Table 4.2.1. Proposed Sewers by Diameters

(Continued)

Sewer Diam. (mm)	Sewer Length (m)	Material	Remarks
600	2,340	Clay or plastic	For gravity flow
Subtotal of clay pipes	172,935		
800	680	Reinforced concrete	For gravity flow
900	20	"	"
Subtotal of concrete pipes	700	"	"
Total of gravity sewers	173,635		
100	2,310	Ductile iron	Pressure sewer
150	1,100	"	"
200	1,300	"	"
350	960	"	"
500	21,300	"	"
Total of pressure sewers	26,970		
Total of sewers	200,605		

4.2.3. Pumping Stations

The proposed sewage pumping stations comprise two different types depending upon the pumping capacity, dry well type with vertical centrifugal pumps for large capacity stations, and wet well type with submergible pumps for small capacity stations. Main features of these pumping stations are as follows:

(a) Dry Well Type Pumping Stations

These are the principal pumping stations for the sewerage system, pumping wastewater from main and submain sewers to either main sewers or sewage treatment plant. Locations and other features of these pumping stations are as follows:

- Main pumping station;

  Pump wells - dry and wet wells with grit and screening facilities.
  Pumps - horizontal centrifugal pumps, 5 Nos.(1 standby) x 250 mm bore x 6.8 m^3/min x 39.00 m x 75 kW.

- El-Risa pumping station;

  Pump wells - dry and wet wells with screening facilities.
  Pumps - horizontal centrifugal pumps, 5 Nos. (1 standby) x 250 mm :x 6.8 m^3/min x 25.00 m x 45 kW.

The pumps in the Main pumping station are preceded by screening and grit removal facilities but for El-Risa pumping station screening equipment is omitted. The pumps are controlled automatically by sensoring the variations of water elevation in the wet well. Figures 4.2.4. and 4.2.5. show the structures of the pumping stations, and further details are illustrated in drawings of Volume Four - 'Drawings.'

The sewage from the main sewers enters the screening chamber (in the case of the El-Risa pumping station, without screening chamber) where the sewage flows through two coarse bar screens to the pump suction wet well. Screens are manually cleaned, and screenings are removed to storage pits. An overhead suspension crane with motor trolley hoist is installed for the convenience of erection and repair of the pump units and other equipment. The entire facility is housed to protect the mechanical equipment and to prevent odour nuisance.

Super and sub structure is of reinforced concrete. Wet and dry wells including their superstructure is completely separated. Suitable and safe means of access will be provided to dry wells,and will be provided to wet well bar screens or mechanical equipment requiring inspection or maintenance. Adequate ventilation is provided for all pumping stations. Consideration will be given to independently ventilate the dry well and wet well.

Provision of an emergency power supply is made, and may be accomplished by provision of in-place internal combusion engine equipment which will generate electrical energy. Unit size of the in-place internal combusion engine is

adequate to provide power for lighting and ventilation systems and such further systems affecting capability and safety. The provision of a high level wet well overflow to supplement alarm system and emergency power generation is considered.

(b) Submersible Pumping Stations

A total of 22 small capacity lift pumping stations are required in addition to the large scale dry well pumping stations.

Pump wells are of reinforced concrete structure with the provision of easy removal of submersible pumps without dewatering the wet well and with continuity of operation of the other unit or units. The submersible pumps are operated automatically by a suitable control device, sensoring the variation of inflow rates.

Submersible pumps will be capable of unsubmerged operation without damage or reduction of service capability or positive provision will be made to assure submergence. The control panel will be located outside the wet well and suitably protected from weather, humidity and vandalism.

All control valves on the discharge line for each pump are placed in a convenient location outside the wet well and are suitably protected from weather and vandalism.

The standard structure for the submersible pumping stations are shown in detail in drawings of Volume Four.

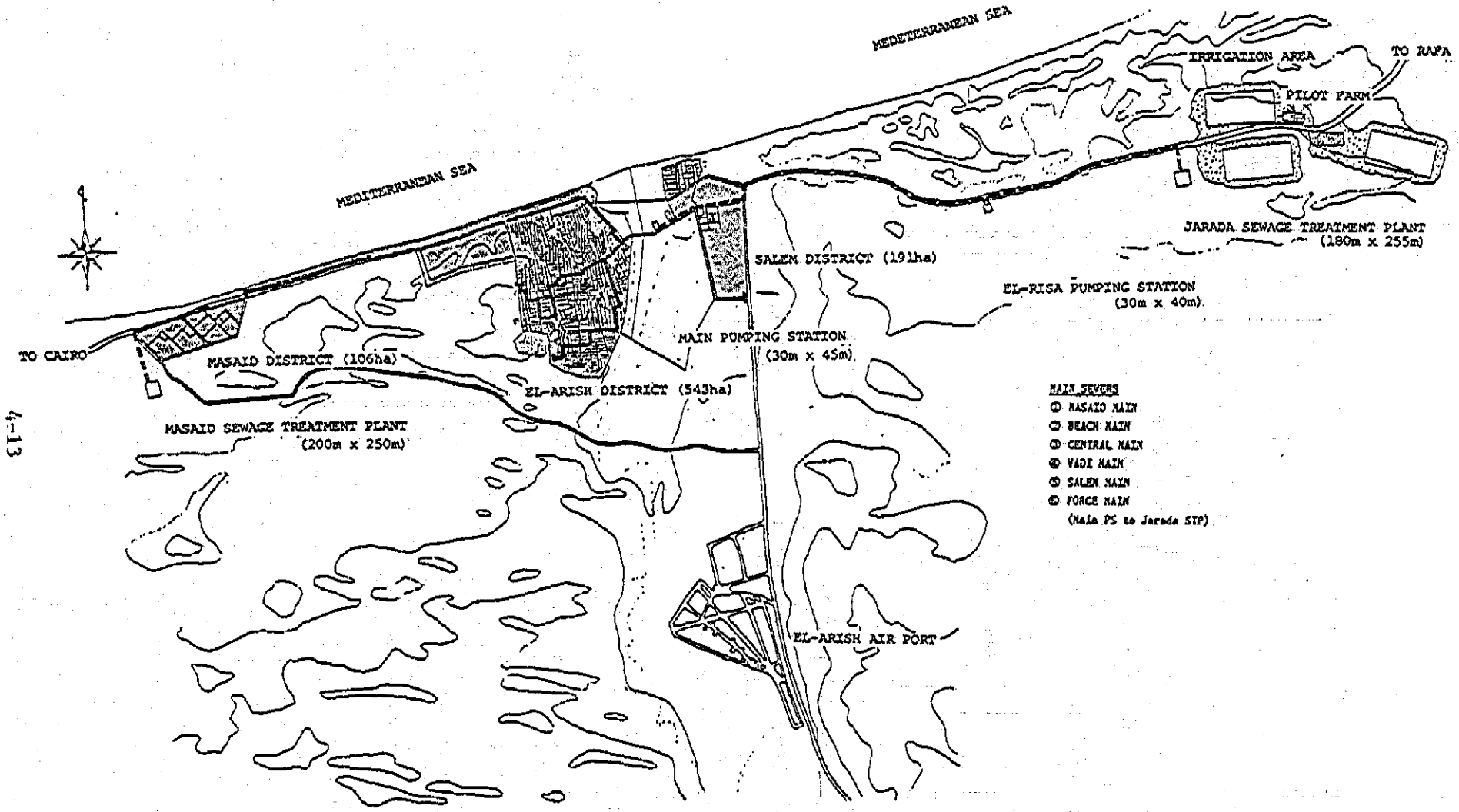


Figure 4.2.2. Layout Plan of the Proposed Sewerage System

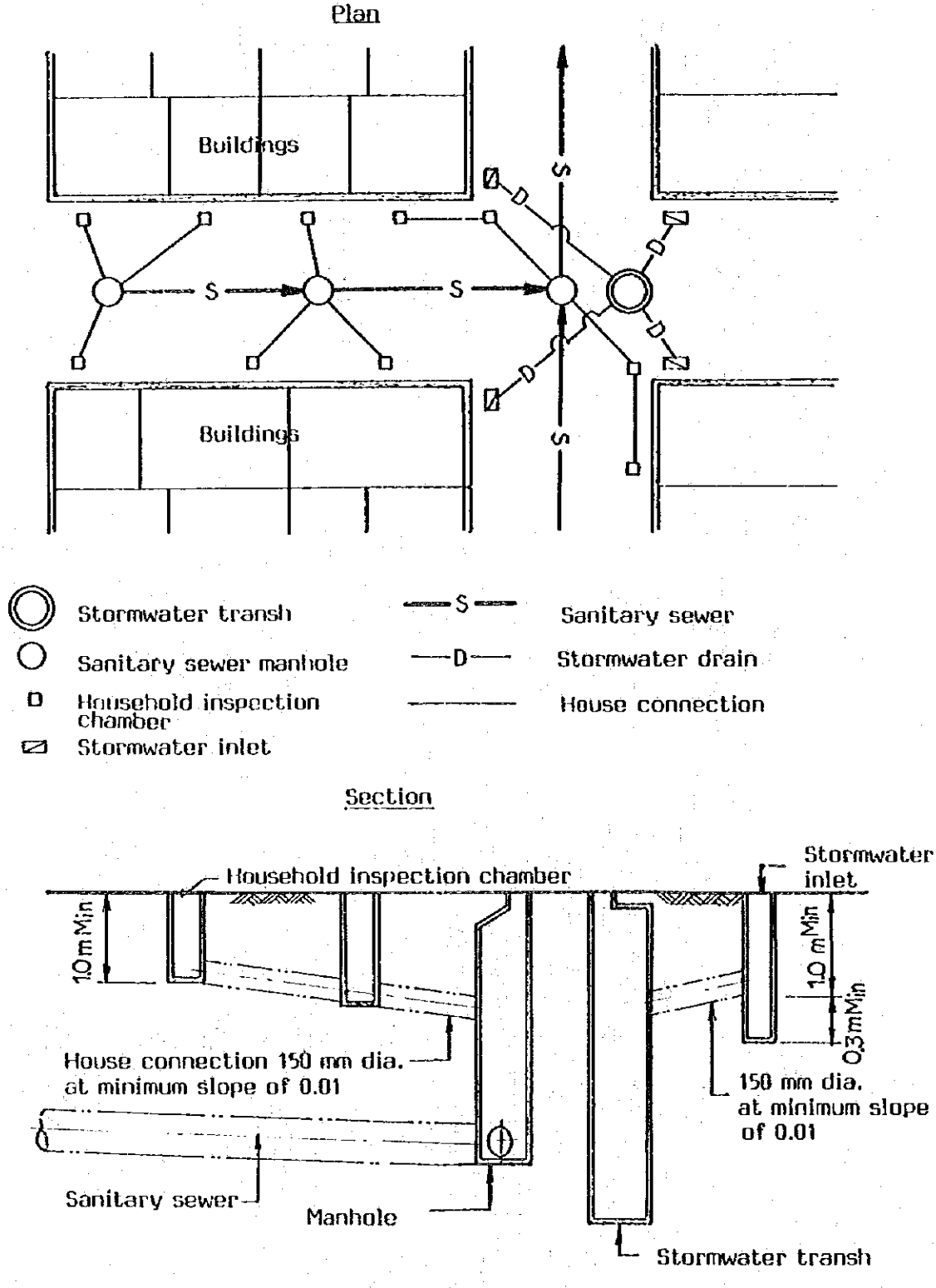
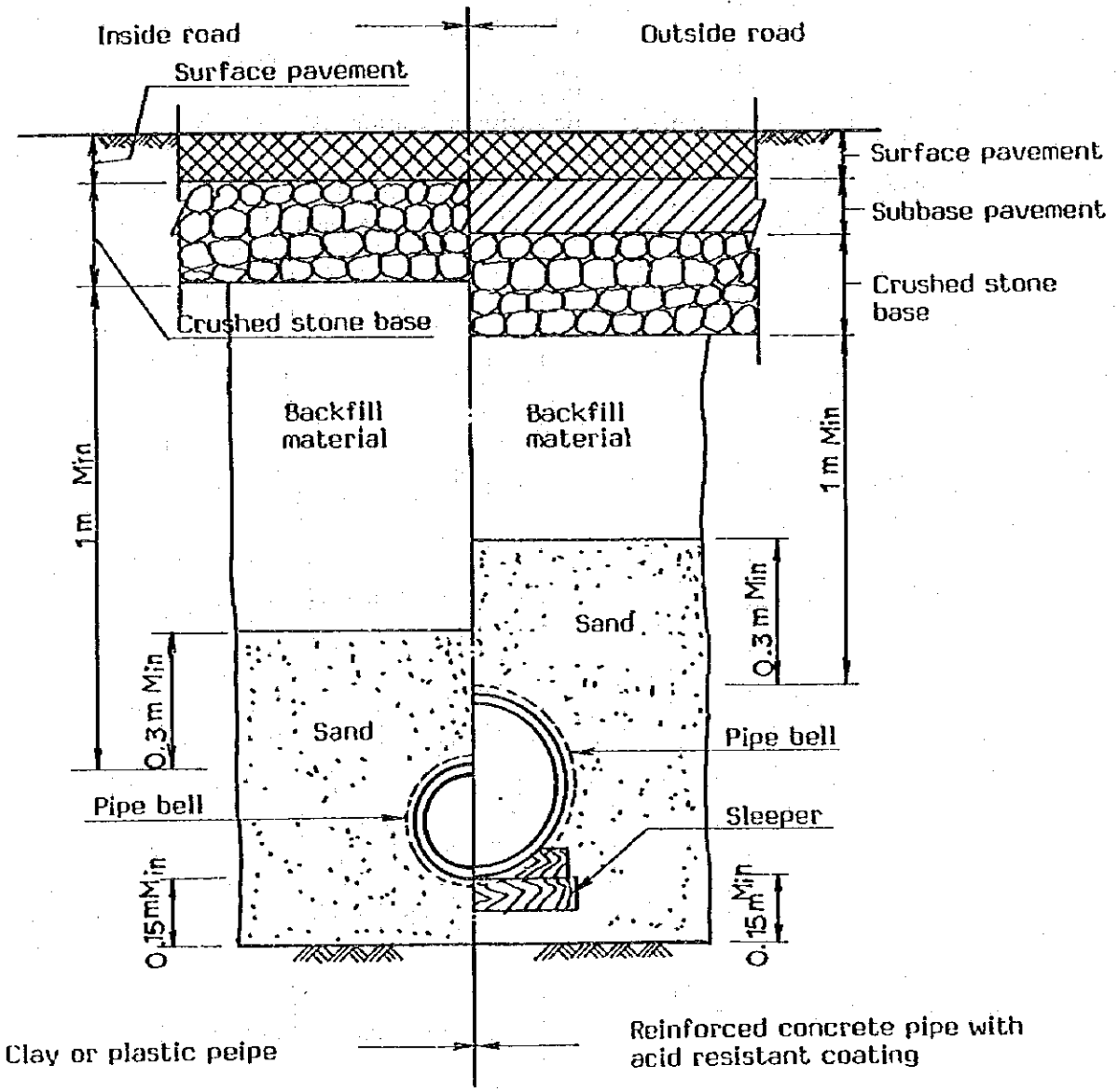
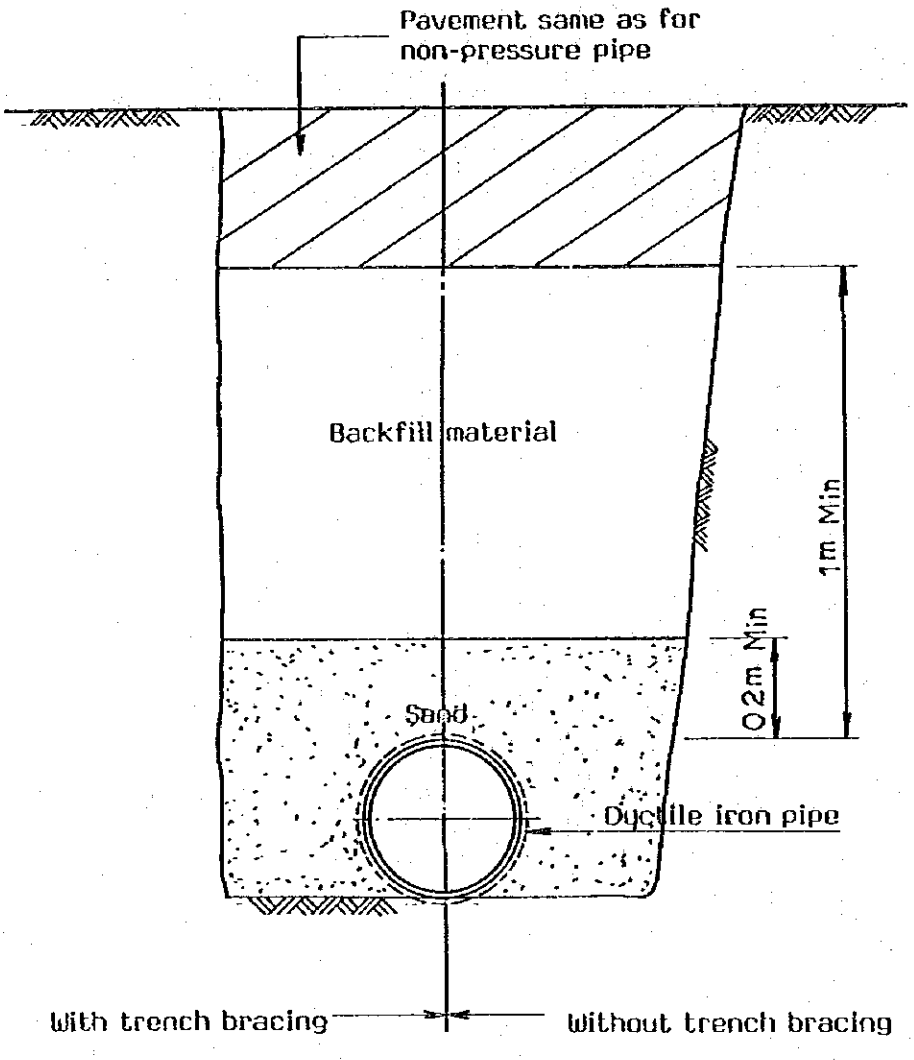


