3.3 Workshop and Vehicle Park

The workshop is located in the extreme north of the project headquarters area, adjacent to the stores compound, the fire station and the fuel station. The whole compound area of 75,000 m^2 provides ample space for the large workshop and a considerable parking area.

4.6 Office block for Deputy General Manager



4.7 Training centre



The fully equipped workshop will have a building area of 500 m^2 supplemented by 1,100 m^2 of covered concrete hardstanding.

Additional hardstanding area of 2,400 m^2 will be provided, fifty per cent of which should be concrete.

4.3.4 Fuel Station

The compound comprises an area of 3,600 m^2 fenced off but located on the spine road to the north of the main project headquarters buildings and on route to the main Jilib Mogadishu highway. The office for the project fuel station (not public) will comprise two rooms, one for the attendant/clerk and one room as a store. An open fenced compound adjacent to the office will be used to store drums of oil and fuel. A concrete hardstanding area is provided to reduce deterioration of the filling area.

4.3.5 Stores

Seeds, chemicals, timber and other materials together with small agricultural implements, will be stored in a 60 m^2 store situated beside the workshop compound. There will be one office for the storekeeper and clerk within the store building. All chemicals and fertiliser which do not need to be kept under cover will be stored outside. The majority of seeds and chemicals will be stored at Block Village level.

4.3.6 Housing

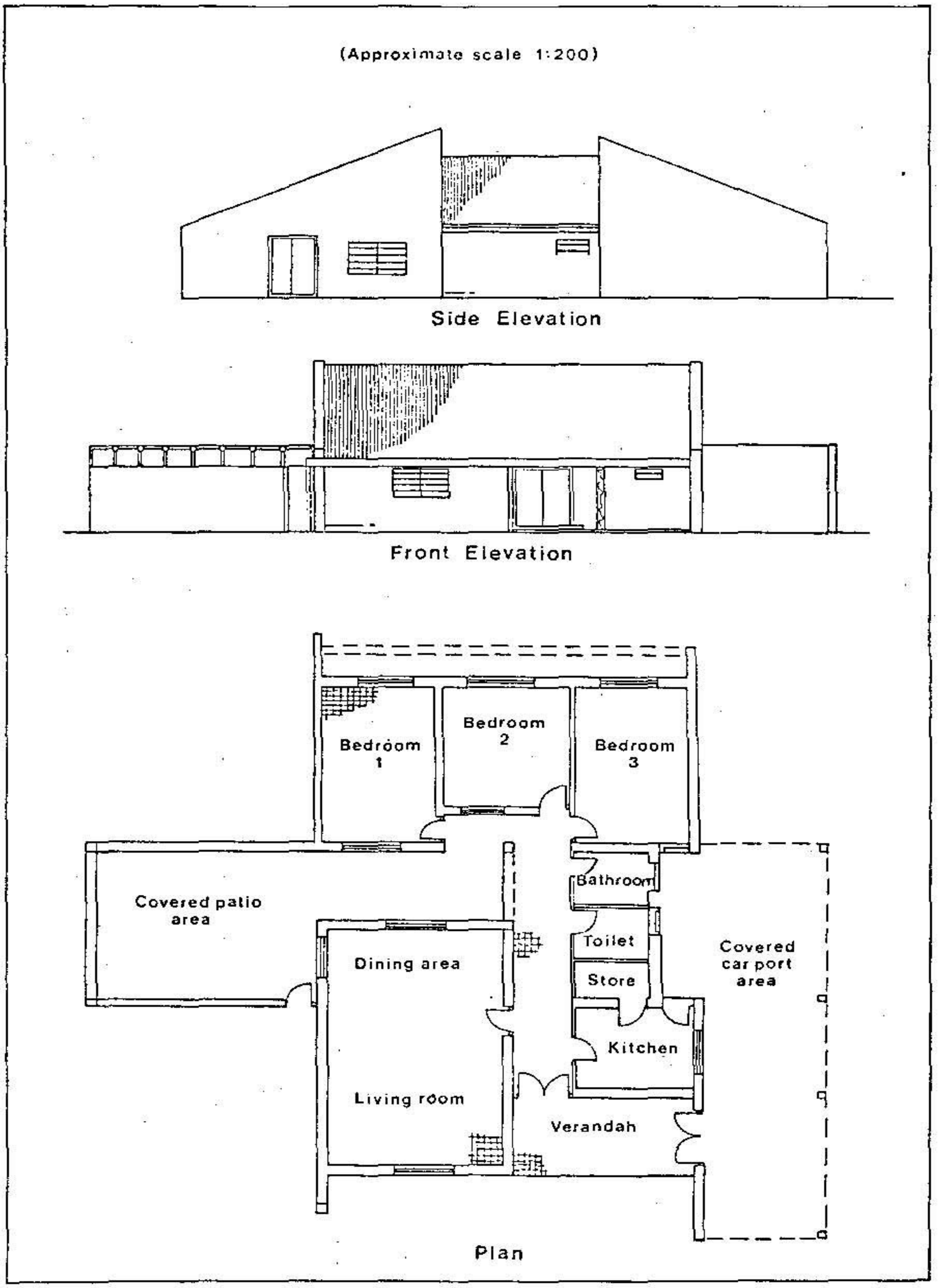
The senior personnel, Somali executives and expatriates will be housed in the management housing complex. Other staff required for the project headquarters will be drawn from the present population of Homboy and New Aminow or from trained members of the resettled population in village 5. No settlers houses are envisaged in New Aminow in the early years of the project and village number 5 will not be built in the first few years of the project (see construction programme).

Any housing at Mogadishu required by the Project Coordinator and the Implementation planning team will be rented. The construction organisation will probably be housed near to New Aminow, their housing costs have been incorporated into the overall contract price as given in the contract documents for the irrigation and drainage project.

The advisory and management team and the Block specialists are to be provided with housing at New Aminow. Some of the advisory and management team will initially be based in Mogadishu but prior to the commissioning of the first area all such staff will be based in New Aminow. It is proposed that the majority of the expatriate staff will be housed in prefabricated units (Figure 4.8) until such time as permanent housing becomes available. The prefabricated housing will then be refurbished and made available to more junior staff. Prefabricated units will also be supplied for immediate occupancy of other key senior personnel until their permanent houses are complete. Suitable house designs are shown at Figures 4.9, 4.10 and 4.11.

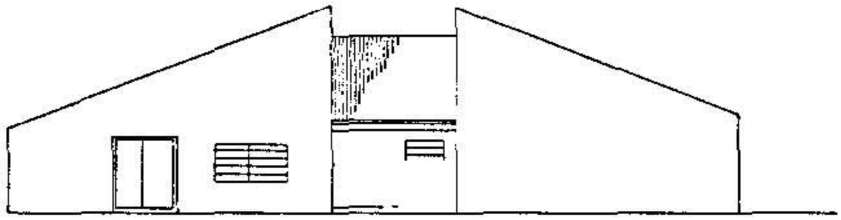
	Housing Type			
Project Headquarters Staff	AA	A	B	C (prefabricated)
Somali executive	1	2	6	12
Expatriate staff (advisory and management)	-	1	-	7
Expatriate staff (task force - field)	1	1	1	3

4.8 House type AA

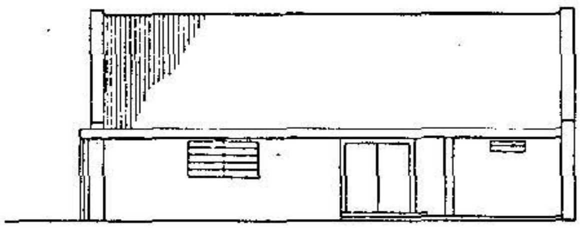


4.9 House type A

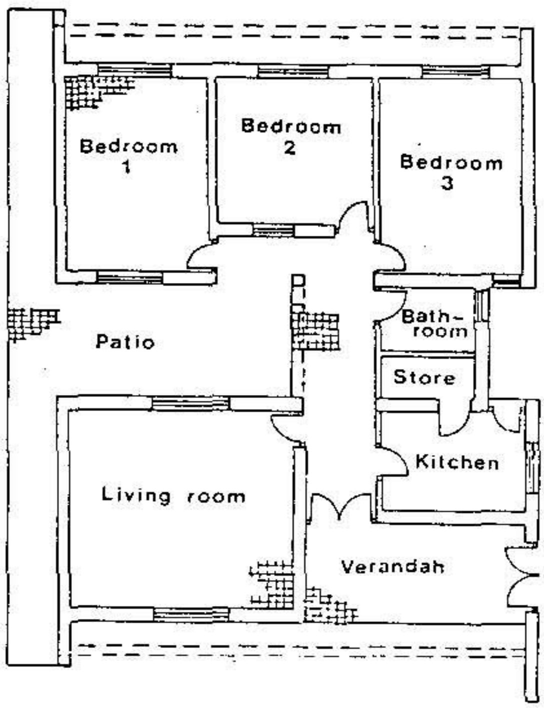
(Approximate scale 1:200)