Figure 4.2.3: Typical Sanitary Sewer and Stormwater Transh System



Note: Special pipe bedding not shown
Trench bracing not shown

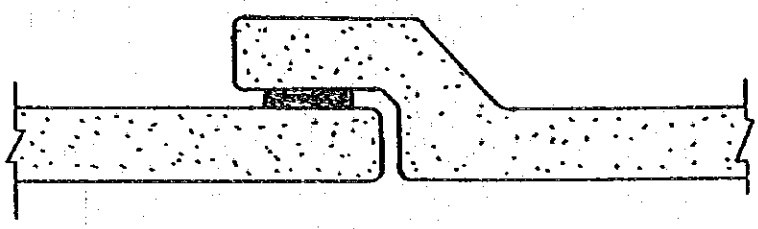
Figure 4.2.4. Typical Trench Section for Non-Pressure Pipe



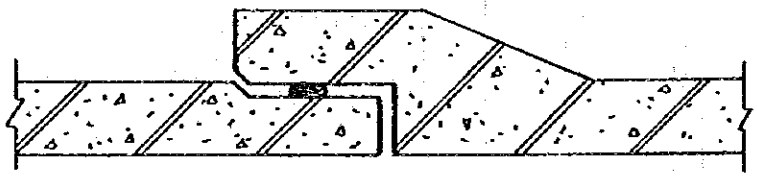
Note: No trench bracing may be required up to 3 m deep

Figure 4.2.5. Typical Trench Section for Pressure Pipe

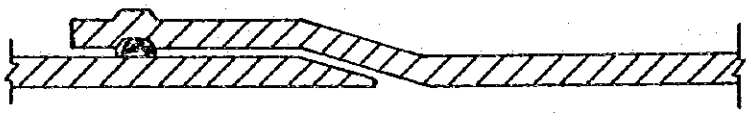
Non-Pressure Pipe Joint



Clay Pipe with Compression Joint



Reinforced Concrete Pipe with Rubber 'O' Ring Joint



Plastic Pipe with Rubber Ring Joint

Pressure Pipe

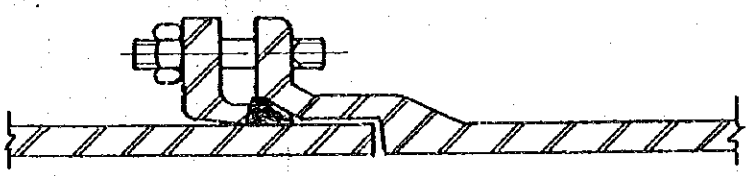


Figure 4.2.6. Ductile Iron Pipe with Mechanical Joint

Typical Pipe Joints

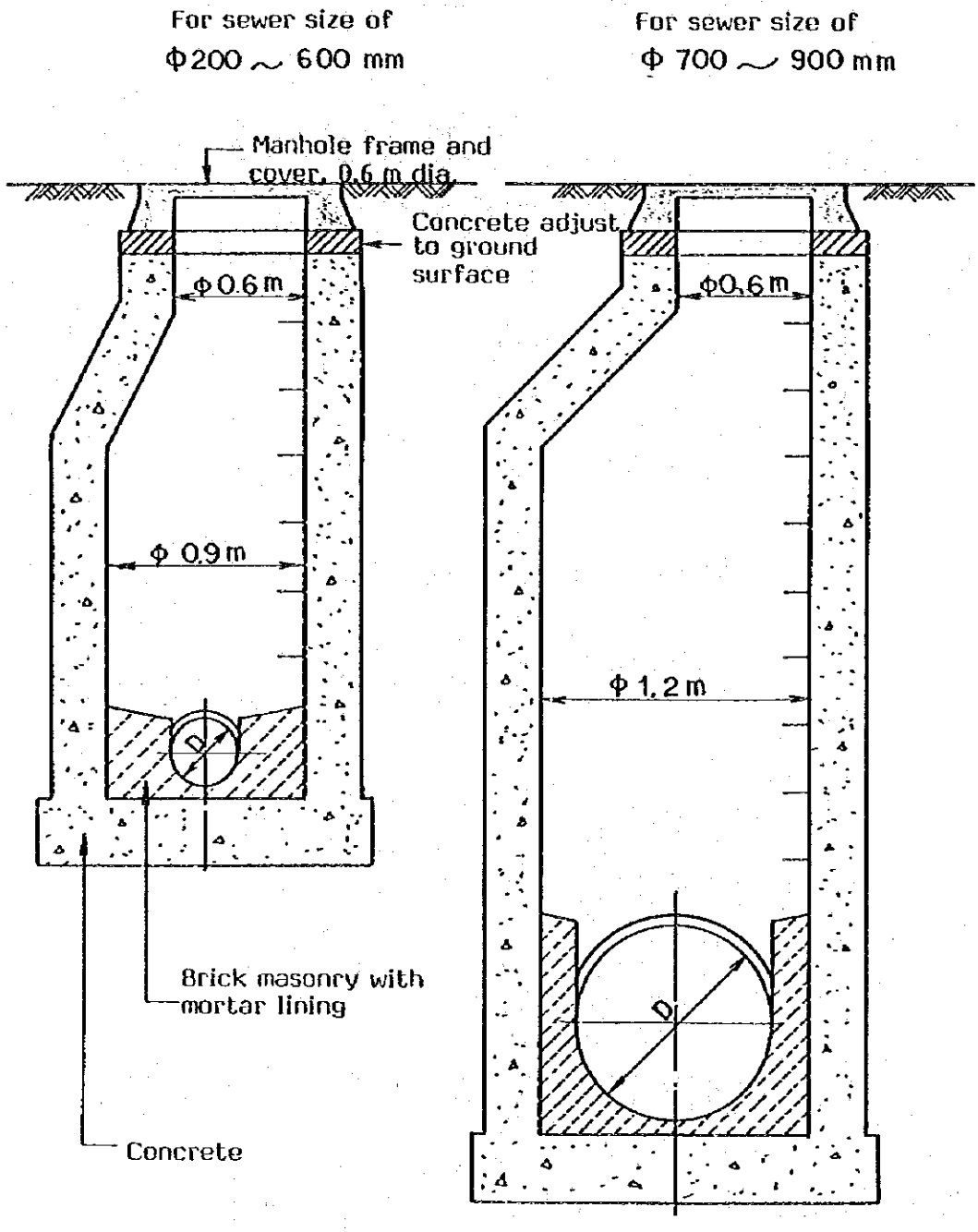


Figure 4.2.7. Typical Manhole for Non-Pressure Pipe

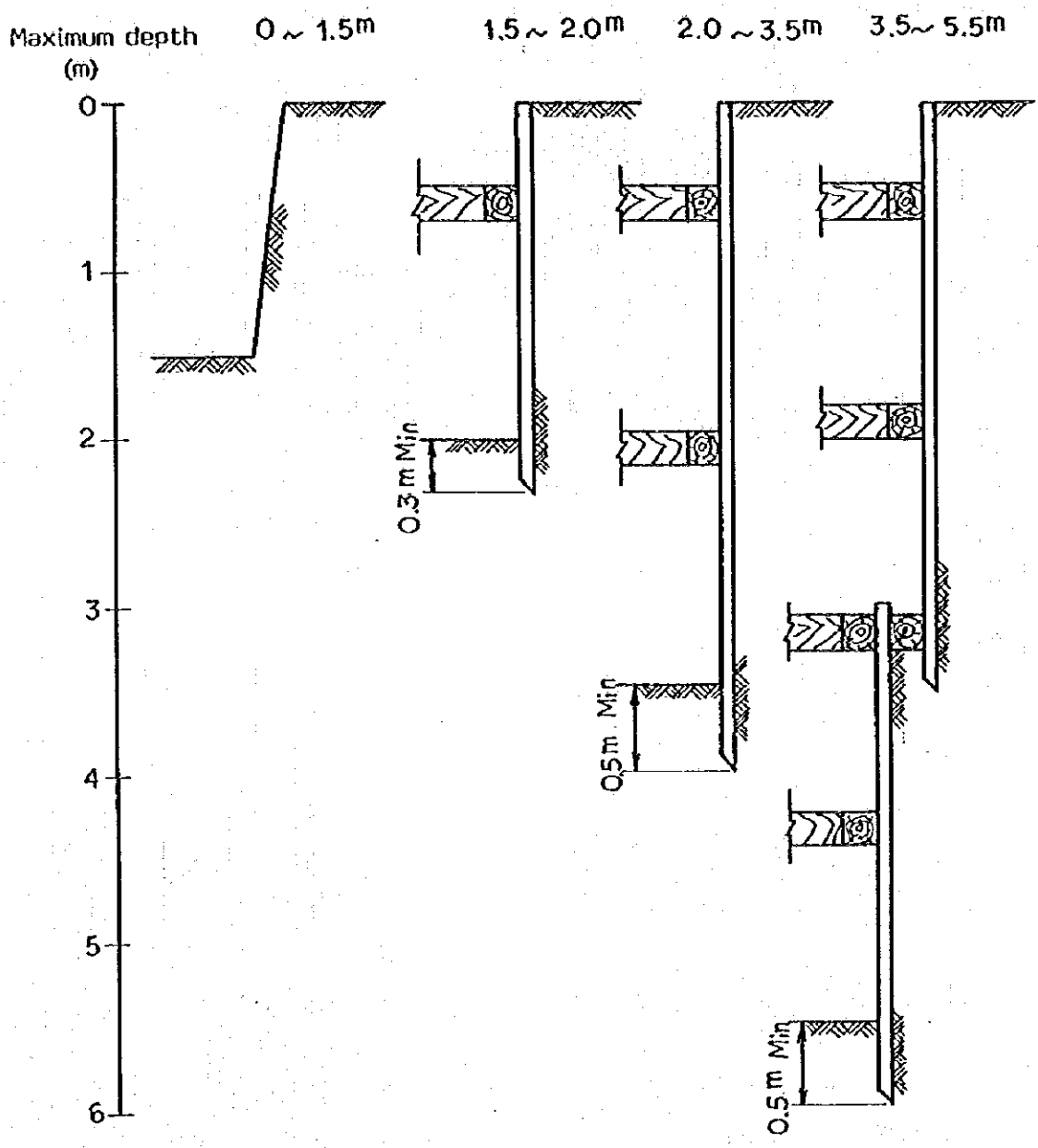


Figure 4.2.8. Trench Lateral Bracing for Various Depths

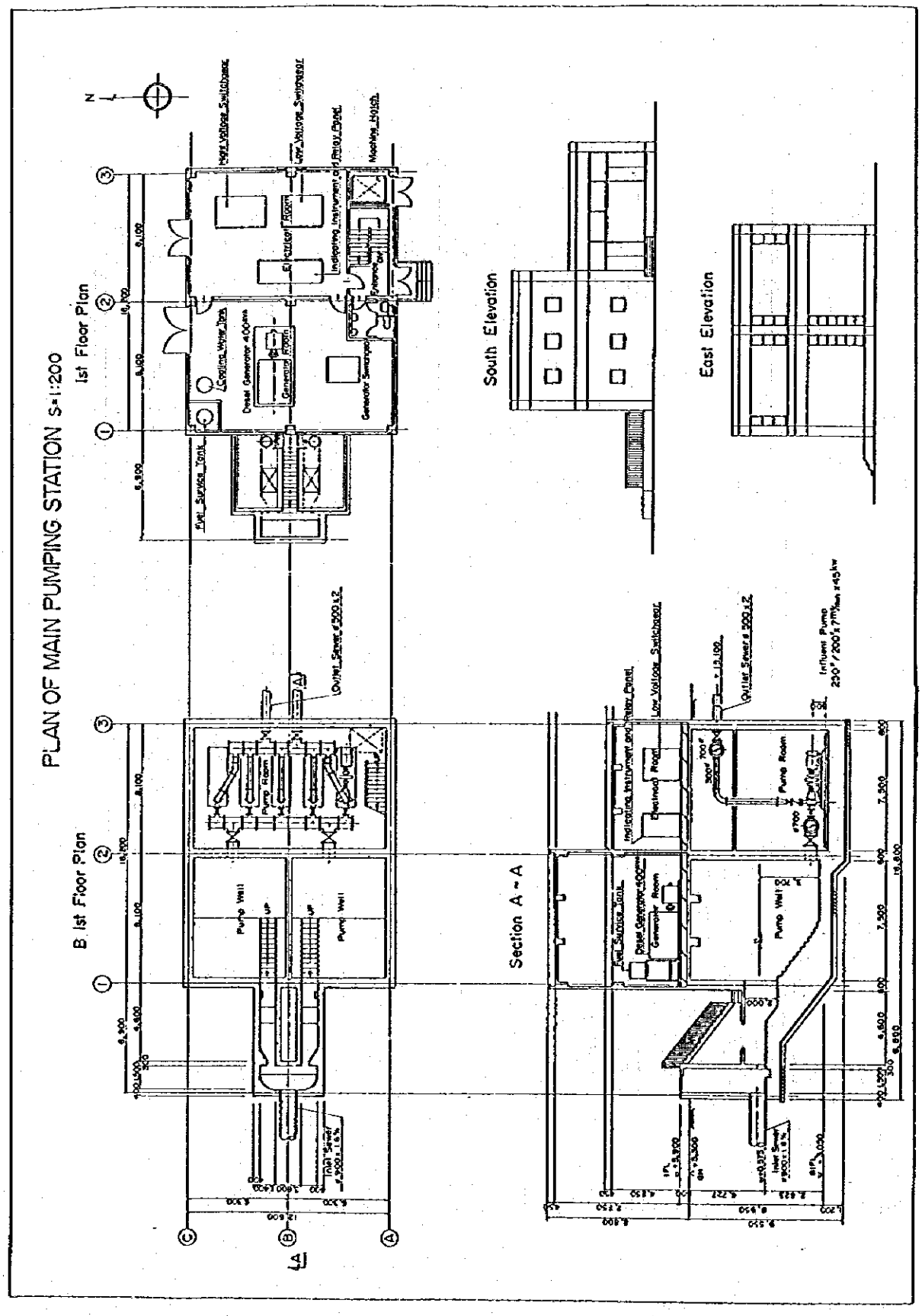


Figure 4.2.9. Main Pumping Station

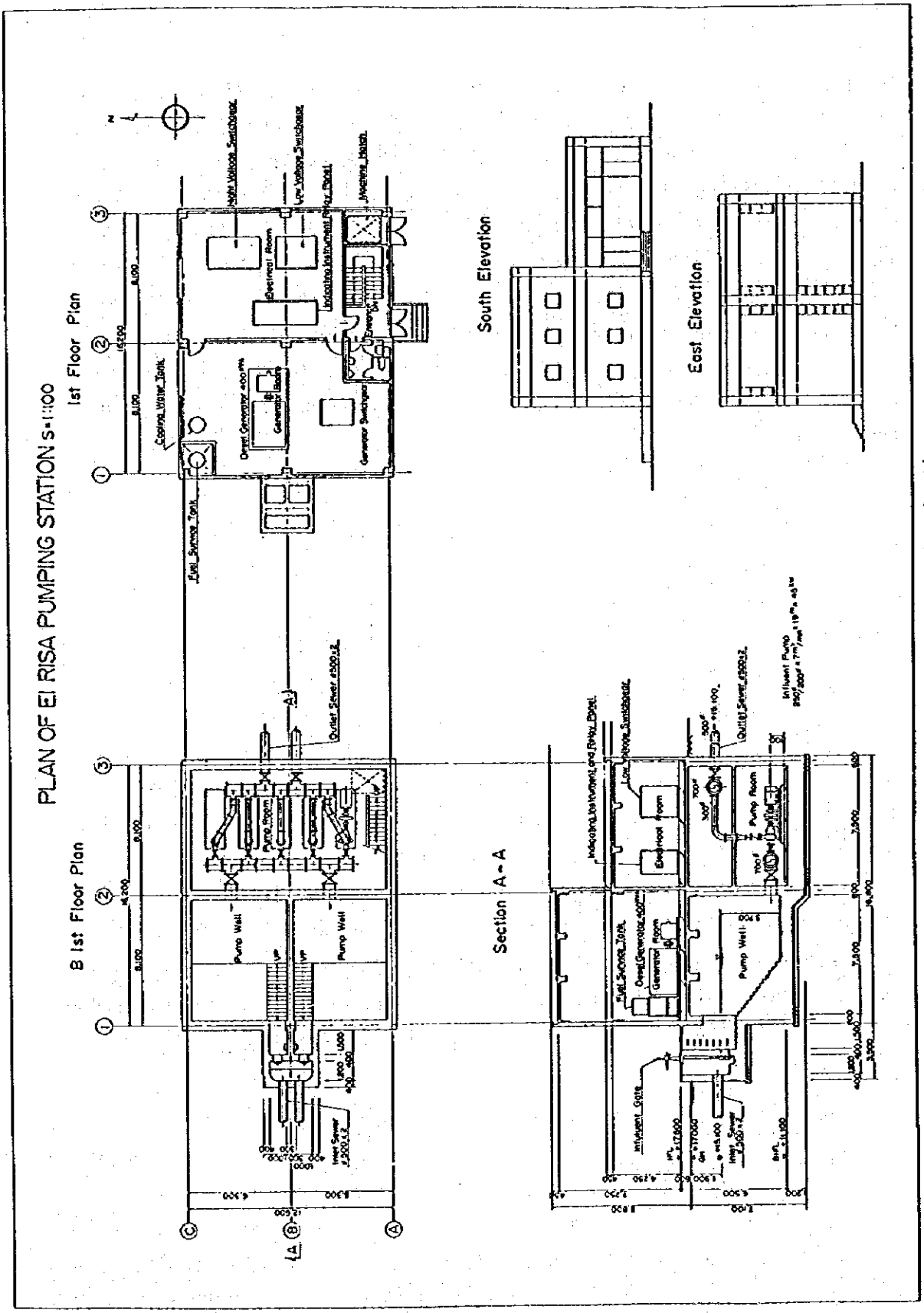


Figure 4.2.10. El-Risa Pumping Station

4.2.4. Sewage Treatment Plant

The proposed flowsheet and general layout plan of the oxidation ditch treatment plant are shown in Figures 4.2.11 and 4.2.12, respectively. Detailed drawings are shown in Volume Three 'Drawings.' The treatment plant will consist of the following facilities:

(a) Screening

Mechanically cleaned screens are proposed to be front-cleaned, with 25 mm opening between bars. Screenings will be stored in a storage bin provided close to the screening device. Major features of the screening equipment are as follows:

- Width of channel 1.3 m
- Water depth 0.6 m
- Thickness of bar plate 9 mm
- Clear opening of bars 25 mm
- No. of units 2 units

(b) Grit Chamber

The grit and screening chamber will have inlet gates, grit chamber with bucket grit collector, and screens. The structure of the chamber will be of reinforced concrete and will be provided above ground elevation to maintain the water surface elevation sufficiently high to deliver the sewage to the farthest removed farm land and at the same time to save the costs for excavation and and structure. Simple grit washing and storage facilities will be constructed alongside the chamber, the supernatant liquor being returned to the incoming sewage flow for treatment. The chamber will be as follows:

- Width of channel 1.3 m
- Length of channel 8.0 m
- Depth of channel 0.6 m
- No. of units 2 units

(c) Oxidation Ditch

The ditch covered by reinforced concrete, will consist of pockets, each aerated by two surface aerators. Return of activated sludge will be by centrifugal sludge pumps feeding to a distribution channel where mixing with the incoming sewage flow will occur. The aerators impart a velocity of 0.3 m/sec to the ditch contents, sufficient to maintain the active solids in suspension. The effluent of the ditch flows to the final sedimentation basins. Dimensions of the ditch are as follows:

- Width of ditch	5.0 m
- Length of ditch	200 m
- Depth of channel	2.5 m
- No. of ditch	8 units
- Total capacity of ditch	20,000 m3

(d) Sedimentation Basin

The basin, constructed in reinforced concrete, will be of the radial flow typr, with sludge removal by electrically driven scraper. Sludge removal will be by sludge pump being automatically operated at adjusted intervals. Four numbers basins will be required each sized and planned as follows:

- Diameter	21.0 m
- Side wall depth	3.0 m
- Weir length	254.0 m
- Surface area	1,385.0 m2
- Capacity	4,155.0 m3
- No. of units	4 units

(e) Chlorine Contact Tank

The tank, constructed in reinforced concrete, will be of the rectangular longitudinal baffling type, with a contact time of about 20 minutes for the average daily sewage flow rate. The turbulence created by a hydraulic action will provide chlorine mixing with the sewage Chlorine equipment will be installed close to the chlorine contact tank, with necessary handling facilities for hypochlorite. The featuire of the tank are as follows:

- Width of channel 2.5 m
- Length of channel 45.0 m
- Water depth 2.5 m
- Capacity 281.0 m3
- No. of tank 1 unit
- Maximum chlorine dosing rate 500.0 kg/day

(f) Effluent Storage Tank

The effluent, after being disinfected in the chlorine contact tank, will gravitate into the effluent storage tanks for adjusting the amount of the effluent for irrigation or other uses. The tanks will be of rectangular reinforced concrete with a capacity of approximately 6 hours sewage. The tanks will be equipped with necessary pumps to transmit the effluent for reuse as required. The dimensions of tanks are:

- Width 22.5 m
- Length 22.5 m
- Depth 5.0 m
- Capacity 5,063 m3
- No. of tank 2 units

(g) Sludge Storage Tank

The excess sludge of about 150 m3/day from the sedimentation basins will be pumped to the sludge storage tanks of rectangular reinforced concrete structure. The sludge will be retained in the storage tanks for over one day and will be withdrawn from the tanks as necessary to the sand drying beds by gravity. Dimensions of the tanks are as follows:

- Width 4.5 m
- Length 4.5 m
- Effective water depth 4.0 m
- Capacity 162.0 m3
- No. of tank 2 units

(h) Sludge Drying Sand Beds

The excess sludge of about 150 m3/day is withdrawn by gravity from the sludge storage tanks to the sludge drying sand beds where the sludge is dried by air. The detention time in the sand beds will be about 5 days. The dried sludge cake will be removed manually and transferred to trucks or carts for final use as fertilizer or land reclamation. The sand beds will be constructed having drainage pipes or tiles about 2 to 3 metres apart on the soil. A layer of graded gravel is then placed above the drains. On top of the gravel is a layer of sand. Details of the beds are as follows:

- Width 10.0 m
- Length 20.0 m
- No. of units 20 beds
- Total surface area of beds 4,000 m2
- Depth of wet sludge 0.2 m
- Capacity 800 m2

(i) General Facilities

The treatment works will be provided with:

- An administration building, with offices, and a laboratory equipped for simple testing of sewage and sludge.
- Garage, workshop and store for spare parts.
- Standby electric power generator.
- Housing for management and staff, as required.

The treatment works will be attractively laid out and will be designed to ensure both ease of operation and subsequent extension. The estimates of cost presented in this report include for all interconnecting pipework and conduits, manholes and distribution chambers, access roadways and footpaths, fencing and general landscaping and site work.

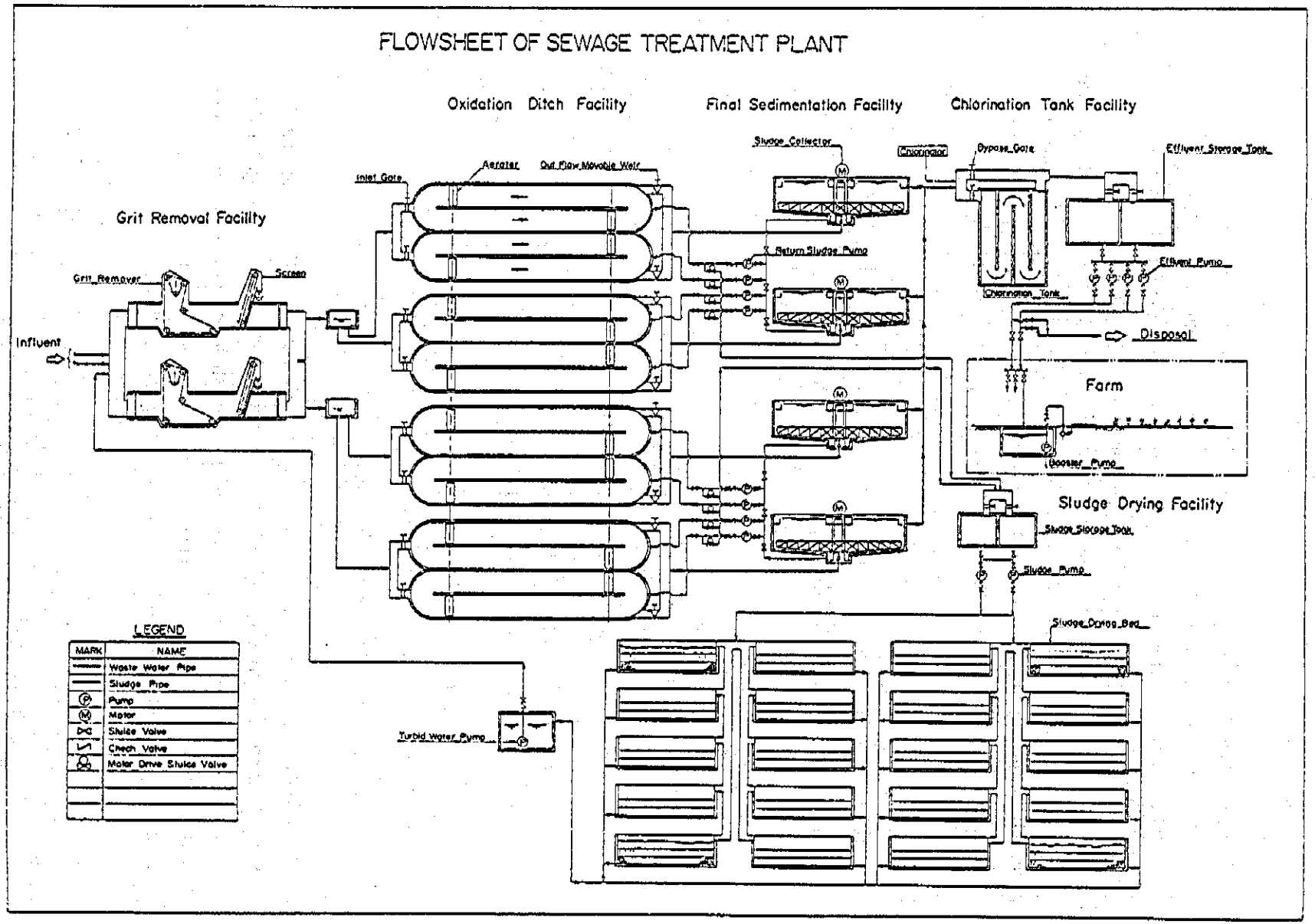


Figure 4.2.11. Flowsheet of the Proposed Oxidation Ditch Process

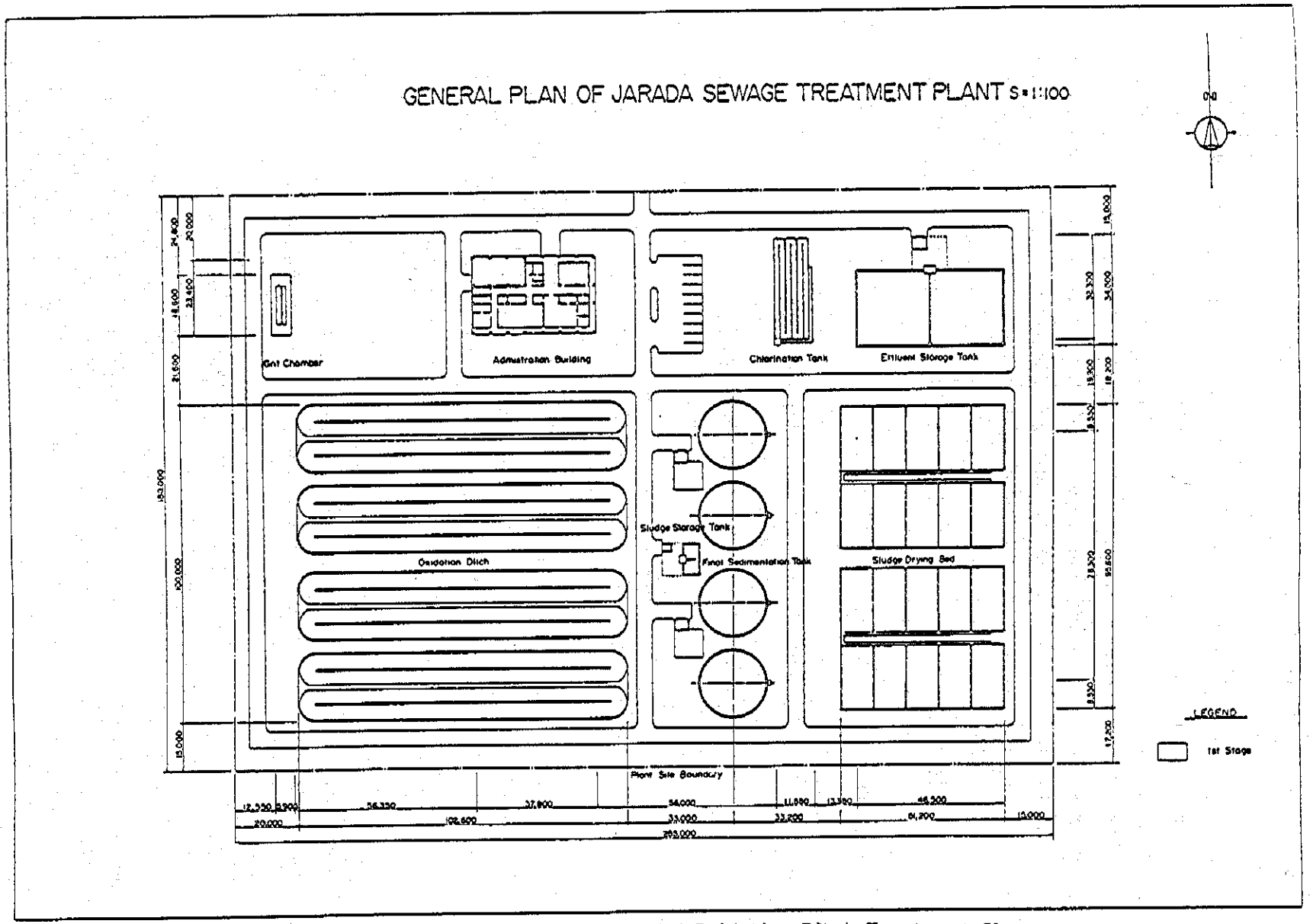


Figure 4.2.12. Layout of the Proposed Oxidation Ditch Treatment Plant

4.2.5 Effluent Reuse System

As one of the most important reuse schemes of treatment plant effluent, in the proposed Jarada area, an agricultural development has been planned as mentioned previously. Effluent derived from the proposed treatment plant at the Jarada area is the most important water resources for crop irrigation in the farm land. The effluent is conveyed from the chlorine contact tank annexed to the treatment plant to the respective farm water tanks provided for three management blocks and an experimental farm through the main pipeline. The effluent stored in the farm water tanks is pumped up and conveyed to hydrants respectively in each field through the secondary pipelines.