Side Elevation

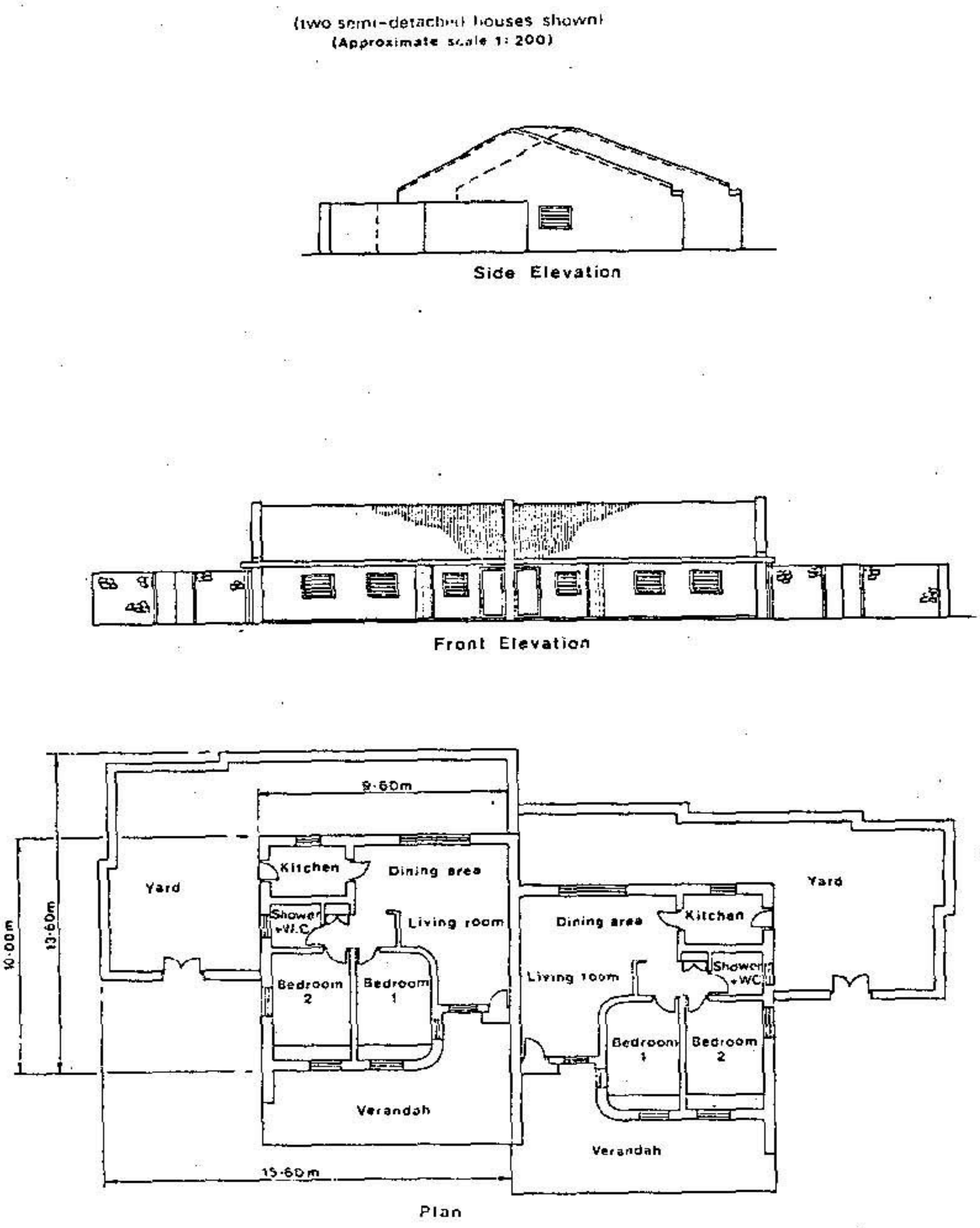


Front Elevation



Plan

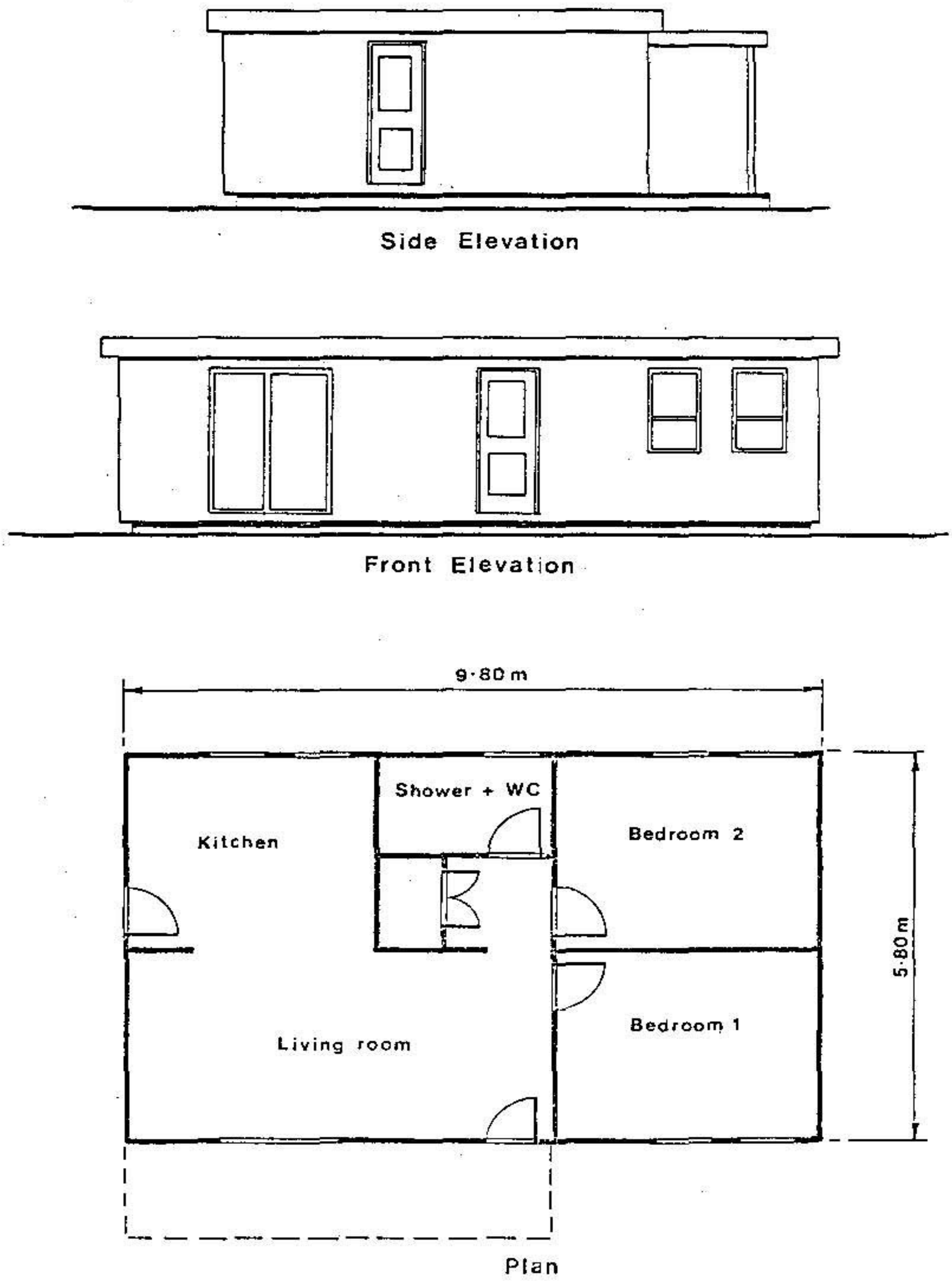
4.10 House type B



4.11 House type C

(prefabricated bungalow–typical design)

(Approximate scale 1 : 100)



Office and housing accommodation has only been quantified and costed for the project support staff. No allocation has been made in the provision of additional facilities for the socio-political organisation which will be established at New Aminow. This organisation headed by the Chairman of the Homboy Scheme will probably require office accommodation similar in floor area to that provided for the project support headquarters. The standard housing types used herein can also be used on a basis for accommodating the socio-political staff.

4.3.7 Power, Water Supply and Sanitation

The project headquarters water supply requirements have been combined with that of Homboy village (equivalent to village number 5), treatment works being provided adjacent to storage reservoir N4.2. Water distribution within the project headquarters area has been based on a supply direct to all buildings giving additional in-house supplies to offices and senior staff housing. An additional allowance has been made to provide stand-pipes for the existing housing at New Aminow at a density of one stand-pipe per ten dwellings. Water pressure within the distribution system is controlled by the elevated 128 m^3 storage tank near the treatment works.

Electricity supply is to be provided to the Project headquarters housing and other buildings (Section 4.2.4) and the workshop has its own power sources, sufficient for all power tools and lighting. Street lighting has also been allowed for in particular in the area of the stores and project office. Two 250 KVA generators will be installed within the stores compound.

All project buildings and senior staff housing are to be provided with a sanitation system based on the use of septic tanks. Owing to ground conditions it may be necessary to pump these tanks out occasionally and transport in tankers to convenient disposal points.

The normal housing and any new wattle type structures which may be built at New Aminow will be provided with the standard privy design to be incorporated in the settlement housing in block villages.

Roads within the project headquarters shall be surfaced with 150 mm of coral and link up with the project spine road and surfaced all weather road through the village of Homboy.

All costs are summarised in Section 4.5.

4.4 BLOCK HEADQUARTERS

Senior staff houses and offices could be constructed of coral stone rather than concrete blocks since the former is likely to be much cheaper. Considerable care will be required in the design of major building foundations since difficulties have been experienced on other projects because of the expansive nature of the clay soils. These difficulties can be overcome to a certain extent by judicious siting of the buildings on more suitable soils, but this will not always be possible. Foundations should generally be deep to avoid the surface soils which will be subjected to considerable wetting and drying. It may be necessary to resort to piled foundations in some cases but this should be avoided if possible since expensive buildings will result. Problems are anticipated in villages 4 and 6 where no beach remnant soils occur.

The block manager's house (Type A) and the other technical staff houses (Type B) will be located a reasonable distance away from the other village housing and away from the generator house. The workshop and vehicle yard will be located near the main access route to the primary project road and the areas farmed by the village, so that as little heavy traffic as possible passes through the village itself.

Administrative offices at Block level were given at 100 m^2 for an 800 family standard village in the Villagisation Report. This building will be sufficiently large to accommodate both the Social Services administration and the project support staff. Block villages vary in size from approximately 600 to 1,500 family units, consequently a variation would be expected in the size of the associated block village offices. Two office floor areas have been adopted to cover the range in village sizes in order to retain a degree of standardisation of construction. Stores of between 40 m^2 and 60 m^2 are also to be provided, covered, half clad and enclosed by chain link fencing. An additional 60 to 120 m^2 of concrete based hard standing area is to be provided for fertiliser and other such agricultural inputs which can be stored out of doors. Hard standing areas of between 200 and 300 m^2 are proposed for machinery. A small proportion of this should be covered and act as the maintenance point for the agricultural machinery which will be supplemented by the use of the mobile workshop. A typical layout is illustrated in Figure 4.12.

A fuel tank of between 4,000 to 6,000 litres capacity will store fuel for farm machinery and be located adjacent to the machinery hard standing area.