The proposed irrigation area is as follows:

Kind of Land	Acreage	
Farm land	576	feddan
Experimental farm	12	"
Reserved area	23	"
Total	611	feddan

Location of the above is illustrated in Figure 3.6.2. The farm land of the Jarada area is largely divided into three water management blocks of 192 feddans each for smoothing the farming and water management programme, and further an experimental farm of 12 feddans is established.

The main pump station is located at the western-most of the proposed Jarada area. The elevation of the main pump station is about 10 m above sea level. Details of the main pump station are explained in 4.2.4 'Pumping Stations".

As mentioned already, the effluent water as irrigation water is conveyed from the chlorine cintact tank to the respective farm water tanks through the main pipeline. The effluent stored in the farm water tanks is further pumped up and conveyed to hydrants respectively in each field through the secondary pipelines. These pipeline systems are applied for the reason that

water level at pipe ends of drip system is higher than the chlorination tank, and the pipeline systems take up less spaces, control water loss from evaporation and are relatively simple for the maintenance. Water conveyance system is illustrated in Figure 4.2.7.

The irrigation method adopted in the area is a drip system suitable for the soils and crops as illustrated in Figure 3.6.1 of 'Representative Cropping Pattern' to reduce both water requirements and salt accumulation.

The force pump is proposed because the elevation of the booster pump station is comparatively lower than that of the pipe end. As a result, water pressure will be kept at a constant level of 1.5 kg/cm^2 at the pipe ends.

All irrigation facilities are designed based on the maximum water requirements of 7.0 mm/day which is the net consumptive use for June in the farm land of the Jarada area. According to the soil survey, it is found that available moisture is low and permeability is high in the farm land. And the total readily available moisture (TRAM) is estimated at 8 to 30. Judged from our study, it is expected that TRAM applicable for vegetables and fruits is about 30 mm and 40 mm respectively.

On the basis of the above TRAM and consumptive use per day, intermittent days for vegetables and fruits are worked out at 4 days and 5 days respectively. Further, water quantity per irrigation is worked out at 28 mm for vegetables and 42 mm for fruits.

In the meantime, according to our calculation, a large quantity of treatment plant effluent is expected to be discharged from the treatment plant at Jarada, and the quantity is worked out to reach about 10,000 m^3/day after completion of the 1st phase project implementation.

Of about 10,000 m^3/day of the effluent, about 300 m^3/day are planned to supply for the operation and management of an experimental farm to be established within the 1st phase implementation period as irrigation water. The remaining about 9,700 m^3/day are planned to supply to three water

management blocks of ordinary farms as illustrated in Figure 3.6.2. If the ordinary farms were not constructed until completion of the 1st phase implementation of the sewerage and drainage system, the effluent is to be discharged in any areas adjacent to the treatment plant.

As one of the alternative plans for effluent reuses, [Water Management Block II] and its surrounding areas illustrated in Figure 3.6.2 are considered to utilize as a most desirable site. In our plan, for the effective discharge of the effluent surplus in such a site, a main pipe and a few secondary pipes with many emitters are located connecting the storage tank of the 'Water Management Block II' and its surrounding areas. Discharge of the effluent is to be conducted in accordance with the 'Overland Flow' method mentioned in the report "Rehabilitation and Expansion of the Canal Cities Wastewater Systems -- Suez Feasibility of Land Application --' prepared by national Organization for Potable Water and Sanitary Drainage (NOPWASD), A.R.E.

Surplus of the effluent is discharged in 'Water Management Block II' and its surrounding areas amounting to about 300 feddans on the basis of the calculation of water requirements. As mentioned above, an overland flow method will be widely applied. It is needless to say that this method is useful for forage crop growing as well as tree planting. Costs for main and secondary pipes necessary for discharging the effluent and related costs are included in the cost for establishing the experimental farm.

On the basis of quantified economic benefits and costs mentioned separately, the Economic Internal Rate of Return (EIRR) of the Project is estimated at 9.36 per cent. The EIRR is calculated on a general assumptions of i) a project life of 50 years; ii) an agricultural development period of five years after completion of the farm land establishment in the Jarada area; iii) desirable operation and management of the farm land utilizing treatment plant effluent with standard water quality. On the other hand, B/C Ratio is calculated at 0.59. Summary of economic benefit and cost of the Project utilized for this calculation are shown in 6.25 "Economic Evaluation" of APPENDIX - SIX.

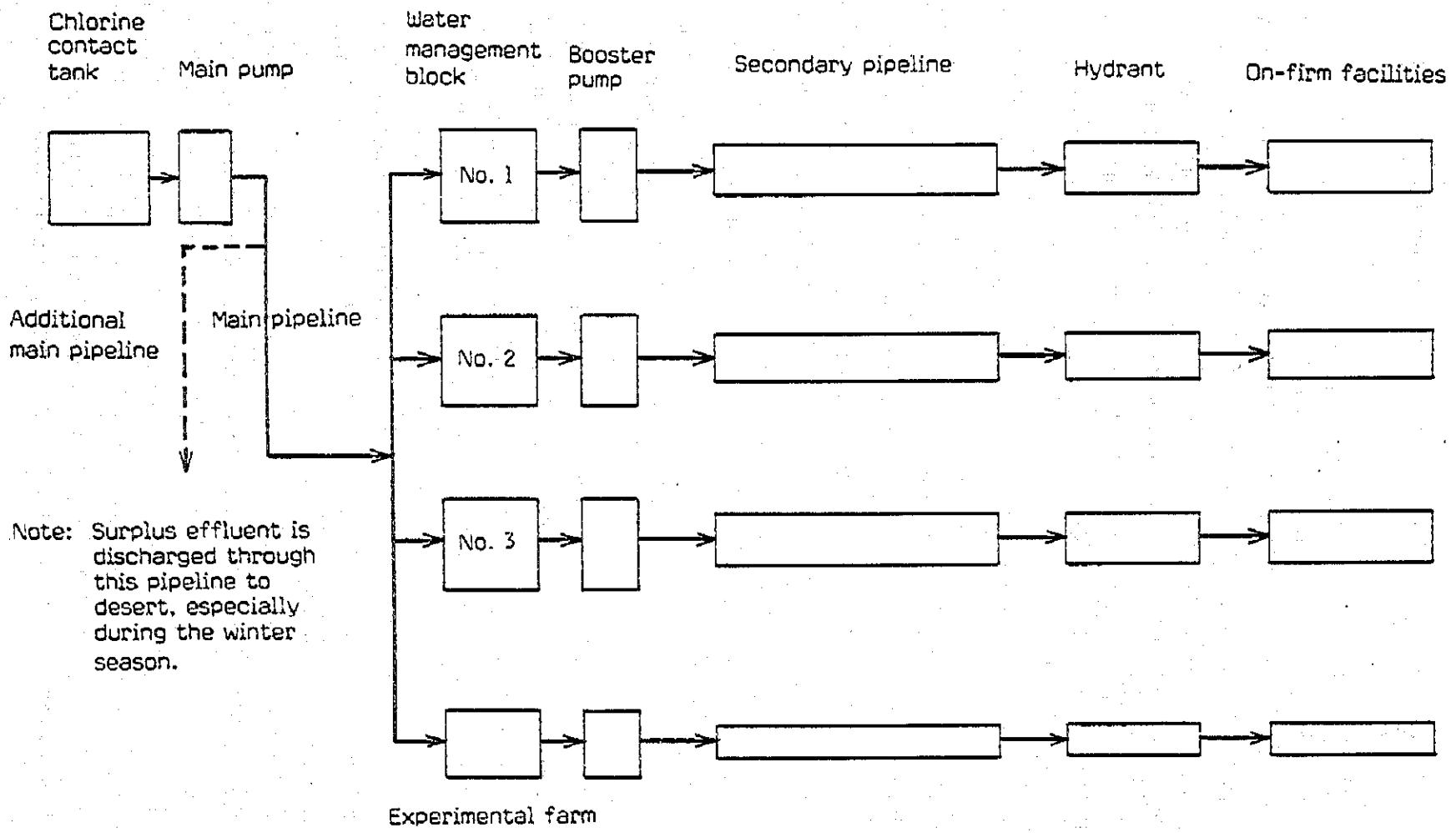


Figure 4.2.13. Water Conveying System for Irrigation

4.3. IMPLEMENTATION PROGRAMME

4.3.1. Materials and Methods of Construction

Most of materials required for the construction of sewerage and drainage system are available locally except mechanical and electrical equipment for sewage treatment plant and pumping stations. The construction methods now being applied to the sewerage system construction in Masaid housing scheme are practical, and it is believed that the local construction industry will play a major role in the project.

(a) Construction Materials

Sand and gravel for concrete works are sufficiently available in acceptable quality. Portland cement is manufactured in Egypt, conforming to internationally acceptable standards, suitable for construction of sewerage facilities, such as concrete pipes, and civil works for pumping stations and sewage treatment plant.

Steel bars both round and deformed are manufactured locally in acceptable quality.

Pipes currently available in the area are limited both in size and material. Reinforced concrete pipe (RCP) is manufactured in the area but is limited in their size and quantity. The sizes of the concrete pipe range from 150 mm to 450 mm dia. but larger size pipes will be available when required.

Clay pipe (CP) is manufactured from 150 mm to 450 mm dia and are widely used for the sewers in Masaid area housing scheme, but for pressure pipelines, cast iron pipes are used.

Ductile iron pipes have to be imported, as do most valves, pumps, motors, and gates.

As mentioned previously pipe materials are mostly available in the area and could be satisfactory for sewer networks in the Project, provided suitable measures are taken to control the quality of the production.

(b) Capability of Contractors

The sewerage and drainage project involves the construction of large-scale and complex facilities, such as intermediate pumping stations and sewage treatment plant, which require skill and experience of the contractors, and some of the work are beyond the previous experience of local contractors in the area. For such important contracts it would be appropriate for foreign and local firms to enter suitable working arrangements, such as a joint venture, in order to ensure efficiency. For most of the civil contracts within the project; however, some contractors within the area have experience, equipment and key staff to carry out the work satisfactorily. It will probably be advisable to prequalify local contractors according to their capacity and experience so they can be utilized as effectively as possible in implementing the project.

Although a significant labour force will be needed when the project starts, there will be no serious problem in finding unskilled labour, but skilled labour, tradesmen, foremen and construction manager at various levels could pose a difficulty. Many large projects are scheduled to start simultaneously with this project requiring labours and materials, and therefore this matter should be well considered in the tendering stage for the construction.

(c) Construction Methods

Major construction works of the project can be classified into two categories, namely 1) sewer pipe laying, and 2) construction of pumping stations and sewage treatment plant, as described below:

There will be two applicable construction methods for sewer pipe laying, one is the open-cut method and the other tunnelling method. The open-cut method is applicable where the sewer size is small and the traffic condition allows to do it. Most of the sewers will be laid using this method.
The tunnelling method, on the other hand, may be used for large and deep sewer construction and where the traffic is heavy and cannot be detoured. This method includes the various forms of jacking of prefabricated units from shaft or pit locations. Since this requires equipment and skills, the

application to sewer construction should be carefully studied for its suitability to the project.

Since the intermediate pumping stations are to be located at relatively congested area close to residential and commercial zones, the land available for the construction will be limited. Moreover, the structure itself will be quite deep, the deepest part being from 6 to 8 m from the ground elevation. Sheeting and bracing should be provided to prevent cave-in of the excavation walls or subsidence of areas adjacent to the stations.

The construction site for the sewage treatment plant is rather isolated from the city and will have less problem with respect to the impacts to the surrounding area than the pumping stations. The excavation may be carried out in open cut, in some cases without sheeting. It is expected that in general the groundwater elevations in the area are high particularly in zones close to the sea, therefore, appropriate dewatering should be practiced all through the construction work.

Some of the pumping stations, where the groundwater elevation is high and the sheet piling is not suitable because of sub-soil condition, the caisson method will be applied. In such a case, a particular consideration should be given to the protection of the connecting sewer pipe from uneven settlement of the backfilled soil or structure.

4.3.2. Cost Estimates

The estimated capital costs are presented for the entire sewerage and experimental farm land components of the project in Table 4.3.1., which total L.E. 42,318 thousand. Interest during construction and cost of land for sewage pumping stations, sewage treatment plant and experimental farm are excluded from this cost summary.

The capital cost estimates are based on the preliminary engineering design prepared during the course of the feasibility study. These estimates are considered to be reliable within 15 per cent of the actual costs at constant prices. Unit prices used for these estimates are based on comparable recent contracts in El-Arish and on budgetary estimates provided by the governments and suppliers. An allowance of 20 per cent of the basic cost estimate to cover physical contingencies (unexpected costs) is reasonable, based on the status of the designs for the project components.

The foreign exchange component of the cost estimates includes both a direct component (imported material for use in the project, foreign experts, etc.), as well as an indirect component (depreciation on imported construction equipment, imported fuels, etc.). The over-all foreign exchange component of the project is estimated to be L.E. 10,810 thousand or some 25.5 per cent of the total capital costs. It is the highest for facilities of pumping stations accounting for about 56 per cent of the total construction costs for pumping stations, because these systems will require foreign pumps and controls.

Detailed estimates of operation and maintenance costs for the project as a whole are shown in the projected income statement. Costs were estimated separately for the sewers, pumping stations, sewage treatment plant, and experimental farm land, and due account taken of volumes of the wastewater and staff required for operation of the new system.

The cost estimate is prepared in prices prevailing in mid-1984. The pattern of expenditures has been estimated for each component from final engineering, beginning in 1985, through completion of construction in 1992. The actual final costs will depend on changes in price levels during the project implementation period.

Table 4.3.1. Summary of Estimated Project Costs

(in L.E. thousand)

Item	Foreign	Local	Total
Construction costs			
a). Collection			
Sewers, force mains, manholes	3,600	19,500	23,100
Pumping stations	1,602	1,255	2,857
b) Treatment	2,945	4,557	7,502
c) Irrigation	297	99	396
Sub-total	8,444	25,411	33,855
d) Engineering design	677	1,016	1,693
e) Contingencies	1,689	5,081	6,770
Sub-total	2,366	6,097	8,463
Total	10,810	31,508	42,318

The breakdown of the project costs is summarized in Table 4.3.1.(b).

4.3.3. Implementation Schedule

(a) Staging of Implementation

The sewerage construction programme has been divided into two interrelated components, the wastewater collection and sewage treatment systems. Each component has its own place in the construction programme recommendations, based on estimated requirements for the particular period. It has been assumed that the construction will be staged in two stages, with the First Stage to be completed by the end of 1992 and the subsequent Second Stage from 1993 through 2005. This phasing, with the inherent flexibility of the system will permit periodic re-evaluation as required.

In determining the appropriate staging of sewerage implementation, all the possible alternative construction programmes and priorities were studied. The elements considered for the study include the following seven features, each of which has impacts on sanitation in the Study Area:

- Population densities.
- Daytime populations.
- Cost effectiveness of the system and promptitude for connecting branch and lateral sewers to main sewers and pumping stations.
- Extent of the groundwater contamination.
- Requirements of sanitation improvement for tourists.
- Geological and topographic conditions.
- Housing and institutional development programmes.

In view of the lack of a clear distinction in tangible aspects between the sewerage districts, non-quantifiable considerations become of prime importance in the selection of a recommended phasing. An evaluation has then been made of the degree to which each is responded to by the districts. A rating of the 11 sewerage districts and subdistricts have been studied with reference to each of these. The eleven districts are shown in Figure 4.3.1.