The block manager, accountant/book-keeper, irrigation and mechanisation supervisors, typists and clerks should all operate from the block headquarters office. The office should also be provided wtih electricity, water supply and toilet facilities linked to a septic tank.

The pump station cross regulator and other structure operators will obtain Social Services support in the villages nearest their place of work and will have a small operators quarters located beside the structure or equipment for which the operators are responsible. The operators quarters are detailed in the tender documents (album of drawings) and construction costs included in the Civil Works Contract. The quarters will act as living accommodation for the operators who should be discouraged from obtaining an alternative dwelling in the block village.

4.5 SUMMARY OF COSTS

One of the problems which has been associated with the Homboy studies is that because of the way in which different components are being financed by various donors, total costs for the scheme were obscured. This section, although based upon the costs summarised in the Villagisation Report (Part 1), is intended to give a more detailed and complete picture of the costs associated with the provision of infrastructure to support village life, agricultural production and management in both the implementation and operational stages of development. The costs are based upon the proposals and recommendations made in the report. Bearing in mind the possibility of donors being found to support individual components of the infrastructure, the summary Table 4.1 is presented in such a way as to make this possible.

4.12 Typical layout for Block Enclosure and Buildings

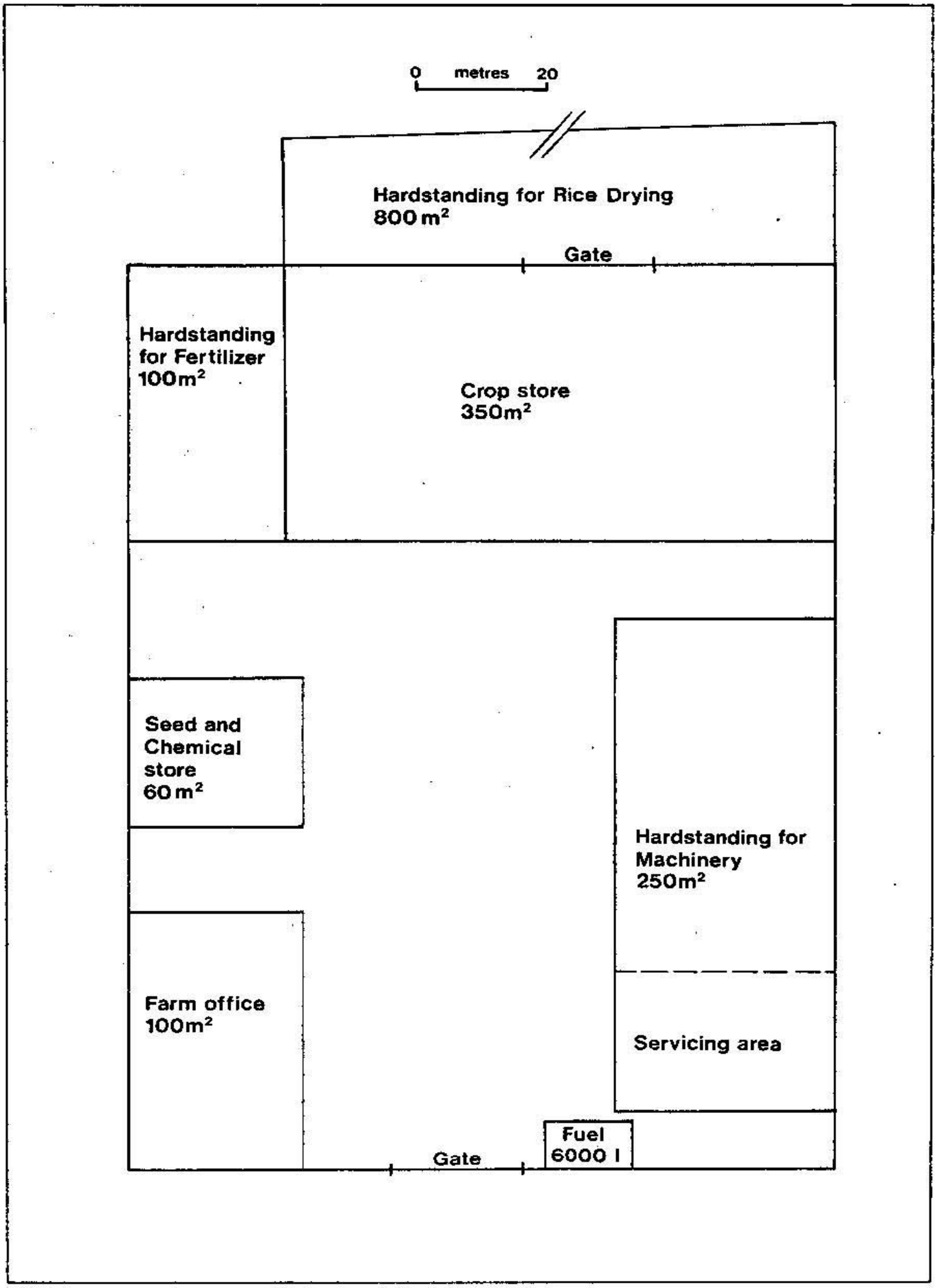


TABLE 4.1 CAPITAL COST FOR INFRASTRUCTURE (So.Sh.'000)

	Year 1	Year 2	Year 3	Year 4	Year 5	Total (economic)	Total (financial)	
1. Homboy to Mogadishu radio transcievers	25	-	-	-	-	25 x 1.425	35.6	Provisional Programme
2. Internal radio transciever sets	18	.108	72	54	-	252 x 1.425	359.1	of Works
3. Potable water supply abstraction and treatment	730	3,097.2	2,335.2	1,787.5	765	8,715 x 1.17	10,196.6	Yr. 1 block village VI
4. Potable water supply trunk mains	473	1,089	3,371	2,310	222	7,465 x 1.17	8,734	Yr. 2 PHQ V2, 3, 4,
5. Potable water supply stand-by pipes and fittings	210	1,002.6	1,032.6	735.1	262.5	3,242.8 x 1.17	3,794.1	Yr. 3 V5, 6, 7,
6. Generators for PHQ, workshop and block villages	115	1,355	345	230	115	2,160 x 1.085	2,343.6	Yr. 4 V8, 9
7. Electrical distribution and main road lighting	57	384	281	201	72	995 x 1.425	1,418	
8. Settlers housing (Alternative 6)	3,363.2	13,023.1	16,585	11,806.3	4,216.5	49,004.1 x 1.0	49,004.1	
9. Additional cost for concrete foundations	-	174	150	-	-	324 x 1.165	377.5	
10. Earth roads with block villages and PHQ	285	1,191.8	1,401.3	997.5	356.3	4,231.9 x 1.055	4,464.6	
11. Disposal of drainage water from blocks and PHQ	2.4	28.9	9.9	2.7	1.0	44.9 x 1.195	47.4	
12. Project staff housing	1,315	13,918	3,945	2,885	1,315	23,378 x 1.195	27,937	
13. Social services	882	3,601.6	1,336.6	3,087.1	1,102.5	13,009.8 x 1.195	15,546.7	
14. Project buildings	803	9,755	3,310	3,260	1,005	18,133 x 1.195	21,669	
15. Electrical fittings and air conditioners for housing	73	809	219	153	73	1,327 x 1.425	1,891	
16. Physical contingencies	836	4,954	3,739	2,751	951	13,231 x 1.1	14,554	
17. Price contingencies	836	4,954	3,739	2,751	951	13,231 x 1.1	14,554	
Total economic So.Sh. x 1,000	**10,034**	**59,445**	**44,872**	**33,011**	**11,408**	**158,770**		
Totals financial So.Sh. x 1,000	**11,181**	**66,243**	**50,003**	**36,786**	**12,713**		**176,926**	

Note: 10 per cent physical contingencies and 10 per cent price contingencies allowed.

Annex

Main Construction Work and Costs

1.1 INTRODUCTION

The project area is located on the eastern side of the River Jubba and stretches from Kamsuuma, north east to the new Jilib/Golweyn road, a distance of approximately 30 kilometres. The gross project area is approximately 14,200 ha.

The project area will be split up into ten irrigation blocks and, associated with each block, a new village will be built to house the settlers working on the scheme. The villages have been located with regard to favourable soil conditions, ease of access and minimum walking distance to the fields of the irrigation blocks they serve.

The soils of the projct area are predominantly fine textured Shabeelle alluvium deposited by flooding from the Shabeelle River and the Harar Naga and Kormajirto depressions that run through the area. This strip of land is relatively narrow and is bounded on either side by very fine textured and saline Marine Plain soils. These are considered unsuitable for either irrigated or rainfed agriculture and thus development has been restricted to the Shabeelle alluvium plus small areas of channel and beach remnant.

Mixed cropping will be carried out on most of the project, although certain areas of the Shabeelle alluvium which are low lying or exhibit poor drainage characteristics have been identified as suitable for paddy rice only. In addition, areas unsuitable for irrigation due to topographic reasons have been marked as areas for rainfed cultivation. Rainfed areas are evenly distributed throughout the project area whereas the majority of the paddy rice areas are in the south.

Details of the ten block areas are given in Table 1.1.

It is recommended that for ease of management a single crop is grown on one distributary canal, with the cropping pattern being applied at block level. Hence the distributary canals must be capable of supplying the maximum requirement of a single crop, whereas the Main Canal need only supply water to meet the requirements of the overall cropping pattern. These figures have been calculated as 2.4 and 2 litres/sec/ha net for a 12 hour day respectively, based on a field efficiency of 60 per cent and watercourse losses of 10 per cent and not including distributary canal losses. The requirements for paddy rice have been calculated as 4 litres/sec/ha net also for a 12 hour day and a field efficiency of 70 per cent.

Associated with these field efficiencies, the ratio of the volume of water going to deep percolation to the total volume of irrigation water placed on the field is quite high. This ratio, normally termed the leaching fraction is much larger than the leaching requirements calculated. These calculations, assuming an average electrical conductivity level of 0.40 mmho/cm for the supply canal water, an electrical conductivity of the saturation extract of the soil of 2.5 mmhos/cm associated with a 10 per cent yield reduction in a maize crop and a leaching efficiency of 45 per cent gave leaching requirements far below the actual leaching fraction. Maize is more sensitive than cotton or rice to salinity increases. Even assuming a high electrical conductivity level of 0.75 mmhos/cm for the irrigation water the leaching fraction was still sufficient for leaching purposes.