The results of the rating are shown in Table 4.3.2. with supporting comentary presented in the following paragraphs.

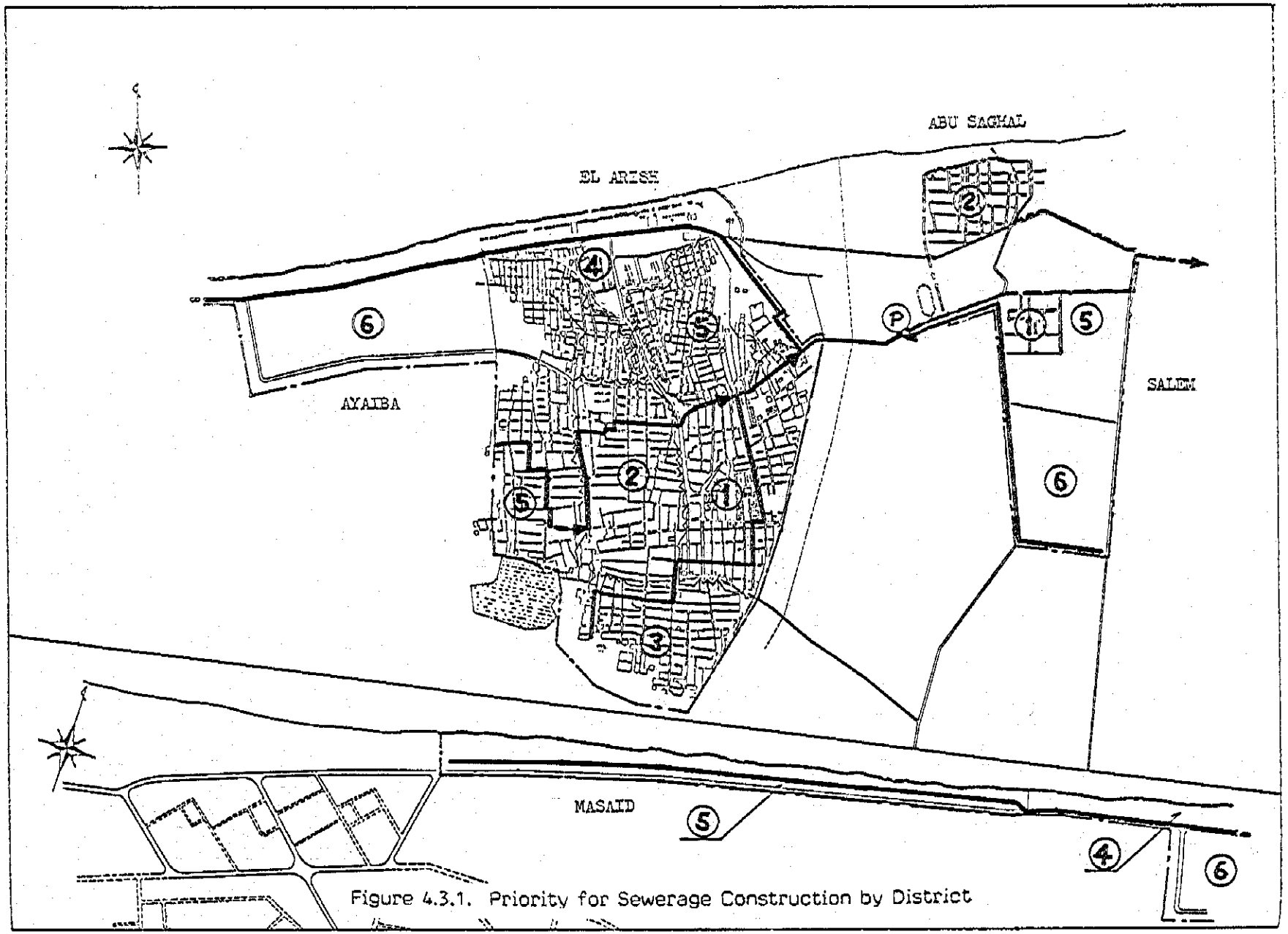


Figure 4.3.1. Priority for Sewerage Construction by District

(b) Application of Rating

Each of the districts and subdistricts has been rated either 'A', 'B', 'C', or 'D' in the decreasing order according to the degree of impacts on the elements or the requirements of the sewerage system.

The population densities in Salem (1), Salem (5) and Salem (6) are highest among other districts, thereby the impacts of the population to the environs and public health have been the greatest in these districts, and the requirements of the sewerage provision are higher than other districts and rated 'A'. The remaining districts, except Masaid, are rated 'B' because of their moderate population densities, while Masaid district is rate 'C' as its population density is low compared with other districts.

The daytime population increase is distinct in commercial and institutional districts of the city. In El-Arish (1) district there exist many institutions and commercial buildings to which the daytime population movements are most significant. This warrants the early provision of the sewerage system since many benefits can be expected by the sewerage system particularly with respect to public sanitation improvement. In Salem (1), El-Arish (2), El-Arish (4) and Masaid districts, considerable daytime population increase is expected but the extent is less significant than in El-Arish (1), and these districts are rated 'B'. Salem (5) has some population movement for institutions and commercial activities but is considered to be a little less than the districts rated 'B' and therefore rated 'C'. The remaining districts are rated 'D' as the daytime population increase is not expected.

Ease and accessibility for connection of households to the sewer system are one of the most important elements to be considered in determining the construction priority of sewerage districts. As shown in Figure 4.3.1., Salem (1) district is located closest to the sewer main and pumping station downstream of the sewerage system. This makes the district superior to other districts with regard to the cost and time saving, thus rated 'A'. For the same reasons, El-Arish (1), El-Arish (2) and Salem (5) districts are also somewhat superior to the remaining districts in this regard and rated 'B'. El-Arish (3), El-Arish (2) and El-Arish (5) are rated 'C', as these districts are located farther from the main sewers and pumping stations. The rests are rated 'D' in comparison

with conditions in other districts.

With respect to groundwater pollution control, the district of El-Arish (3) is the most urgently required to be provided with the sewerage system. As already described in the previous chapters, the water supply deep wells are mostly concentrated in the district. Should the sewerage system be provided in the district and most of the direct discharge of untreated sewage is cut off, the groundwater contamination by the wastewater can be eliminated. In view of this, El-Arish (3) district is rated 'A'. Other districts are more or less in the same situation in terms of the groundwater contamination protection, but influential to certain extent thus rated 'C'.

Tourism activities are most active in El-Arish (4),(5) and Masaid districts, since these districts encompasses tourist facilities along the beach and particularly during summer seasons tourists are concentrated in these districts. Sanitary facilities are therefore most urgently needed in these districts, so that rated 'A'. Ayaiba district is located close to the tourist zones along the beach and tourists are expected to stay within the district, thus rated 'B' in comparison with El-Arish (4) and Masaid districts. The remaining districts are considered to have less tourists than others and rate 'D'.

The extent of road network provision is an element to be considered for the sewerage provision. Where the road network is well planned and provided, the construction of sewers will be effective and economical. In Salem (1) district the road network is best provided and the requirements of the sewer system is urgent and at the same time construction of sewers is easy. For these reasons, the district is rated 'A'. Other districts such as El-Arish (1), El-Arish (2), and Masaid districts are also provided with well planned road networks and rated 'B' accordingly. The remaining districts are inferior to these districts and rated either 'C', or 'D'.

The above rating system adopted in this study, while arbitrary in many respects, nevertheless reasonably reflects and quantifies both present and future conditions of the project area with respect to need for the sewerage system. The results have also been confirmed by thorough field investigations and surveys and over-all evaluation of each district for the construction

priority made by the study team's own judgement. The results of such rating are summarized in Table 4.3.2.

The results are considered a good indication of the over-all need of the various districts and should be taken into account in determining the staging of the sewerage system construction.

Table 4.3.2. Priority of Sewerage Implementation by District

Order of priority	District	Population density	Daytime population	Cost effectiveness	Groundwater contamination	Tourist population	Road network	Overall evaluation
1	El-Arish (1)	B	A	B	C	D	B	A
1	Salem (1)	A	B	A	C	D	A	A
2	El-Arish (2)	B	B	B	C	D	B	B
2	Abu Soghal (2)	B	D	B	C	D	C	B
3	El-Arish (3)	B	D	C	A	D	C	B
4	El-Arish (4)	B	B	C	C	A	C	B
5	El-Arish (5)	B	D	C	C	D	D	D
5	Masaid	C	B	D	C	A	B	C
5	Salem (5)	A	C	B	C	D	D	D
6	Ayaiba	B	D	D	C	B	D	D
6	Salem (6)	A	D	D	C	D	D	D

Note: A = highest priority. B, C, and D = in the decreasing order for priority.

(c) First Stage Programme

Based on the results of evaluation of the priority of sewerage districts as discussed previously, and also after discussions with agencies concerned, five alternative combinations of the higher priority sewerage districts have been set for a preliminary economic and financial analysis, as discussed in detail in Chapter 5. Each of the alternative plans has been estimated in its capital and operation and maintenance costs and analysed in terms of B/C, PV and IRR and compared for the feability,

The five alternative plans are:

- Scheme 1; covering the sewerage districts of (1), (2) and (4), with a total service area of 325.78 ha.
- Scheme 2; covering the sewerage districts (1), (2), (3) and (4), with a total service area of 402.59 ha.
- Scheme 3; covering the entire sewerage districts of 894 ha, excluding Masaid district.
- Scheme 4; covering the sewerage districts (1) and (2), with a total service area of 209.19 ha.
- Scheme 5; covering the sewerage districts (1), (2) and (3), with a total service area of 286 ha.

The above five alterbnative combinations have been compared in their feasibility and also in consideration of a reasonable magnitude of the investment for the sewerage programme implementation during the First Stage, three most desirable alternative plans have been sorted out for further detailed economic and financial analysis. As described in detail in Sections 5.2. and 5.3. of this volume, the computations have led to the conclusion that candidature for the optimum scheme would be converged into Scheme 1 or Scheme 2, in which latter might outweigh.

The preceding analyses suggest that Scheme 2 is superior to other alternative plans and thus selected as the optimum plan for the implementation of the seweage project. The high priority area is shown in Figure 4.3.2.

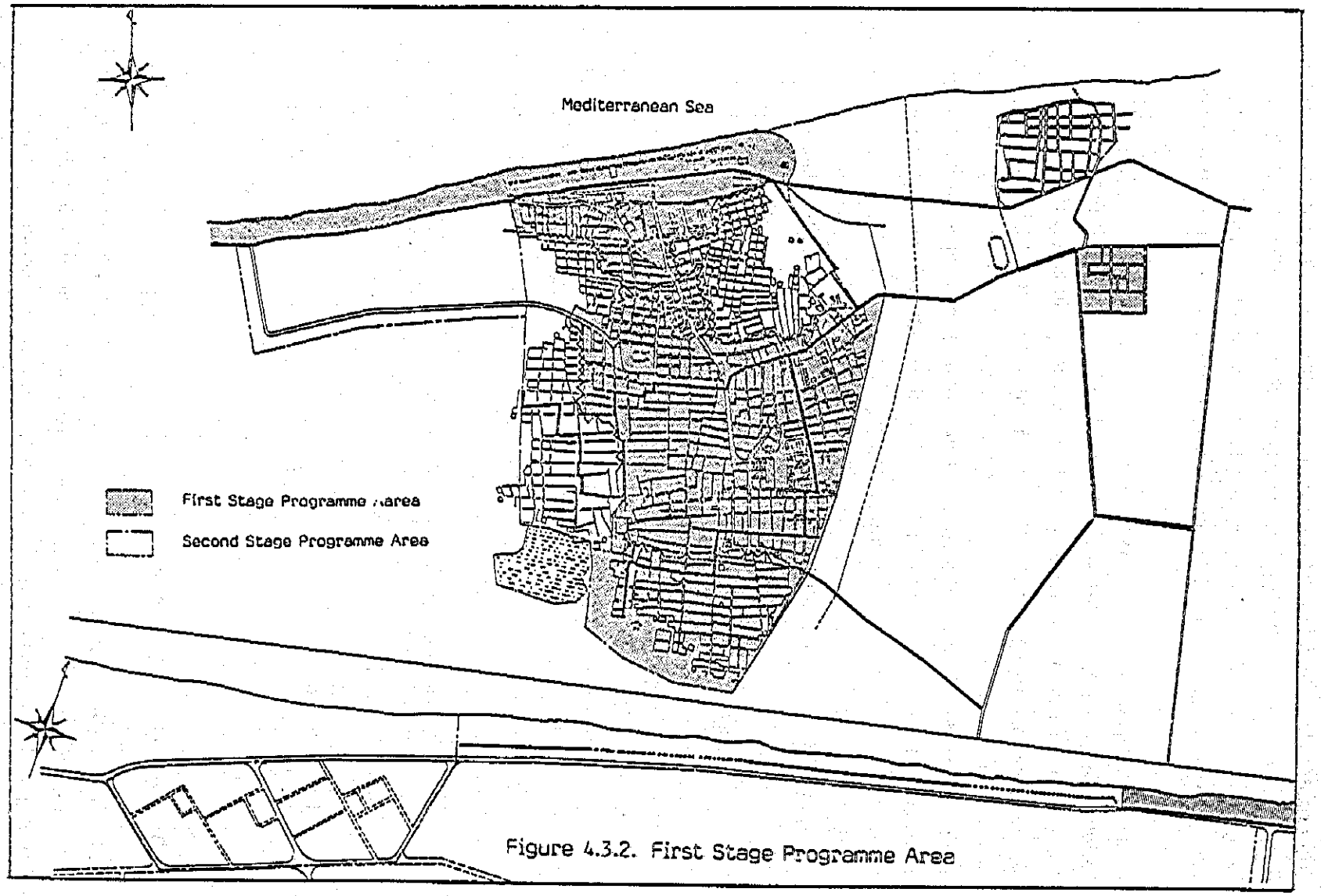


Figure 4.3.2. First Stage Programme Area

The construction of the sewerage facilities will comprise two consecutive construction stages, the First Stage from 1985 through 1992 and the Second Stage from 1993 to 2005. The construction is scheduled to commence in 1986 after the detailed design work and tendering are completed in 1985.

Certain sewerage facilities are essntial to the entire sewerage system, which must be constructed in the First Stage Programme to permit the further progressive development of the system, including 1) main trunk sewers running from the Jarada sewage treatment plant to the main pumping station, 2) El-Risa pumping station, 3) small manhole type intermediate pumping stations, 4) branch and lateral sewers, and 5) experimental irrigation facilities at Jarada. The facilities to be constructed under the First Stage Programme are summarized in Table 4.3.3.

Table 4.3.3. Summary of Proposed Sewerage Facilities by Stage

Component	1st Stage (1985 to 1992)	2nd Stage (1993 to 2005)	Total
1. Sewers, manholes			
Gravity sewers	80,230 m	93,405 m	173,635 m
Pressure sewers	24,510 m	2,460 m	26,970 m
Subtotal	104,740 m	95865 m	200,605 m
2. Pumping stations			
Main p.s.	1	-	1
El-Risa p.s.	1	-	1
Manhole type p.s.	8	14	22
3. Jarada sewage t.p.	1/2	1/2	1
4. Experiemental irrigation farm facilities	12 feddan		12 feddan

(d) Construction Schedule

In preparing a realistic schedule for implementing the First Stage project, detailed consideration has been given to the manner in which the construction activities will be organized by NSG. The basic asssumption is

that most construction will be carried out by contractors supervised by NSG and its consultants. However, certain activities such as repairs to the existing facilities, will probably be undertaken by NSG staff directly.

Realistic allowances are provided for each step in the contract process, including; completion of final design; preparation of and approval of tender documentss; tender period; tender evaluation; recommendation and approval of contract award; negotiation and contract signature; and mobilization by contractor. For large contract these steps are expected to require a total of up to one year after the decision to proceed with the recommended project.