Distributary canals have been designed for the highest single crop water requirement thus providing plenty of scope for altering the crop rotation if necessary.

TABLE 1.1 DETAILS OF BLOCK AREAS

Block Nr.	Mixed Crop (ha net)	Paddy Rice (ha net)	Total Irrigated (ha net)	Rainfed (ha net)	Total (ha net)
1	550	50	600	40	640
2	775	50	825	150	975
3	675	25	700	235	935
4	925	-	925	315	1,240
5	1,025	-	1,025	220	1,245
6	700	100	800	485	1,285
7	1,125	-	1,125	360	1485
8	550	25	575	350	935
9	1,025	500	1,525	195	1,720
10	550	200	750	315	1,065
Total	7,900	950	8,850	2,675	11,525

The recommended cropping pattern, based on financial returns and water availability is given below:-

TABLE 1.2 PROPOSED CROPPING PATTERN

Crop	Gu Season %	Der Season %
Vegetables	5	5
Groundnuts	15	-
Upland Rice	20	20
Maize	20	20
Sesame	-	15
Cotton	-	40
Total	60	100

Canal seepage losses were estimated using the Lacey formula with a Lacey seepage factor of 0.012. It was not found economically viable to provide a lining to all storage reservoirs or the canal system although provision has been made to install clay lining in areas of lightly textured soils.

1.2 Irrigation System

The basic field unit will be 25 ha net (approximately 30 ha gross) with settlers each being allocated 1 hectare. The fields will be fed by watercourses having discharges of 60 litres/sec and 100 litres/sec for mixed crop areas and paddy rice areas respectively. Due to the irregular topography of the project area it was found impossible to standardise unit dimensions; the area of both unit types has however, been kept constant.

The mixed crops will be irrigated either by border strips or furrows. The maximum border strip or furrow length has been taken as 300 m with a maximum slope of 0.3 per cent The border strips or furrows are aligned in the direction that gives the most acceptable slope thus reducing land levelling costs; a watercourse itself may sub-divide in order to facilitate irrigation, the flow being controlled by earth bunds or portable checks.

Paddy rice will be irrigated in horizontal basins of variable size. The minimum basin dimension has been set at 30 m to tie in with the proposed land levelling grid. The maximum basin length has been set at 200 m for ease of management and to keep the time required to fill the basin within reasonable limits.

Sample field layouts are given in Figures 1.1, 1.2 and 1.3.

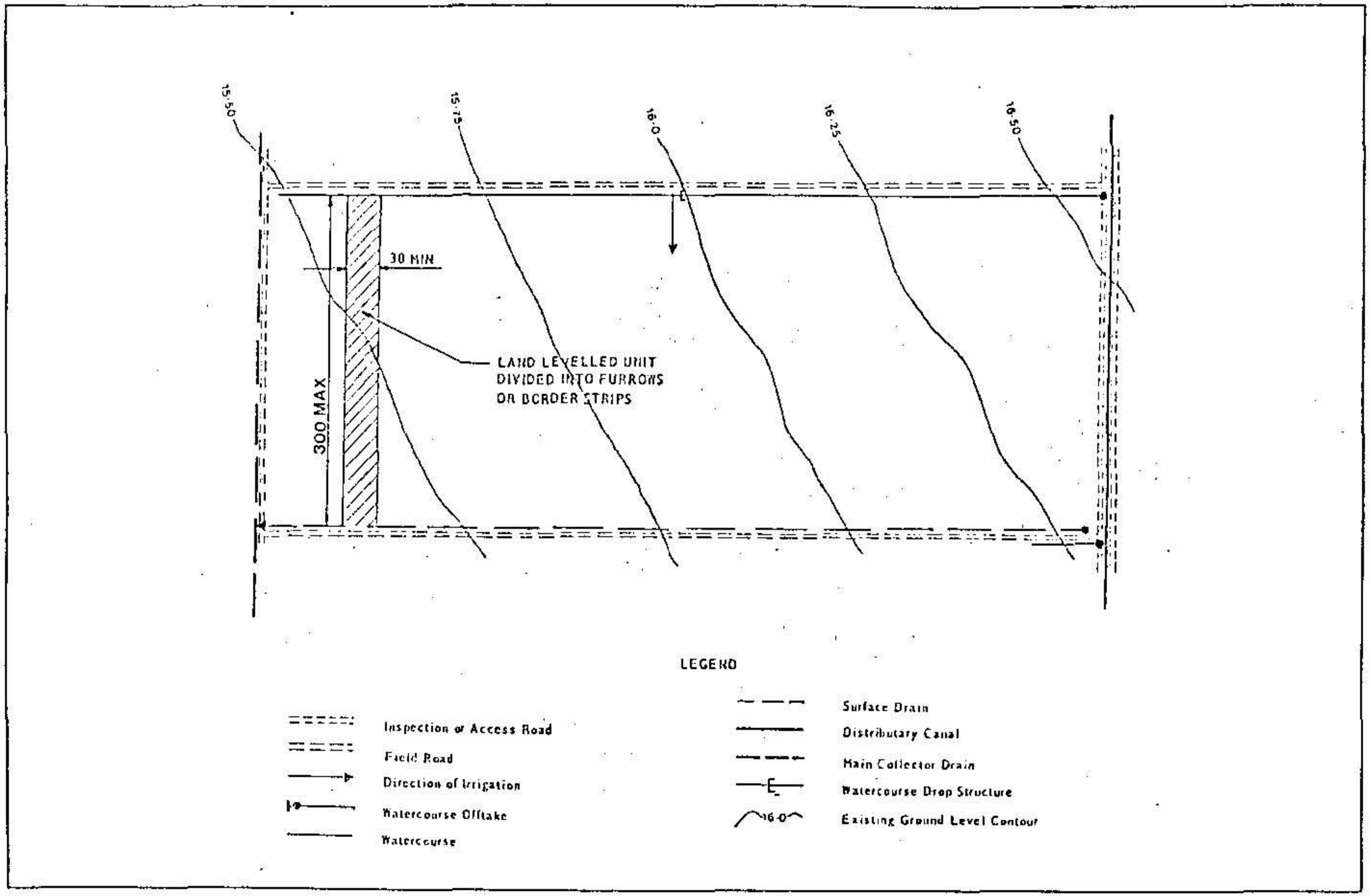
Flow into the watercourses will be by means of gated pipes offtaking from distributary canals which will be controlled by cross regulating structures located at suitable positions. As night watering is not considered feasible for the Homboy Scheme, the watercourses and distributary canals will operate therefore for 12 hours in the daytime only, with the Supply, Main and branch canals running continously. Water will be stored at the head of each distributary in storage reservoirs which will be filled from the Main and branch canals at night and discharge into the distributary canals by day. Wherever possible, more than one distributary will offtake from a reservoir to reduce the number of reservoirs required, and reservoirs on opposite sides of the main canals have been grouped to minimise the number of cross regulators required on the Main Canal.

The night storage reservoir embankments have internal side slopes of 1 in 3 and external side slopes of 1 in 2. The minimum bank top width is 5 metres but this should be increased where necessary to give a seepage gradient of 1 in 7 minimum.

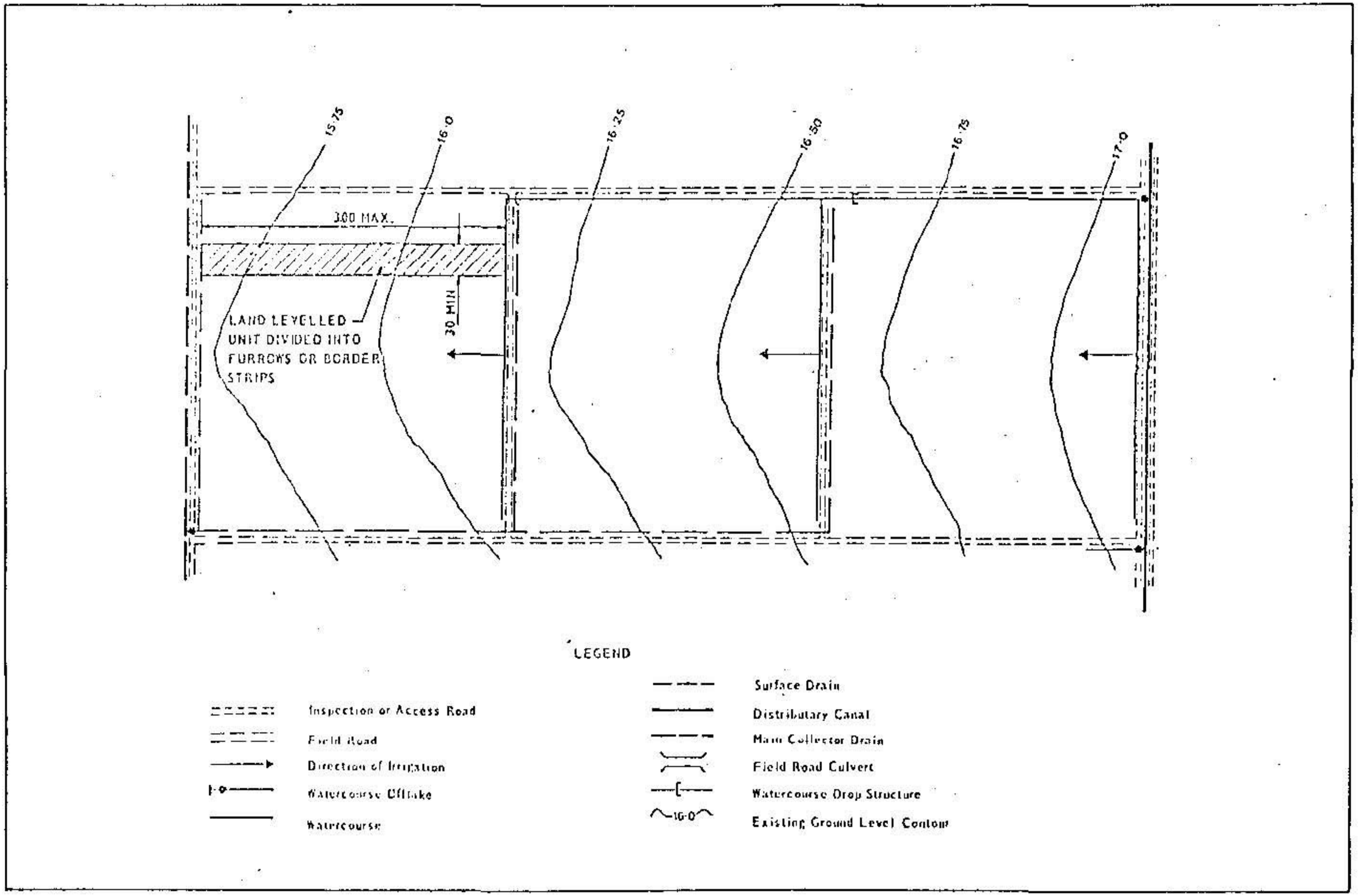
Sedimentation of the Storage Reservoirs was studied in the light of available data on sediment. Owing to the possible construction of Bardheere Dam and the long lengths of the Fanoole Main Canal and the Supply Canal sedimentation within the project area itself is not considered a problem of major proportions although some problems will nevertheless occur, mainly in the storage reservoirs.

Other methods of night storage were investigated as an alternative namely storage in the distributary canals or storage in the Main Canal.

1.1 Typical mixed crop watercoarse unit I



1.2 Typical mixed crop watercoarse unit II



1.3 Typical paddy rice watercoarse unit

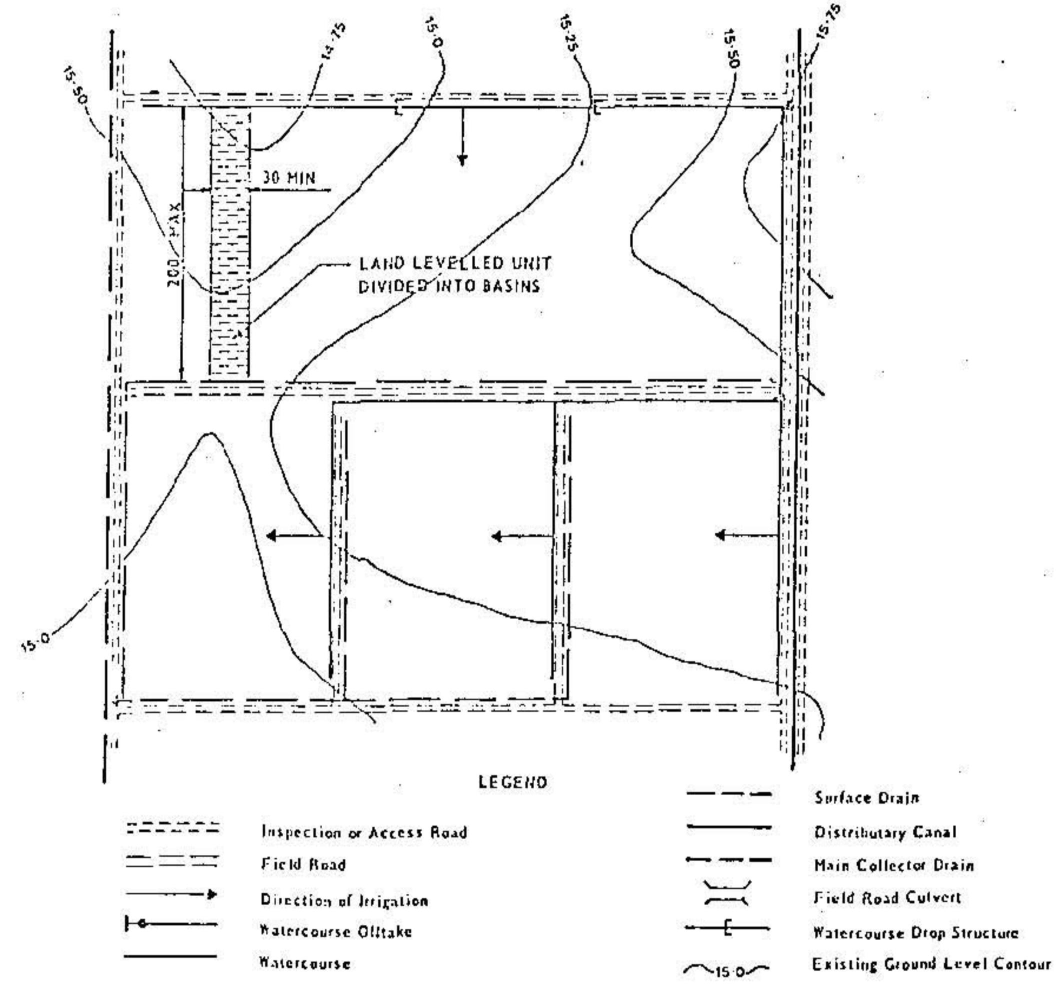


TABLE 1.3 DETAILS OF NIGHT STORAGE RESERVOIRS

Reservoir Number	Water level Range (m)	Live Storage Volume (m^3)	Approximate Water Surface Area (m^2)
N 1.2	0.90	16,100	18.000
N 2.1	0.50	38,900	78,000
N 2.2	0.90	40,400	45,000
N 3.1	0.72	20,200	28.000
N 3.2	0.79	18.100	23.000
N 4.1	0.88	13,400	15.000
N 4.2	0.72	71,600	99,000
N 5.1	0.70	60,400	86,000
N 5.2	0.48	45.600	95,000
N 6.1	0.90	18,500	21,000
N 6.2	0.71	13,800	19,000
N B1	0.49	97,200	198,000
N B2	0.50	49.500	99,000

1.2.1 Storage in Distributary Canals

This method can be discounted due to the excessive amount of earthworks involved in raising the embankments caused by the long lengths of distributary canal and the broken topography. It is also difficult to accommodate storage within the steeper canal reaches unless cross regulators are provided at short intervals. Storage in distributary canals is really only applicable for irrigation projects on very flat land where the canal commands can be kept low.

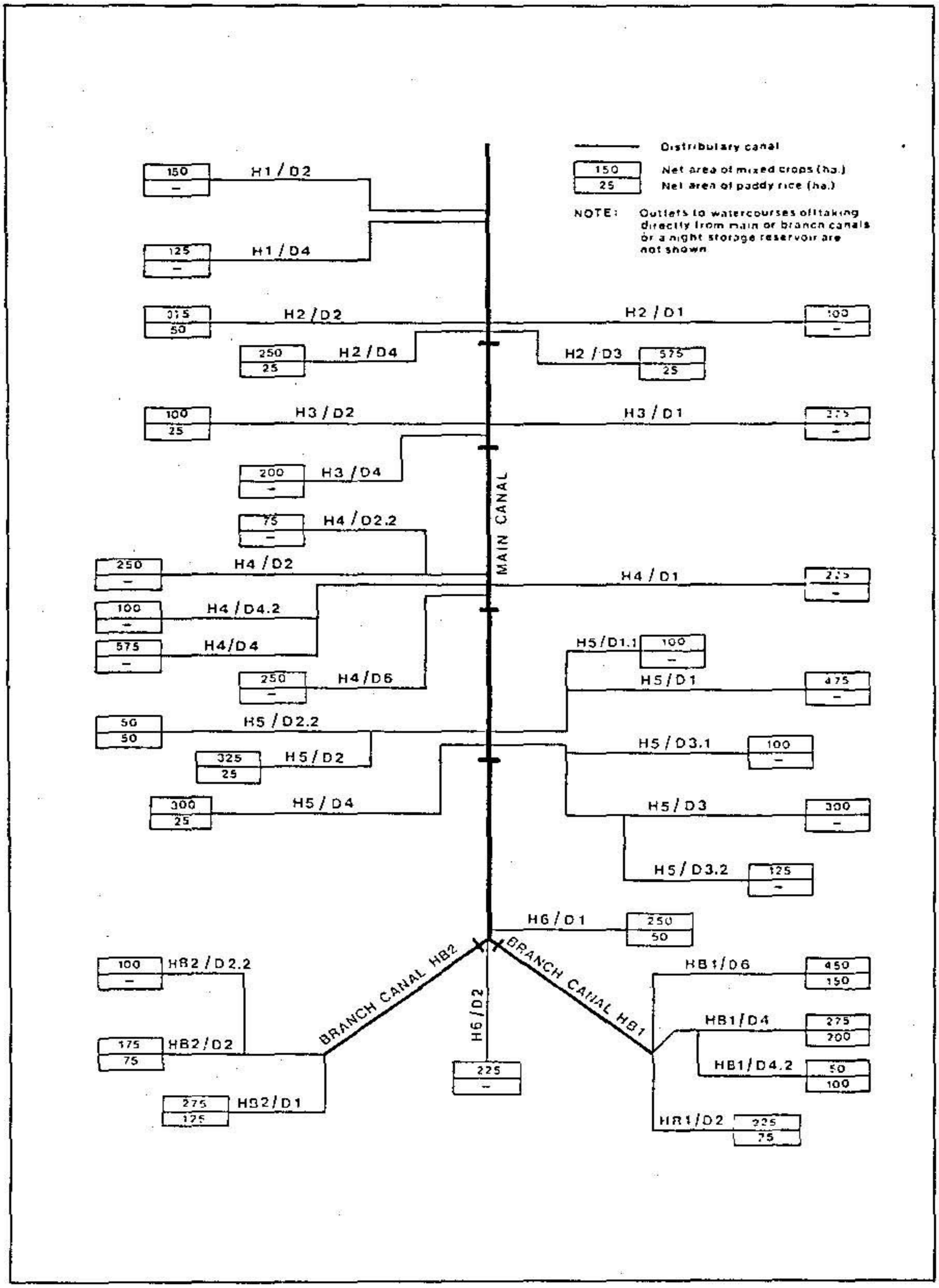
1.2.2 Storage in The Main Canal

This method necessitates the widening of the Main Canal to give a water surface width of about 45 m. Although this method does not result in extra earthworks cost (because the Main Canal is predominantly in fill), it does increase the size and hence the cost of the Main Canal structures. It has been estimated that the costs of storage in the Main Canal and in the storage reservoirs are of the same order, but the reservoir system has been chosen since storage in the Main Canal would result in complicated operation of the canal at night. Furthermore, desilting and weed clearing for a canal of up to 45 m wide would be an expensive and time consuming operation.