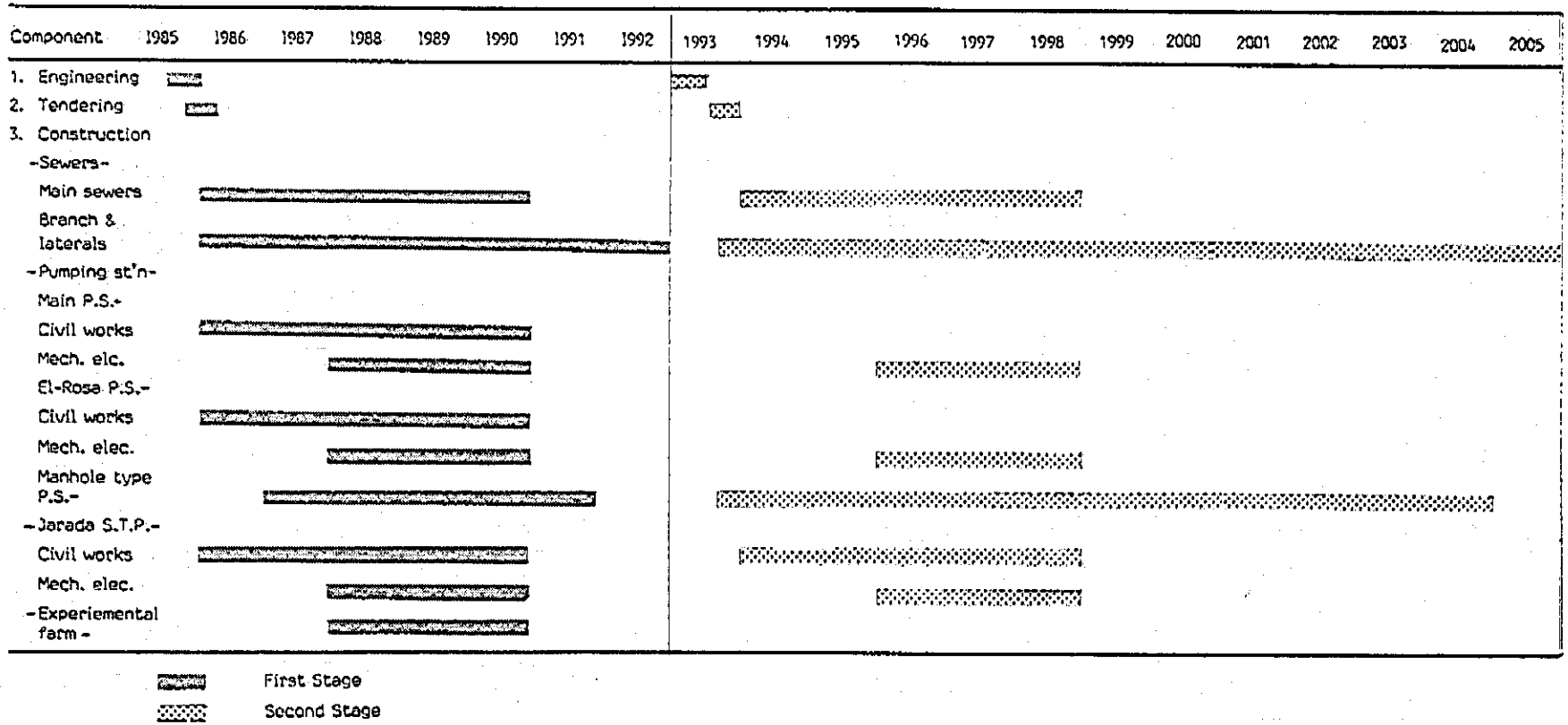
The design work is assumed to start by August 1985 and the construction schedule assumes that consultants can be engaged by April 1986. It is also assumed that all necessary financing (local and international) is assured before the end of 1985 and that construction contracts can be signed from 1986 onwards.

Many specific actions need to be taken before the sewerage components can be completed, such as purchasing land, arranging pipeline routes, etc. The largest elemnts in the sewerage component are the sewage treatment plant and the intermediate pumping stations.

The proposed construction schedule for the First Stage Programme is illustrated in Figure 4.3.3.

Figure 4.3.3. Proposed Construction Schedule

Figure 7 Proposed Construction Schedule



CHAPTER-FIVE

FINANCIAL, ECONOMIC AND INSTITUTIONAL PROJECTION

CHAPTER FIVE

FINANCIAL, ECONOMIC AND INSTITUIONAL PROJECTION

5.1. OBJECTIVES AND APPROACHES

For the sake of the utmost utilization of a limited fund for development, which is the common constraint in any countries today, the main assignment imposed upon the financial analysis is to seek the optimum viability of a project at the base of market economy, while the major objective of the economic analysis is to qualify its vital contribution in return for spending capital, material and manpower at the basis of national economy. The schemes selected and discussed in this Chapter are, therefore, circumspectly sorted out of 8 altanative plans at the first stage and 5 alternative plans at the second stage. (Refer to Appex. 5.1 and 5.2)

Approaches of the analytical works should be finally converged in computation of cost/benefit confrontation calibrating the cases "without the project" versus "with the project", otherwise the utilization would not ultimately be justified. The analyses should also compute verification of sensitivity for the confrontation giving oscillation on cost and benefit, respectively, since fluctuation of demand/supply and pricing/marketing would not be unusually expected.

For validation of the above quantitative analyses, legal and institutional arrangement necessary for effective operation of the project are the must to examine. Environmental situation from the point of views of not only mere ecological aspect but also broader socio-environmental scope necessary for progression of well-being is consequently discussed, too.

5.2. FINANCIAL ANALYSIS

5.2.1. Scope

The works assigned upon the financial analysis are to cover and appraise the project cost with upkeeping of operated facilities and the implementation for financing programme with possible mobilization of endogeneous/exogeneous funds. The coverage and

appraisal of the project benefit derived from difference of the cases between "without the project" and "with the project" are also included in the works. Various statements such as the balance sheet on the operating cash-flow should be prepared for the optimum scheme of the project.

The analytical conclusion of the works would be convergently indicated as Benefit versus Cost Ratio (B/C), Net Present Value (NPV) and Financial Internal Rate of Return (FIRR), which are necessarily required by international lending organizations if the project might ask their financing assistance. The sensitivity assumption in order to verify the conclusion, which is also ordinarily requested by them, should be computed too.

As for the conclusive indices, it should be previously noted that they might be relatively lower level than that of the ordinary one. In the ordinary way of sewerage and drainage development, a value of disease-relief and a growth of land property value are involved in computation for benefit. In the works, however, both of them are excluded. A probability of the former is nebligible if any. (Refer to Chapter Two, 2.10) For the latter, the Study Area is exceptionally out of rule of land-taxation after the restoration from Israel to A.R.E., although the Law No. 157/1981 and No. 87/1983 stipulate and impose tax for land property and its dealing. It is that a value of land property is not authorized, setting aside fait accompli.

Opportunity Cost of Capital (OCC or discount rate) necessary for working out B/C, NPV and FIRR quots 13% as the official premium rate in accordance with Resolution of Governor No. 45/1982. The project-life is 50 years ordianry characterized by the nature of sewearge and drainage facilities, while the targeted year is 20 years ending in the year of 2005 that is ordained by the Scope of Work for this project..

5.2.2. Project Cost

Calibration of the project cost is prerequisitely processed in two compatible directions. The one is to examine the cost necessary for all of construction and maintenance and operation (MO) together with land aquisition if any. The other is to re-examine the cost in diversifying into two portions, i.e. components obtainable by domestic currency and by foreign currency, respectively. In principle, the calibration is processed at the base of domestic current market price in 1984, referring to the past records of wholesale/consumer prices. (Refer to Appex.Table V-7 and V-8.

(1) Construction Cost

Summary of the construction cost for the schemes finally selected is shown in Table 5-1 (For details, refer to Chapter Four, 4.3.2.). The specifics of the cost by scheme are that the total cost of each one is almost simular and the heaviest burden on it is allocated to sewer piping networks, around 55% among it. For Scheme 1 and Scheme 2, the specifics consist in the heavier burden for the precedence, the foregoing stage of the construction, than that for the sequence which is planned as the following stage of it. The heaviest burden on and at the precedence is particulary recognized in Scheme 2 but, on the contrary, the easiest burden on and at the sequence is undertaken for it. For the portion of domestic and foreign components seem to be almost same throughout the schemes, i.e. roughly 7 (domestic) : 3 (foreign).

(2) Operation and Maintenance (OM) Costs

Summary of the O & M costs for the schemes finally selected is shown in Table 5-2 (For details, refer to 4.3.2.). The specifics of the costs are that the portion given to farming pilot plant is unanimously distinct throughout the schemes, some one-third among it, and the percentage share of domestic and foreign components is varied both on and at the precedence and sequence in Scheme 1 and Scheme 2

5.2.3. Implementation, with Financing Programme

(1) Implementation

Implementation, the disbursement schedule of the project cost, is as shown in the Figure 5-1 (A) and (B) which are circumspectly arranged mainly from the point of view of the following four conditions:

(a) Relation in/between the NSG total budget at the annual average base and the disbursement of the project cost at the peak-year.

(b) Relation in/between the NSG utilities budget at the annual average base and the disbursement of the project cost at the peak-year.

(c) Relation in/between the NSG balance of payment and the disbursement of the project cost at the peak-year.

(d) Relation in/between the NSG sewerage budget at the annual average base and the MO cost of the project.

The annual total budget of NSG ranges from LE 9.5 million in 1982/83 to LE 13.1 million in 1986/87 and indicates LE 10.8 million in per annum (p.a.) average, while

Table 5 - 1

Summary of Construction Cost

(LE 1,000)

	Sheme 1			Scheme 2			Scheme 3		
	D.	F.	T.	D.	F.	T.	D.	F.	T.
Sewer									
P.	7,568	2,242	9,810	9,100	22,64	11,364			
S.	11,932	1,358	13,290	10,400	1,336	11,736			
T.	19,500	3,600	23,100	19,500	3,600	23,100	19,500	6,600	23,100
Pumping									
P.	1,001	1,255	2,256	1,035	1,318	1,353			
S.	254	347	601	220	284	504			
T	1,255	1,602	2,857	1,255	1,602	2,857	1,255	1,602	2,857
Treatment									
P.	3,646	2,356	6,002	3,646	2,356	6,002			
S.	911	589	1,590	911	589	1,500			
T.	4,557	2,945	7,502	4,557	2,945	7,502	4,557	2,945	7,502
Farm. Plant									
P.	99	297	396	99	297	396			
S.	-	-	-	-	-	-			
T.	99	297	396	99	297	396	99	297	396
D/D									
P.	554	369	923	604	402	1,006			
S.	462	307	769	412	275	687			
T.	1,016	676	1,692	1,016	677	1,693	1,016	677	1,693
Supervision									
P.	2,463	1,228	3,691	2,776	1,247	4,023			
S.	2,617	461	3,078	2,307	449	2,747			
T.	5,080	1,689	6,769	5,083	1,787	6,770	5,081	1,689	6,770
Grand Total									
P.	15,331	7,747	23,078	17,260	7,884	25,144			
s.	16,176	3,062	19,238	14,250	2,924	17,174			
T.	31,507 (74.5%)	10,809 (25.5%)	42,316 (100.0%)	31,510 (74.5%)	10,808 (25.5%)	42,318 (100.0%)	31,508 (74.5%)	10,810 (25.5%)	42,318 (100.0%)

Remerks : D. ; domestic component F. ; foreign component
P. ; precedent stage S. ; sequent stage
T. ; total

Table 5 - 2

Maintenance and Operating Cost

	Scheme 1			Scheme 2			Scheme 3		
	D.	F.	T.	D.	F.	T.	D.	F.	T.
Sewer									
P.	10	24	34	10	24	34			
S.	120	288	408	125	300	425			
T.	130	312	442	135	324	459	130	312	442
Pumping									
P.	87	-	87	109	-	109			
S.	1,401	-	1,401	1,409	-	1,409			
T.	1,488	-	1,488	1,578	-	1,578	1,792	-	1,792
Treatment									
P.	63	6	69	79	8	87			
S.	1,016	98	1,114	1,063	104	1,167			
T.	1,079	104	1,183	1,142	112	1,254	1,297	126	1,423
Famr. Plant									
P.	75	464	539	75	464	539			
S.	308	1,376	1,684	308	12	1,684			
T.	383	1,840	2,223	383	1,840	2,223	383	1,840	2,223
Grand Total									
P.	235	494	729	272	496	769			
S.	2,845	1,762	4,607	2,965	1,780	4,745			
T.	3,080	2,256	5,336	3,238	2,276	5,514	3,602	2,278	5,880

Remarks : D. ; domestic component F. ; foreign component

P. ; precedent stage S. ; sequent stage

T. ; total

Figure 5 - 1 (A)