The water for the project will be supplied from an enlarged Fanoole Main Canal which itself offtakes from the River Jubba at the Fanoole Barrage. The Homboy Supply Canal, which has a capacity of about 12 cumecs, will offtake from the Fanoole Canal just north of Jilib and then run parallel to the new Jilib/Golweyn road for about 15 km before reaching the project area.

The Main and branch canals run approximately through the centre of the project area on the elevated levee soils of the old Shabeelle meander complex. All canals will generally be unlined except where they pass through localised sandy areas; in these cases they will be lined with selected clay material. The irrigation distribution system is illustrated in Figure 1.4.

1.4 Water supply network



Escape structures have been provided at the tails of distributaries to prevent overtopping in the event of excessive discharge being passed down the canal or incorrect outlet operation. Two Main Canal escapes have also been provided to safeguard against breaching and to draw down the canal for maintenance purposes.

In the event of the Fanoole Canal not being completed in time an alternative temporary supply system should be used. This would include a small temporary pump station near Limoole pumping directly from the river Jubba discharging into a short canal to convey the water to the Supply Canal.

1.3 Flood Protection

Flood protection works are necessary to protect the project area from the Shabeelle river and the Harar Naga depression. The proposed works will divert the flood water away from the project area and into the River Jubba via two storage reservoirs and an Upper and a Lower Outfall Drain.

The Northern Reservoir is situated to the north of the new Jilib/Golweyn road and is designed to collect and store advancing flood waters from storms in its catchment area. The reservoir has a gated outlet structure which will be capable of passing the 1 in 1,000 year flood from the N. Reservoir catchment. The outlet structure discharges into the Upper Outfall Drain which then conveys the flood waters into the Eastern Reservoir.

The Eastern Reservoir is required as an additional storage area to store the flood water discharged from the Northern Reservoir. the combination of these two reservoirs are capable of storing the 1 in 1,000 year flood. Results from computer flood routing models indicate that the maximum rate at which stored water is discharged into the Lower Outfall Drain, and hence into the Jubba river, should be 10 cumecs. This will ensure the safe operation of the reservoir network.

Water from the internal drainage system will also discharge into the lower outfall drain and a description of the operation of this drain and the southern reservoir area is given in the following section.

1.4 Drainage System

The drainage system is provided to dispose of surface water from storm run-off within the irrigation area or excess irrigation supplies. A deep drainage system is not proposed at present since the water table is currently some 20 m below ground level, and it is unlikely to be required during the projects life. However, as the project develops both the soil salinity and the water table level should be monitored for any significant changes. This must be installed prior to the commencement of irrigation to record the movement of the water table and of the wetting front as the moisture moves down the profile.

The drains have been designed to dispose of a 1 in 5 year storm within three days - i.e. ponding of the fields is permitted for up to three days. This period is not considered to be significantly injurious to the crops and allows a reduction in the size of the drains. The drainable surplus has thus been calculated as 1.5 litres/sec/ha gross which is equivalent to 45 litres/sec for a 30 ha gross watercourse unit.

The drainage system consists of shallow field drains which can be crossed by tractors and serve each watercourse unit, discharging into deeper main collector or branch drains by means of a culvert. These larger drains in turn discharge into the Lower Outfall Drain either by gravity or by means of small drainage pump stations where the levels so require. It is estimated that some 3,000 ha gross will require pumped drainage. On economic grounds pumping of the Outfall Drain has been discounted. Gravity flow from the outfall drain into the River Jubba will only be possible when the river levels are low. For the remainder of the year, flow in the Outfall Drain will be stored in the Southern Reservoir area between Kamsuuma and Buulo Waamu. The banana plantations to the south of Kamsuuma will be protected by raising and restoring the existing bund where necessary. Water in this Southern Reservoir will flow back into the Outfall Drain and thence be discharged when the river levels are low, with any residual water being disposed of by percolation and evaporation.

Surface water escapes have been provided throughout the project area to dispose of water from depressions, in particular the old river meanders or fartas.

1.5 Canal Structures

Canal structures are provided to regulate and measure the flow of water and to give crossing points for project vehicles and machinery. A brief description of the major structures is given below:-

(a) The Supply Canal Head Regulator is a gated weir structure with three vertical lifting gates of span 2.5 m and height 2.0 m. The structure incorporates a stilling basin to dissipate excess energy and a bridge deck giving a 4 m wide road crossing.

(b) The main canal cross regulators, the branch canal head regulators and the night storage reservoir regulators are all movable weir structures. They incorporate a bridge deck giving a 4 m wide road crossing.

(c) The distributary canal head regulators are pipe structures with a lifting gate over the pipe on the upstream end and an energy dissipating outlet box downstream. The gate opening must be adjusted at intervals throughout the day to allow for the falling water level in the storage reservoir.

(d) The distributary canal cross regulators are simply pipe culverts with screw operated lifting gates fixed to the upstream wingwall.

(e) The outlets to watercourses supplying mixed crops are gated pipes of 0.30 m diameter and those supplying paddy rice are 0.375 m diameter gated pipes.

(f) Box and pipe culverts are provided to give road crossing points. Pipe culverts are used for canal discharges of up to 2.6 m^3/s and box culverts for discharges greater than this.

(g) There are two Main Canal escape structures. The one near the head of the Main Canal has 3 vertical lifting gates of width 2.5 m and height 1.5 m. The one near the tail of the Main Canal has 1 vertical lifting gate of width 2.5 m and height 1.5 m.

(h) The distributary tail escapes consist of a fixed weir inlet box, a pipe of 0.45 m diameter passing through the canal bank and an outlet box.

1.6 Drain Structures

Drain structures are provided to control flood waters and to provide crossing points for project vehicles and machinery. A brief description of the major structures is given below:-

(a) The Northern Reservoir Outlet Structure controls the flow from the Northern Reservoir and passes it under the proposed roadbridge for the new Jilib/Golweyn road. It has six vertical lifting gates (each of width 4 m and height 1.8 m) which, when fully opened with the reservoir full (water level 22.5 m), can pass the 330 m^3/s peak flow calculated from the hydrological study for the 1 in 1,000 year flood. Upstream of each gate is a streamlined intake to minimise entrance losses, and downstream a culvert which is shaped to allow supercritical flow to expand as it passes under the new bridge into the stilling basin. The overall length of the structure is 54 m and its width is 50 m.

(b) The Eastern Reservoir Outlet Structure consists of three 1.2 m diameter pipes passing through the reservoir embankment. There are screw operated gates on the upstream ends of the pipes and outlet boxes on the downstream ends.

(c) The Lower Outfall Drain Outlet Structure is a three barrelled 1.8 m square box culvert with a outlet box for each barrel. Positioned at the inlet to each barrel is a flap gate to prevent river water flowing back into the drain at times of high river level.

(d) Surface water escapes are positioned so as to drain water from low lying land or natural channels into the drainage system. The structure consists of a single 0.45 m diameter pipe and a outlet box. There is also one larger surface water escape which has a pipe diameter of 1.2 m.

(e) Box culverts have been provided on the branch and outfall drains to give road crossing points. The structures consist of 3 reinforced concrete barrels square in section.

(f) Box culverts with flap gates attached to the downstream ends of the barrels have been used for the junction of the branch drain D2 with the Lower Outfall Drain. The flap gates prevent reverse flow occurring in the drains at periods of high levels in the Outfall Drain.

(g) Pipe culverts are provided at drain junctions to accommodate differences in bed level and to give road crossing points. Three types of inlet and outlet arrangements have been designed to suit the varying combinations of discharge and head loss.

1.7 Surfaced Roads

Good road access within the project is essential to ensure that the movement of agricultural and maintenance machinery, farm inputs and produce, and farm labour is unrestricted. The road system, or at least provision for it, must be built into the project because the later addition of such a system would involve major engineering works.

A good quality bitumen surfaced road already exists connecting Jilib to the port of Kismaayo; a similar quality road connecting Jilib to Mogadishu is due for completion in 1981. These roads will provide the necessary access for transportation of materials and machinery to the project area.

New coral surfaced roads are proposed to provide the access between the project headquarters and block villages within the project area as described below:-

(a) Spine Road
The Spine Road runs approximately north-south along the western boundary of the project area connecting the Jilib/Golweyn road to the Jilib/Kismayo road. It has a surfaced width of 8 metres and is about 23.5 km long.

(b) Feeder Roads
The feeder roads connect the block villages to the spine road. They have a surfaced width of 7 metres and a total length of about 21 km.

Five cross drainage culverts have been provided at intervals along the length of the Spine Road to drain storm run-off from the marine plain. The storm run-off is passed under the road by means of pipe culverts and then flows into the branch drain D2 via surface water escape structures.

A number of pipe and box culverts have been provided in the project area where the surfaced roads cross canals, drains and natural channels (fartas).

The surfaced road construction essentially comprises a layer of selected fill, a coral sub-base and coral road base.

1.8 Earth Roads

The earth roads in the project area can be divided into three categories as described below:-

(a) Access Roads
These roads are generally provided on both sides of the drains and will be the main access routes within the project area. They will be formed from material excavated from the drains and will be on embankments with a bank top width of 6 m.

(b) Inspection Roads
These roads are provided on top of all Supply, Main, branch and distributary canal embankments. They are generally for inspection and operation and maintenance of the canals and will not be heavily trafficked. In fact, the use of these roads by general traffic should be discouraged so as to prevent damage to canal banks. The bank top width for the supply, main and branch canals is 5 m and for the distributaries it is 4 m.

(c) Field Roads
These roads are to be graded at ground level to give access within the field units. A reservation width between the centrelines of the watercourse and field drain of 10 m has been allowed to accommodate the field road.