Disbursmenr Schedule of the Project Cost

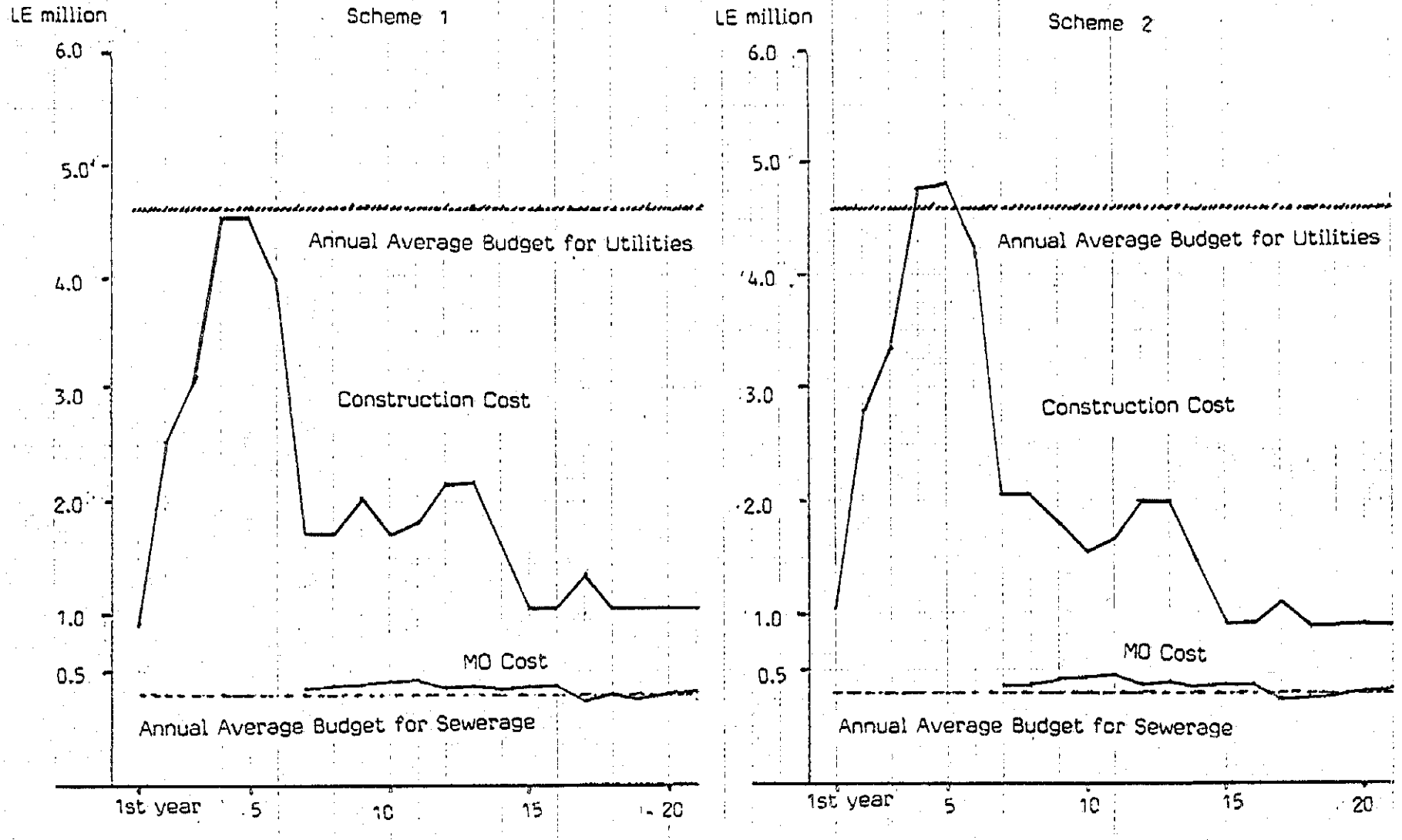
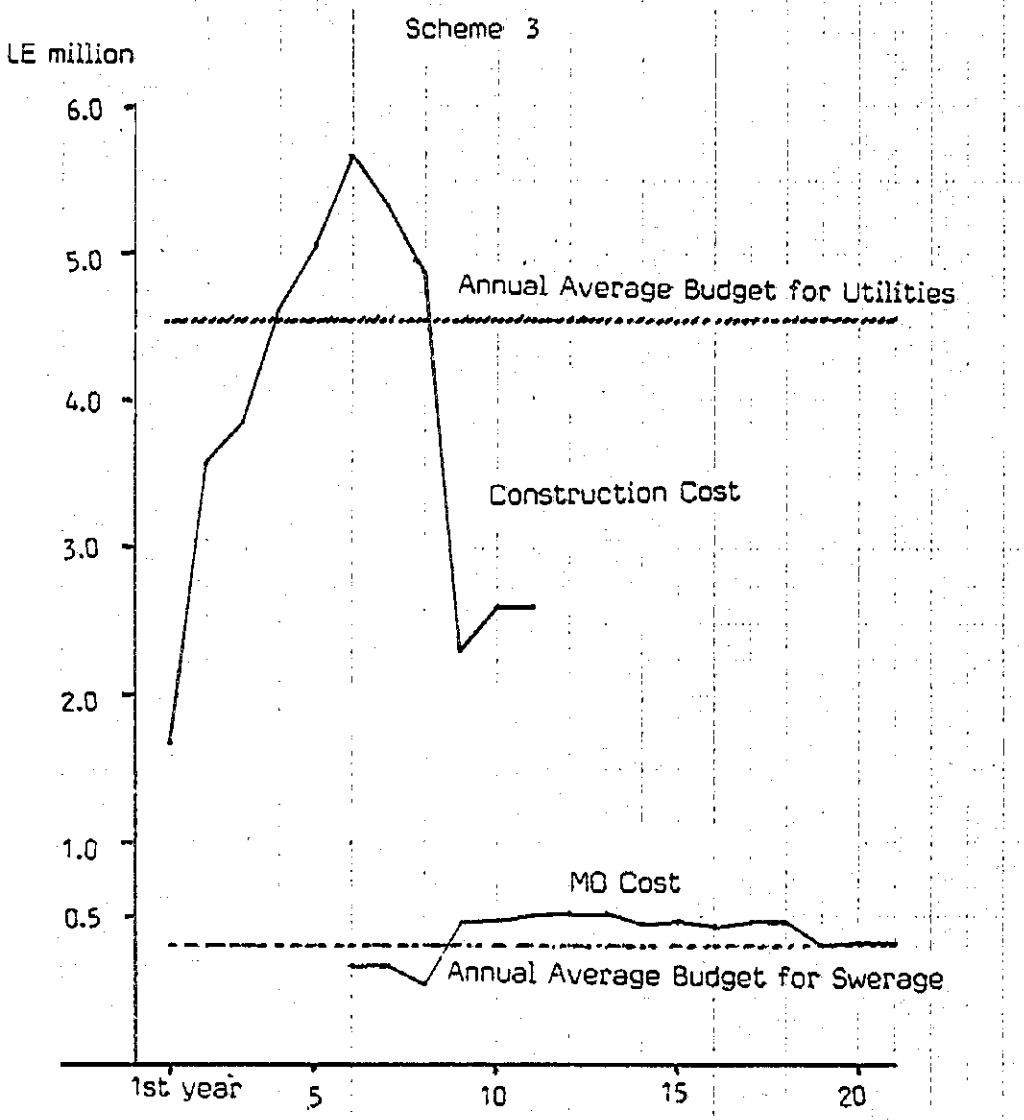


Figure 5 - 1 (B)

Disbursment Schedule of the Project Cost



the annual utilities budget varies from LE 4.4 million to LE 5.0 million and shows LE 4.6 million in p.a.average for the same period. The allocation for sewerage in the budget is LE 0.3 million in p.a. average for the same period. (Details, refer to Chapter Two and Table 2.2.8.) In the meantime, the balance of payment of NSG, the income-and-expense account, records LE 29.6 million both of credit/debit items in 1982/83. (Refer to Appex. Table V - 40)

Figure 5 - 1 would, in which the average level of the total budget and the balance of payment are incommensurably out of the drawing, clarify the above relation as shown in Table 5-3.

(2) Financing Programme

The relation comparatively indicated in Table 5-3 would, however, slightly change if the condition is considered solely by domestic component. It should be as indicated as in the Table 5 - 4.

The difference between the Table 5 - 3 and 5 - 4 obviously indicates the important role of foreign component, particulary on its condition such as interest, grace, amortization etc., for which the Chapter Three precisely discusses the affection of interest against the original cost in case of treatment plant. (Refer to Chapter Three 3.6.5.) As prevailingly known, for the interest, the birateral example is 4.0 - 5.0% p.a. as the lowest level, e.g. Overseas Economic Cooperation Fund (OECF) of Japan, and the multinational example is 8.0 - 9.0% p.a., e.g. IBRD or the World Bank, Asian Development Bank (ADB) etc. The following section 5.2.7. would clarify the certain role of foreign financing assistance to the project, together with cash-flow programming on it.

5.2.4. Project Benefit

The project benefit is, in response to the project cost as investment, composed of three categories. The first is the benefit derived from saving the cost, which should be otherwise obviously and/or continuously spent it if the project might be not realized. The second is the benefit brought from reducing the loss, which

Table 5 - 3

Comparative Relation in/between the annual average budget and the project cost at the peak-year

	Scheme 1	Scheme 2	Scheme 3
For condition			
(a)	41.7%	44.4%	52.8%
(b)	97.8	104.3	123.9
(c)	15.2	16.2	18.9
(d)	145.3 *	150.3 *	179.0

* : the figure in the case maximum exceeded.

Table 5 - 4

Comparative Relation of Table 5 - 3 at the domestic component base

	Scheme 1	Scheme 2	Scheme 3
For condition of			
(a)	25.0%	27.8%	35.2%
(b)	58.7	65.2	82.7
(c)	9.1	10.1	12.8
(d)	57.7 *	62.3 *	85.0

* : the figure in the case maximum exceeded

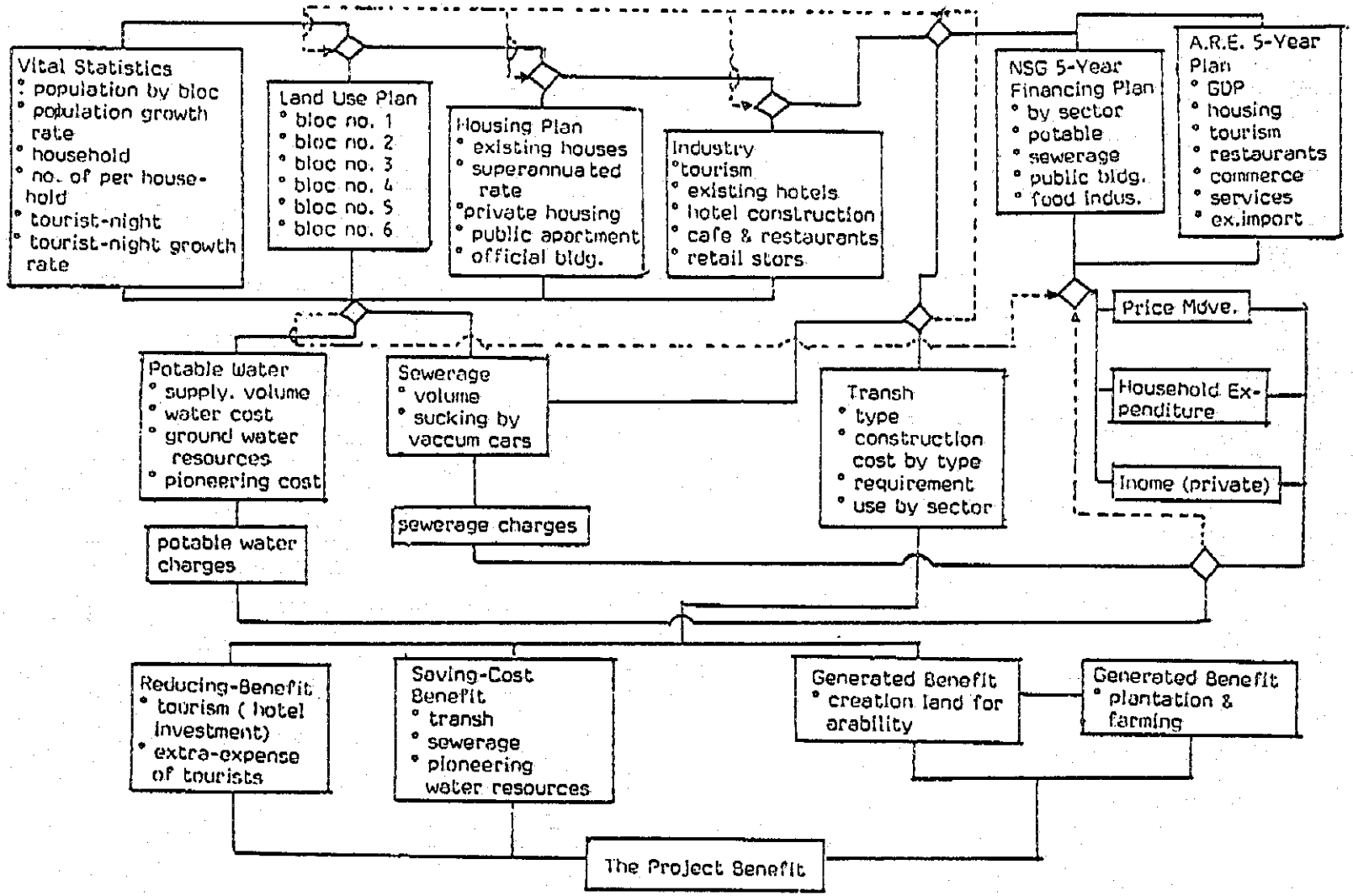


Figure 5.2. Flow-Chart on the Project Benefit

should be otherwise definitely and/or unavoidably damaged if the project might be not made up. The third is the benefit produced from generating the gain which should be otherwise absolutely nonentity if the project might be not came out. Flow-chart of the project benefit would be clarified in Figure 5-2. Dimension of each category is as follows:

(1) Saving Cost Benefit

(a) The construction cost for transh in private housing. The record of housing, whether scrap-and-building or new building, indicates p.a. increase ranged from 720 to 1,847 since 1979/80 when the Director Office of Engineering Dept., City Council of NSG roughly counted 20,000 as existing houses in El Arish as a whole, among which at least 10,000 houses were absoultly needed to scrap-and-build. (Refer to Appex. Table V-13)
In addition, according to the Five-Year Plan, the projected growth of housing property is 8.5% p.a. in the production and 9.0% p.a. in GDP. (Refer to the Chapter Two, 2.2.)

(b) The construction cost for transh in public apartment. The record of building apartment indicates p.a. average 161 flats which would be equivalent some 10 buildings. (Refer to Appex. Table V-14)
In addition, according to the Five-Year Plan, 6.9% p.a. increase for housing and construction is targeted at the base of Ministry of Housing. (Refer to Chapter Two, 2.2.).

(c) The construction cost for transh in public building. In accordance with the NSG, there are some 100 official or public buildings in El Arish area in 1984, among which 36 buildings are schools and 4 buildings are hospitals and/or clinics. Besides the streneous effort in furnishing requirement for public services, the facilities such as gymnasium, cultural centre, library, etc., are insufficient at all and the conventional buildings which are superannuated and inconvenient are so many employed. from necessities.
In addition, according to the NSG budget, LE 7.6 million is allocated to

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Transh : Conventional and/or traditional facility for sewerage and drainage. There are several types and patterns in transh. In this works, the transh only for sewerage use is discussed. (Detains, refer to Appex. Table V-21) The transh used for drainage is discussec in 2.9. and 3.6.7.).

municipal and city establishments for 1982/83 - 1986/87 with 4.4 % p.a. average increase.

(d) The construction costfor transh in private services sector, e.g., cafe, restaurant and retail shops such as fish-store, laundry and bakery which have to consume much water. Although the present numbers of them are quite minor (Refer to 2.4.1.), it should be noted that the Five-Year Plan aims 7.0 % p.a. average growth for restaurant services. The Plan also aims 6.7 % p.a. average growth for commercial sector and 6.7 % p.a. increase as its production in GPD, respectively (Refer to 2.2.).

(2) Reducting Loss Benefits

(a) The reduction for possible stagnation of tourism development, which might be caused by not only environmental deterioration in natural features of the region but also assumed loss derived from promoting hotel and/or recreation facilities which are now actively proceeding to invest (Refer to 2.4.3.). According to the Tourism Department of NSG, 105,264 tourist-nights is recorded in 1983/84 with the assumption of 7.7 % p.a. increase. The weighted average of hotel charges is L.E. 13 per tourist-night, to which one-third of the charges is internationally assumed to consume as the least additional extra-expense such as meals and drinks. In the work, however, the additional extra-expense is excluded (For detail, refer to Appendix 5.4.3.).

(b) The reduction for expenditure of sewerage (Refer to the aforementioned 5.2.3. in this Chapter). The reduction should also be necessary to avoid the double-account on it, since the project cost involves it as the OM cost.

(c) The reduction for possible expenditure of pioneering groundwater resources together with additional and/or connected supplying equipment. The existing well as water supplying sources are 22 and their cost such as excavation, installation, etc., is L.E.50,151 per well (Refer to 2.7. and 3.4, and Appendix Table V-20).

(d) The reduction for additional purchase of vacuum-pumping lorry, which is operated in sucking sludge inside transh (Refer to Appendix 5.4.6.).

(3) Generated Benefits

(a) The creation of land for arability in the present mere desert. The land would be reclamated by outflow of recycled water through sewage treatment system of the project.

(b) The creation of plantation land for forage cropping and trees, in which livestock is to be fed and diary is generated.

(c) The creation of farming and consequently harvesting crops.

In the work, the possible value induced by creation of arable land with crops is assumed. Others are discussed in 2.4.2., 3.6. and 4.2.5. (Also refer to Appendix 5.4.8.).

5.2.5. B/C, NPV, FIRR

Computation for the cost versus the benefit as aforementioned is convergently processed. The concluded indices of B/C and NPV as well as FIRR at the domestic market price, 1984, are as the Table 5 - 5

Table 5 - 5
Concluded Indices
of the Financial Analysis

	B/C	NPV*	FIRR
Scheme 1	0.63	(-) 7,819	9.50
Scheme 2	0.63	(-) 8,200	9.47
Schme 3	0.57	(-)11,248	8.93

* LE 1,000

Remarks : discounted at 13%

For the reference on the indices, the computation is simultaneously processed as for the precedence, the foregoing stage of the project, on the cases of Scheme 1 and Scheme 2, respectively. The results are that Scheme 1 shows B/C 0.23 and FIRR 0.59 and Scheme 2 indicates B/C 0.25 and FIRR 1.25.

5.2.6. Sensitivity Verification

Computation for the sensitivity analysis is processed incorporating the oscillated

conditions ranged from (±) 5 % to (±) 15 % by 5 % cutting-input both of the cost and the benefit (For details, refer to Appendix Tables V-23 to V-25).
In the analysis, it should be noted that the A.R.E. Government just announced to introduce the new system on floating exchange rate in parallel with the existing fixed exchange rate. (For the latter, refer to Appex. 5.3) In the fixed rate, the conversion has been dealt some LE 0.83 against U.S. ¢ 1.00 although it has been traded less/over LE 1.25 at the floating rate base afeter when the Go Government introduced it on January 5th,1985.

Difference between the introduced system and the existing rate would suggest roughy 50% minus-or-plus of purchasing load for import goods. In this project, as discussed already, around 30% equivalence of the construction has to rely on foreign component. This, briefly, should reflect some 15% reduction of the cost at the precedent stage at least, if the floating rate might be able to apply. In this respect, the assumption in case of (-)15% of cost involves in the concluded key-indices of the sensitivity analysis as indicated in Table 5 - 6.