1.9 Bush Clearance

It has been estimated that about 25 per cent of the project area has previously been cleared for rainfed cultivation. The remainder of the land is covered with medium to dense mixed acacia and scrubland, although there are small areas of swamp grasses and sedges with relatively few emergent trees in the deeper depression areas. Tree density in the uncleared areas is estimated as approximately 500 per hectare. Tree heights are typically 2 to 3 metres and trunks 100 to 200 millimetres in diameter.

It is recommended that bush should be cleared by a root or multi-application rake with a root plough behind the tractor to bring up the roots in the same operation. This will leave some roots on the ground surface which can be collected by hand. Bush and roots should be heaped into windrows at a convenient interval during raking, and thence transported by lorry to designated points in the villages for use as tenant house building material or domestic firewood. In areas where this is not practicable or for small material the bush and roots should be burnt.

1.10 Land Levelling

Land levelling is of fundamental importance to the success of any surface irrigation scheme. If the accuracy of land levelling is low it will prove impossible to achieve an even distribution of water across the fields and, as a result the efficiency of the system will be reduced dramatically.

In order to assess the land levelling requirements of the project area 8 sample areas (300 m x 300 m) were surveyed on a 30 m grid. To obtain the desired degree of land levelling, calculations indicated that the average volume of excavation required per hectare should not exceed 400 cu. m. The areas were chosen to represent the variety of soil and topographic conditions prevailing in the project area. The results of these land levelling sample surveys were analysed using a computer program to determine the earth moving requirements for various irrigation systems.

It is proposed that a detailed survey be carried out on a 30 x 30 m grid to determine the size of plots to be land levelled for each watercourse unit. Calculations will then be made to give the plane of best fit for each plot by cutting high areas and filling in the low areas.

It is recommended that the land levelling for the Homboy Scheme is carried out by laser controlled self-elevating scrapers and motor graders. The scrapers are used to cut the majority of the earth from the high spots and to transport it to the low areas of the plot. The elevating attachment on the scraper enables it to load its bucket full while still taking shallow cuts as required. The motor graders are used for the finer cutting and moving of the soil. The laser control system can be fitted to most models of modern earthmoving machinery.

1.11 Effects of Bardheere Dam

Bardheere dam, if constructed, will provide reservoir storage for up to 4,100 x $10^6 m^3$. It will permit regulation of flows downstream such that the problems of water shortages in the gilal season and flooding in the 'der' season are virtually eliminated. Clearly this change in the flow pattern of the river will have some effect on the regime of the river channel.

The effect of the reservoir can be divided into two parts.

(a) The reduction of the maximum flood flows which generally determine the river channel section.

(b) The reduction in the river silt load and consequent increase in the river sediment carrying capacity.

It is not considered likely that these effects will have any significant detrimental influence on the characteristics of the Homboy irrigation system. Advantages will be gained in the increased reliability of water supplies, a possible reduction in the rate of sedimentation of the storage reservoirs, and an extension to the growing season.

The effects of Bardheere dam on the drainage within the project are twofold. Firstly, with increased irrigation applications and the resulting increase in deep percolation, the rise of the groundwater table may be affected. Secondly the control of flood flows in the River Jubba will enable the discharge under gravity of stored water from the Eastern and Southern Reservoirs to the river to be possible for a greater proportion of the year.

1.12 Construction of Civil Works

The Civil Works associated with the Homboy Irrigated Settlement Scheme includes the construction of the flood protection works, surfaced roads, hydraulic structures and the irrigation and drainage system.

The total cost of the works covered by the civils contract is estimated as 424.3 million So.Sh. This estimate assumes a direct labour force employed by the SDA with an expatriate management construction team supplied either by an International Contractor or other suitable organisation.

All costs included in the estimate are based on December 1979 prices and, in terms of evaluating the costs for each item of work, it has been assumed that the project will be exempt from import taxes, custom's and other duties. The financial costs have also been estimated for the scheme and have been used in the financial studies in volume 3 section 3.

The construction programme has been assumed a commencing date in late 1980 with a 66 month construction period. An annual inflation rate of 15 per cent on materials and equipment has been used. A lower rate of increase in wages has been assumed. A provisional sum item has been incorporated to allow for price increases.

Organisation and Management inputs required for the construction of the works are fully discussed in Volume 3 Part 2 section 3.2. Construction Management team requirements are defined; salaries and housing allowances have been included in the overall costs of the Civil Works contract.

The construction of the scheme has been divided into three sections, of duration 18 months, 32 months and 20 months as illustrated in Figure 1.5. Section 1 of the works incorporates the majority of the heavy construction work including the flood protection works, the Supply Canal and the major part of the road system. This is evident from inspection of the cost of the works. Solely in terms of materials costs, Section 1 has a cost per hectare irrigated of So. Sh. 51,000, whilst sections 2 and 3 yield values of So. Sh. 3,700 and So. Sh. 4,200 respectively. The average cost per hectare over the whole project is some So. Sh. 48,000.

1.5 Construction programme and commissioning schedule

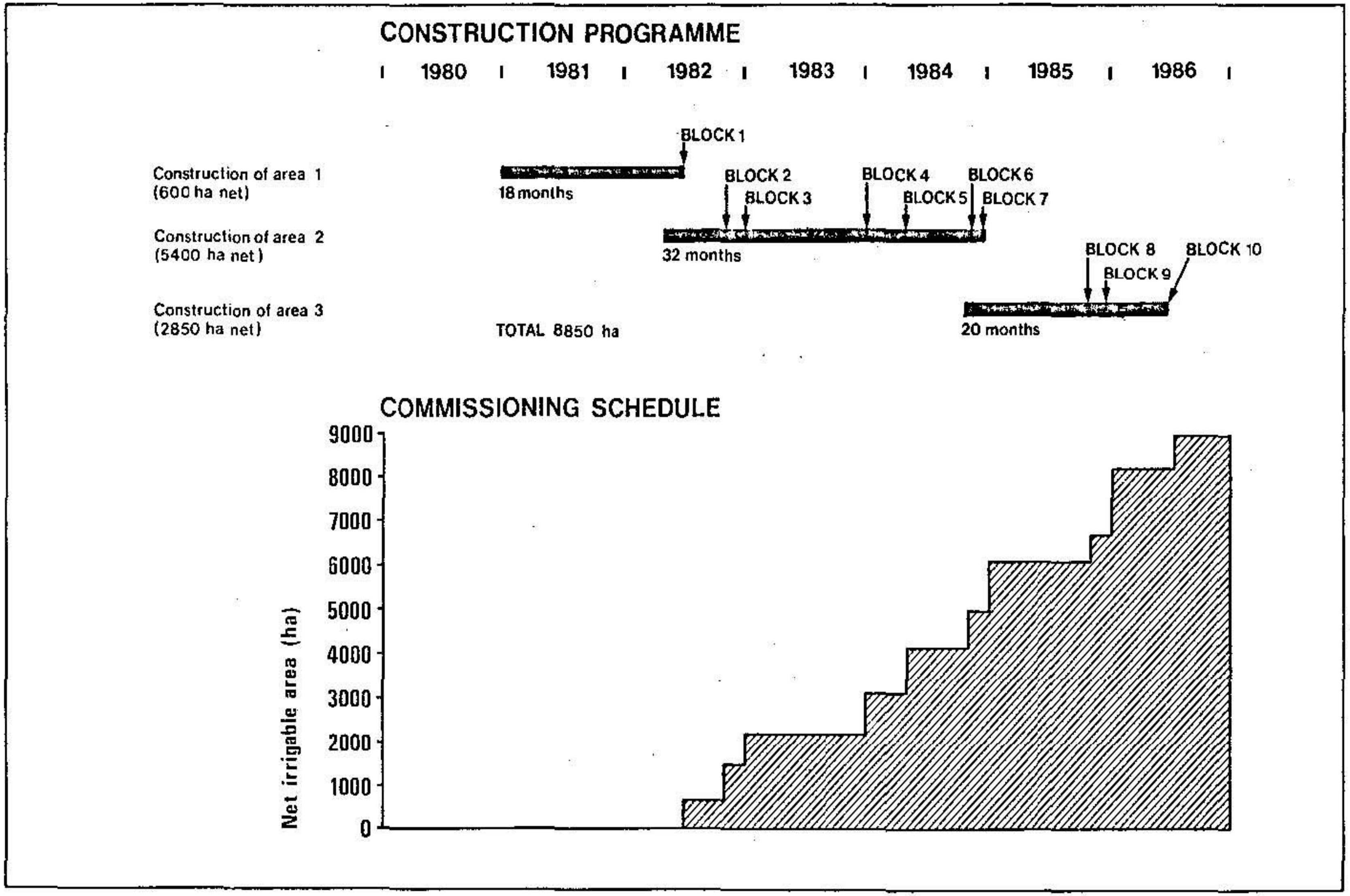


Figure 1.5 also shows the possible build up in the areas of the project to be brought under the command of irrigation water

Tables 1.4 1.5 and 1.6 show both the quantities of different materials estimated for the three sections of the scheme and also the total material costs for each section.

Plant requirements have been assessed considering the existing SDA equipment in use on the two other settlement projects together with the provisional plant order sheets drawn up by the SDA for possible supply under the IDA and AF loan agreements. Owing to the nature of the Homboy Scheme the numbers of heavy machinery are more than would be required for the development of Dujuuma Scheme. These heavy construction items already discussed are included in Section 1 of the works.

The most critical part of the construction programme (see Figure 1.5) is the first 18 months. Therefore the bulk of the plant should be received during Section 1 of the Works. If the plant is bought at the beginning of the project construction there will be no increase in capital cost as a result of inflation.

In the evaluation of plant costs for the project (Tables 1.7 and 1.8) no value has been included for the interest on the loan supplied for the purchase of the construction equipment.

Labour requirements have been summarised in Table 1.9. These values are only approximate and should besupplemented by the managerial and professional staff numbers outlined in Volume 3 Annex 2 section 3.2.

The costs of the basic elements comprising the works in terms of materials, plant and labour are summarised in Table 1.10.

Table 1.11 gives the full projext economic costs for each section of the works. These prices include the basic costs of materials, equipment and machinery together with the costs associated with the Engineers Requirements and the pumping plant, together with allowances for inflation and contingencies.

TABLE 1.4 DETAILS OF MATERIALS FOR CIVIL WORKS CONTRACT

Description	Unit	Section I Quantity	Section II Quantity	Section III Quantity
Concrete				
Blinding 0.05 m thick	m^2	35	300	180
Blinding 0.10 m thick	m^2	3,459	2,240	1,345
Mass Concrete D	m^3	250	280	390
Mass Concrete C	m^3	609	2,110	1,567
Mass Concrete BS	m^3	131	289	183
Reinforced Concrete B	m^3	3,070	155	120
Reinforced Concrete BS	m^3	900	75	50
Reinforced Concrete A	m^3	606	957	758
Reinforced Concrete AS	m^3	624	1,246	580
Reinforcement				
Not exceeding 12 mmϕ	t	67	92	50
Not exceeding 16 mm ϕ	t	449	107	45
Fabric Reinforcement	m^2	615	264	566
Shuttering				
Back	m^2	5,325	7,285	4,775
Face	m^2	6,890	12,535	7,425
Saffits	m^2	1,600	970	825
Top	m^2	320	360	255
Curved	m^2	370	200	130
Dry Stone Pitching				
0.3 thick on 0.15 gravel	m^2	3,850	3,630	1,260
0.2 m thick on 0.15 m gravel	m^2	3,710	13,780	8,830
Concrete Blockwork				
0.3 thick on 0.20 gravel	m^2	1,170	580	80
0.225 thick on 0.20 gravel	m^2	325	406	829
Concrete Paving				
0.08 m thick on 0.10 gravel	m^2	115	-	-

TABLE 1.4 Continued.

Description		Unit	Section I Quantity	Section II Quantity	Section III Quantity
PIPE CLASS M					
Class A1 Bed	1.20ϕ	m	316	72	175
	1.05ϕ	m	55	240	180
	0.90ϕ	m	60	90	95
	0.75ϕ	m	-	85	177
	0.60ϕ	m	57	82	84
	0.45ϕ	m	395	2,545	1,310
	0.375ϕ	m	15	50	215
Class B Bed	1.2 ϕ	m	65	-	-
	1.05ϕ	m	50	30	20
	0.9ϕ	m	22	32	60
	0.75ϕ	m	16	-	-
	0.6ϕ	m	-	16	-
	0.45ϕ	m	40	265	130
	0;375ϕ	m	50	160	680
Class A2 Bed	1.2ϕ	m	-	77	-
	0.45ϕ	m	30	-	-
Class H Pipe					
Class A1 Bed	0.3ϕ	m	140	1,330	550
Class B Bed	0.3ϕ	m	150	930	390
Class A2 Bed	0.3ϕ	m	96	-	-
Roads					
Sub-base		m^3	44,300	16,600	7,400
Base		m^3	45,500	13,200	5,900

TABLE 1.5 TYPICAL UNIT RATES USED IN COST ESTIMATES

Item	Unit	Rate (SoSh)
Bush clearance (light)	ha	1,372
Bush clearance (dense)	ha	1,715
Land levelling	ha	3,149
Excavation to form embankments (short haul)	m^3	11
Excavation to form embankments (medium haul)	m^3	13
Excavation to form embankments (long haul)	m^3	18
Excavation for foundations of structures	m^3	16
Compacted backfill for structures	m^3	25
Concrete class D blinding (0.1 m thick)	m^2	87
Mass concrete	m^3	834
Reinforced concrete class A	m^3	1,046
Mild steel reinforcement	tonne	11,134
Mesh reinforcement	m^2	181
Shuttering (back)	m^2	295
0.3 m Dry stone pitching on 0.15 m gravel backing	m^2	241
Spigot and socket concrete pipe and bedding (A1) 0.45 mϕ	m	840
Spigot and socket concrete pipe and bedding 0.90 mϕ	m	2,625
Spigot and socket concrete pipe and bedding 1.20 mϕ	m	3,885
Compacted aggregate sub-base	m^3	275

TABLE 1.6 SUMMARY OF BASIC MATERIAL COSTS

	Costs So. Sh x 10^3			
Item	Section I	Section 2	Section 3	Total
Concrete	3,995	3,163	2,204	9,362
Reinforcement	3,892	1,522	778	6,192
Shuttering	1,824	2,635	1,662	6,121
Dry Store Pitching	918	1,960	1,111	3,989
Concrete Blockwork and Paving	349	181	38	568
Pipework	1,639	3,714	2,765	8,118
Roads*	15,242	5,022	2,242	22,506
	27,859	**18,197**	**10,800**	**56,856**
Add 10% for contingencies	2,786	1,820	1,080	5,686
	30,645	**20,017**	**11,880**	**62,542**

Notes: (i) Wastage is included in all the rates.
(ii) Roads item is approximate only and depends on location of quarry, transport etc.

TABLE 1.7 DETAILS OF PLANT REQUIREMENTS FOR CIVIL WORKS CONTRACT

Type of Machine	Nr	Total Cost x 1,000 So.Sh
Heavy Earthworks		
Dozer 270 HP	3	6,954
Motor Scraper 11 m^3	12	28,224
Self loading Scraper 9 m^3	2	3,662
Motor Grader 140/150 HP	7	6,286
Elevating Grader Unit	2	1,446
Off Road Truck 14 tonne	7	3,864
Dozer 140 HP	4	2,144
Dozer 110 HP	1	351
Dozer 180 HP	1	845
Sheepsfoot Roller, pairs	4	112
Hydraulic Excavator 0.75 m^3	3	2,100
Roller 10 tonnes	1	141
(spares)		
		56,129
Clearing and Levelling		
Self Loading Scraper 9 m^3	6	11,136
Motor Grader 140/150 HP	3	2,604
Dozer 180 HP	4	3,380
Plough and Root Rake Attachments	4	2,596
Tractor Wheeled 90 HP	8	1,088
Trailer	8	184
(Spares + 15%)		
		20,988
Structures		
Hydraulic Exc. 1 m^3	1	650
Tractor Excavator/Loader MF 50	2	592
Truck 14 tonne on-off Road	2	1,104
Dozer 140 HP	1	536
Impact Rammers	8	104
Crane 10t 4 x 4	2	2,184
Self-Load Truck Mixer 2.5 m^3	3	1,710
Bar Bender, Diesel 50 mm	1	78
Tractor 90 HP	2	272
Trailer	2	46
Circular Saw	1	31
12 tonne lorry & loader	1	320
Compressor	3	438
Pump diesel 100 m	6	294
Pump diesel 75 mm	8	288
Vibrator, diesel 50 mm	6	54
		8,701

TABLE 1.7 Continued.

Type of Machine	Nr	Total Cost x 1,000 So.Sh
General		
Land Rover	10	1,620
Pickups 500 kg	10	1,270
Service Trucks	2	360
Water Tankers 4/6,000 litres	4	680
Fuel Tankers 4/6,000 litres	2	340
Trucks, 8 tonne tipper	4	1,172
Alternators 150 KVA	2	710
Low Loading Tractor & Trailer	1	352
Crane, 5-7 tonne mobile	2	300
		6,804

TABLE 1.8 PLANT REQUIREMENTS SUMMARY SHEET

Item of Works	Cost of Plant So Sh x 1,000
Heavy Earthworks	56,129
Clearing and levelling	20,988
Structures	8,701
General	6,804
Allow for variation of 5% in prices during year 1 and any additional plant not included	4,634
Total Cost	97,256

TABLE 1.9 CONSTRUCTION LABOUR REQUIREMENTS AT PEAK PRODUCTION

Trade	Numbers
Plant Operators	112
Craftsmen	49
Mechanics	20
Labourers	397
	578
Ancillary Workers (watchmen, cooks, etc)	100
	678

TABLE 1.10 BASIC COST OF MAJOR ITEMS

Item	Cost SoSh x 103
Materials	62,500
Plant	97,300
Fuel and Stores	20,800
Construction Labour	19,600
Surveying Labour	500
Total	**200,700**

TABLE 1.11 PROJECT CIVIL WORKS COSTS

Part Nr	Title	Total for Part A (Section 1) So.Sh.	Total for Part B (Section 2) So.Sh.	Total for Part C (Section 3) So.Sh.	Total for 3 Sections So.Sh.
1	Sampling and Testing	-	-	-	4,222,400
2	Bush Clearance and Land Levelling	4,285,800	37,374,700	20,525,200	62,186,700
3	Canal, Drain and Reservoir Earthworks	45,109,200	49,132,800	22,315,400	116,557,400
4	Surfaced Roads	34,880,000	11,396,300	4,392,200	51,163,500
5	Major Canal Structures	5,150,900	3,041,800	3,215,800	11,408,500
6	Minor Canal Structures	2,053,100	11,132,600	7,574,300	20,760,000
7	Major Drain and Reservoir Structures	12,642,300	6,093,000	9,28,800	19,664,100
8	Minor Drain Structures	3,214,900	6,735,600	4,268,200	14,218,700
9	Drainage Pump Stations	-	-	2,200,300	2,200,300
10	Operators' Quarters	427,100	534,900	811,500	1,773,500
11	Nominated Sub-Contracts	-	-	-	1,826,300
12	Engineer's Requirements	-	-	-	8,495,400
13	Dayworks	-	-	-	9,175,000
14	Provisional Sums	-	-	-	100,662,500
Total Amount of Tender				**So.Sh.**	**424,319,300**

2.13 Component Costs of Selected Items

For information the component costs for selected items of the civil workers are given below:-

Overall Civil Works cost	=	So Sh 424,320,000
of which the sum of is allocated to Engineers Requirements, Dayworks and Provisional Sums	=	So Sh 118,332,900
Cost of Major construction items	=	So Sh 306 million approx).

Item of Work	**Cost as per Contract Document for full Project**	**Percentage of Major Construction Works**
Bush Clearance and Land Levelling	So.Sh.62.2 m	20.3%
Surfaced Roads	So.Sh.51.2 m	16.7%
*Flood Protection Works.	So.Sh.44.1 m	14.4%

* Earthworks costs associated with Flood Protection Works	= So.Sh. 30 million
Structure costs associated with Flood Protection Works	= So.Sh. 12.2 million
Water Control Equipt associated with Flood Protection Works	= So.Sh. 1.9 million
	So.Sh. 44.1 million