The computation suggests that candidature for the optimum scheme would be converged into Scheme 1 or Scheme 2, in which the latter might outweigh. The key-indices of the analysis, together with the concluded ones of the financial analysis, shows that they are seemingly nearly same but the former is distinctly inferior to the latter at the precedent stage of the project in particular.

5.2.7. Statements as for the Optimum Plan

In regard to the indices computed in the financial analysis and the sensitivity analysis as well, the statements necessary for operation of the project should be prepared for Scheme 2, for which the Table 5 - 7 to 5 - 8 would clarify the details.

In preparation of the statements, the following five conditions are pre-requisitely taken into account:

(a) The fund to make finance the whole of the project should, setting aside the difference of the component obtainable endogeneously or exogeneously, be secured by the Government, the state in other words, where is aimed to achieve

Table 5 - 6

Concluded Key-Indices

of the Sensitivity Analysis

As for B/C			Scheme 1	Scheme 2	Scheme 2
Cost(+)10%	Benefit(±)0		0.57 (0.21)	0.57 (0.23)	0.52
" 0	"	(+)10%	0.69(0.25)	0.69 (0.28)	0.63
" (-)10%	"	0	0.70 (0.25)	0.70 (0.28)	0.63
" 0	"	(-)	0.57 (0.21)	0.56 (0.23)	0.51
" (+)10%	"	(-)10%	0.51 (0.19)	0.51 (0.21)	0.47
" (-)15%	"	0	0.74(0.27)	0.74 (0.30)	0.67

As for FIRR					
Cost(+)10%	Benefit(±) 0		8.84 (-0.08)	8.81 (0.60)	8.31
" 0	"	(+)10%	10.18 (1.25)	10.14 (1.91)	9.57
" (-)10%	"	0	10.25 (1.32)	10.22 (1.98)	9.64
" 0	"	(-)10%	8.77 (-0.15)	8.74 (0.53)	8.25
" (+)10%	"	(-)10%	8.13 (-0.82)	8.10 (-0.13)	7.65
" (-)15%	"	0	10.67 (1.71)	10.64 (2.37)	10.03

REMARKS : Figures in ( ) are the indices at the precedent stage of the construction

Table 5-7 Consolidated Statement of Projected Income and Cash-Flow up to 40th Year After Launching (In case of 30-year-amortization with 10-year grace period and 3.5 % p.a. interest as for foreign component)

(L.E. 1.000)

	Income			Outlay					Balance 1)		Accumulated 2)	
Year No.	Charge	Subsidty	Total	MD*	MA**	Interest***	Depreciation****	Total				
1	0	0	0	0	0	293	(0)	293 (293)	-293	(-293)	-2,931	(-293)
2	0	0	0	0	0	293	(27)	293 (320)	-293	(320)	-586	(-613)
3	0	0	0	0	0	293	(41)	293 (334)	-293	(334)	-879	(-947)
4	0	0	0	0	0	293	(101)	293 (394)	-293	(-394)	-1,172	(-1,341)
5	0	0	0	0	0	293	(162)	293 (455)	-293	(-455)	-1,465	(-1,796)
6	0	0	0	0	119	293	(233)	293 (645)	-293	(-645)	-1,758	(-2,411)
7	43	147	190	378	119	293	(256)	790 (1,064)	-600	(-856)	-2,358	(-3,297)
8	51	177	228	391	119	293	(279)	803 (1,082)	-575	(-854)	-2,933	(-4,151)
9	60	207	267	405	119	293	(304)	817 (1,121)	-550	(-854)	-3,483	(-5,005)
10	71	243	314	439	119	458	(323)	1,016 (1,339)	-702	(-1,025)	-4,185	(-6,030)
11	82	280	362	451	119	448	(342)	1,018 (1,360)	-656	(-998)	-4,841	(-7,028)
12	92	317	409	391	119	439	(369)	(1,378)	-540	(-090)	-5,381	(-7,937)
13	101	346	447	401	119	429	(396)	(1,345)	-502	(-898)	-5,843	(-8,835)
14	114	391	505	373	119	419	(415)	991 (1,326)	-406	(-821)	-6,289	(-9,656)
15	126	436	562	386	119	409	(420)	914 (1,334)	-352	(-772)	-6,641	(-10,428)
16	139	480	619	399	119	400	(425)	918 (1,343)	-299	(-724)	-6,940	(-11,152)
17	156	539	695	262	119	390	(429)	771 (1,200)	-76	(-505)	-7,016	(-11,657)
18	173	598	771	280	119	380	(431)	779 (1,210)	+ 8	(-439)	-7,008	(-12,096)
19	190	657	847	298	119	370	(433)	787 (1,220)	60	(-373)	-6,948	(-12,469)
20	214	738	952	319	119	361	(435)	799 (1,234)	153	(-282)	-6,795	(-12,751)
21	236	811	1,042	341	119	345	(437)	805 (1,242)	242	(-195)	-6,553	(-12,946)
22	236	811	1,047	341	119	330	(437)	790 (1,227)	357	(-180)	-6,296	(-13,126)
23	236	811	1,047	341	119	314	(437)	774 (1,211)	273	(-164)	-6,023	(-13,290)
24	236	811	1,047	231	119	300	(437)	760 (1,197)	287	(-150)	-5,736	(-13,440)
25	236	811	1,047	341	119	284	(437)	774 (1,181)	303	(-134)	-5,433	(-13,574)
26	236	811	1,047	341	119	269	(437)	729 (1,166)	318	(-119)	-5,115	(-13,693)
27	236	811	1,047	341	119	253	(437)	713 (1,150)	334	(-103)	-4,781	(-13,796)
28	236	811	1,047	341	119	239	(437)	669 (1,136)	348	(-89)	-4,433	(-13,885)
29	236	811	1,047	341	119	223	(437)	683 (1,120)	364	(-73)	-4,069	(-13,958)
30	236	811	1,047	341	119	208	(437)	668 (1,105)	379	(-58)	-3,690	(-14,016)
31	236	811	1,047	341	119	192	(437)	652 (1,089)	395	(-42)	-3,295	(-14,058)
32	236	811	1,047	341	119	177	(424)	637 (1,061)	410	(-14)	-2,885	(-14,072)
33	236	811	1,047	341	119	162	(410)	622 (1,032)	425	(+15)	-2,460	(-14,057)
34	236	811	1,047	341	119	147	(396)	607 (1,003)	440	(44)	-2,020	(-14,013)
35	236	811	1,047	341	119	131	(336)	591 (927)	456	(120)	-1,564	(-13,893)
36	236	811	1,047	341	119	116	(275)	576 (851)	471	(196)	-1,093	(-13,697)
37	236	811	1,047	341	119	101	(204)	561 (765)	486	(282)	-607	(-13,415)
38	236	811	1,047	341	119	86	(181)	546 (727)	501	(320)	-106	(-13,095)
39	236	811	1,047	341	119	70	(158)	530 (688)	517	(359)	+411	(-12,736)
40	236	811	1,047	341	119	56	(133)	516 (649)	531	(398)	942	(-12,338)
41	236	811	1,047	341	119	49	(114)	509 (623)	538	(424)	1,480	(-11,914)

* Maintenance & Operation
** Maintenance & Administration as for "Head Office"
*** Only as to foreign component
**** Only as to foreign component

1) the figures in ( ) are the one with depreciation for foreign component
2) the figures in ( ) the one with depreciation for foreign component

Table 5-7 Consolidated Statement of Projected Income and Cash-Flow up to 40th Year After Launching (In case of 30-year-amortization with 10 Year grace period and 4.5 % p.a. interest as for foreign component)

(L.E. 1,000)

Year	Income			Outlay					Balance			
	Charge	Subsidy	Total	MO *1	MA *2	Interest *3	Depreciation *3	Total *4	Single year base *4		Accumulated *4	
1	0	0	0	0	0	377	(0)	377 (0)	- 377	(- 377)	- 377	(- 377)
2	0	0	0	0	0	377	(27)	377 (404)	- 377	(- 404)	- 754	(- 781)
3	0	0	0	0	0	377	(41)	377 (418)	- 377	(- 418)	- 1,131	(- 1,199)
4	0	0	0	0	0	377	(101)	377 (478)	- 377	(- 478)	- 1,508	(- 1,677)
5	0	0	0	0	0	377	(162)	377 (539)	- 377	(- 539)	- 1,885	(- 2,216)
6	0	0	0	0	119	377	(233)	496 (729)	- 496	(- 729)	- 2,381	(- 2,945)
7	43	147	190	378	119	377	(256)	874 (1,130)	- 684	(- 940)	- 3,065	(- 3,885)
8	51	177	228	391	119	377	(279)	887 (1,166)	- 659	(- 938)	- 3,724	(- 4,823)
9	60	207	267	405	119	377	(304)	901 (1,205)	- 634	(- 938)	- 4,358	(- 5,761)
10	71	243	314	439	119	589	(323)	1,147 (1,470)	- 833	(- 1,156)	- 5,191	(- 6,917)
11	82	280	362	451	119	577	(342)	1,147 (1,489)	- 785	(- 1,127)	- 5,976	(- 8,044)
12	92	317	409	391	119	564	(369)	1,074 (1,443)	- 638	(- 1,034)	- 6,614	(- 9,078)
13	101	346	447	401	119	551	(396)	1,071 (1,467)	- 624	(-1,020)	- 7,238	(- 10,098)
14	114	391	505	373	119	539	(415)	1,031 (1,446)	- 526	(- 941)	- 7,764	(- 11,039)
15	126	436	562	386	119	526	(420)	1,031 (1,451)	- 469	(- 889)	- 8,233	(- 11,928)
16	139	480	619	399	119	514	(425)	1,032 (1,457)	- 413	(- 838)	- 8,646	(- 12,766)
17	156	539	695	262	119	501	(429)	882 (1,311)	- 187	(- 616)	- 8,833	(- 13,382)
18	173	598	771	280	119	489	(431)	888 (1,319)	- 117	(- 548)	- 8,950	(- 13,930)
19	190	657	847	298	119	476	(433)	893 (1,326)	- 46	(- 479)	- 8,996	(- 14,409)
20	214	738	952	319	119	464	(435)	902 (1,337)	+ 50	(- 385)	- 8,946	(- 14,794)
21	236	811	1,047	341	119	444	(437)	904 (1,341)	143	(- 294)	- 8,803	(- 15,088)
22	236	811	1,047	341	119	424	(437)	884 (1,321)	163	(- 274)	- 8,640	(- 15,362)
23	236	811	1,047	341	119	404	(437)	864 (1,301)	183	(- 254)	- 8,457	(- 15,616)
24	236	811	1,047	341	119	384	(437)	844 (1,281)	203	(- 234)	- 8,254	(- 15,850)
25	236	811	1,047	341	119	365	(437	825 (1,262)	222	(- 215)	- 8,026	(- 16,065)
26	236	811	1,047	341	119	345	(437)	805 (1,242)	242	(- 195)	- 7,784	(- 16,260)
27	236	811	1,047	341	119	326	(437)	786 (1,223)	261	(- 176)	- 7,523	(- 16,436)
28	236	811	1,047	341	119	306	(437)	766 (1,203)	281	(- 156)	- 7,242	(- 16,592)
29	236	811	1,047	341	119	287	(437)	747 (1,184)	300	(- 137)	- 6,942	(- 16,729)
30	236	811	1,047	341	119	267	(437)	727 (1,164)	320	(- 117)	- 6,622	(- 16,846)
31	236	811	1,047	341	119	247	(437)	707 (1,144)	340	(- 97)	- 6,282	(- 16,943)
32	236	811	1,047	341	119	228	(424)	688 (1,112)	359	(- 65)	- 5,923	(- 17,008)
33	236	811	1,047	341	119	208	(410)	668 (1,078)	379	(- 31)	- 5,544	(- 17,039)
34	236	811	1,047	341	119	189	(396)	649 (1,045)	398	(+ 2)	- 5,146	(- 17,037)
35	236	811	1,047	341	119	169	(336)	629 (965)	418	(82)	- 4,728	(- 16,955)
36	236	811	1,047	341	119	150	(275)	610 (885)	437	(162)	- 4,291	(- 16,793)
37	236	811	1,047	341	119	130	(204)	590 (794)	457	(253)	- 3,834	(- 16,540)
38	236	811	1,047	341	119	111	(181)	571 (752)	476	(295)	- 3,358	(- 16,245)
39	236	811	1,047	341	119	89	(158)	549 (707)	498	(340)	- 2,860	(- 15,905)
40	236	811	1,047	341	119	71	(133)	531 (664)	516	(383)	- 2,344	(- 15,522)
41	236	811	1,047	341	119	63	(114)	523 (637)	524	(410)	- 1,820	(- 15,112)

*1 : Maintenance and operation
*2 : Management and administration as for "Head Office"
*3 : Only as to foreign component
*4 : The figures in () are the one with depreciation for foreign component.

Table 5.8. Statement for Projected Balance Sheet (In case of 30-year-amortization with 10-year grace and 3.5 % p.a. interest as for foreign component)

(L.E. 1,000)

	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th	21th
Assets																					
Fixed assets:																					
Project in service		1,006	3,778	7,031	11,717	16,361	20,463	22,381	24,373	26,144	27,646	29,268	31,212	33,145	34,552	35,421	36,300	37,388	38,270	39,158	40,046
Depreciation (-)		34	94	112	160	160	142	69	69	61	52	56	67	67	49	31	31	37	31	31	31
Net fixed assets in service		972	3,684	6,919	11,557	16,201	20,321	22,321	24,304	16,083	27,594	29,212	31,145	33,078	34,503	35,390	36,277	37,351	38,239	39,137	40,015
Construction in progress	1,006	2,806	3,347	4,798	9,804	4,262	2,060	2,061	1,840	1,563	1,674	2,000	2,000	1,474	918	918	1,111	919	919	919	919
Total	1,006	3,770	7,031	11,717	20,463	23,381		24,373	26,144	27,646	29,268	31,212	33,145	34,552	35,421	36,300	37,388	38,270	39,158	40,046	40,934
Current assets:																					
Cash & account receivable							190	228	267	314	362	409	447	505	562	619	695	771	847	952	1,047
Total assets	1,006	3,778	7,031	11,717	16,361	20,463	22,571	24,601	26,411	27,960	29,630	31,621	33,592	35,057	35,983	36,927	38,083	39,041	40,005	40,998	41,981
Liabilities																					
Long term debt (foreign loan)	402	822	1,242	3,054	4,876	7,019	7,451	7,884	8,381	8,800	8,980	9,606	10,232	10,640	10,653	10,666	10,756	10,769	10,782	10,795	10,800
Current liabilities																					
Total liabilities	402	822	1,242	3,054	4,876	7,019	7,451	7,884	8,381	8,880	8,980	9,606	10,232	10,640	10,653	10,666	10,756	10,769	10,782	10,795	10,800
Equity																					
Central Government																					
Construction Subsidities:	604	2,990	5,917	8,903	11,885	14,004	15,632	17,260	18,603	19,067	21,241	22,615	23,909	25,055	25,960	26,865	27,806	28,792	29,698	30,604	31,510
1. Interest	293	586	879	1,172	1,465	1,750	2,051	2,344	2,811	3,278	3,726	4,164	4,592	5,010	5,419	5,018	6,207	6,586	6,950	7,298	7,630
2. MD cost							378	769	1,174	1,613	2,064	2,455	2,856	3,229	3,615	4,014	4,276	4,556	4,854	5,173	5,514
3. Operation expenses			119	238	357	476	595	714	833	952	1,077	1,190	1,309	1,428	1,547	1,666	1,785	1,904	2,023	2,142	2,216
Total	897	3,576	6,915	10,313	13,707	16,238	18,656	21,087	23,421	15,710	28,102	30,424	32,746	34,722	36,541	38,361	40,154	41,838	43,525	45,217	46,915
Retained earning	-293	-506	-879	-1,172	-1,465	-1,758	-2,051	-2,344	-2,811	-3,278	-3,726	-4,164	-4,592	-5,000	-5,419	-5,818	-6,207	-6,586	-6,950	-7,298	-7,630
1. Interest							-370	-769	-1,174	-1,613	-2,064	-2,455	-2,856	-3,299	-3,615	-4,014	-4,276	-4,556	-4,854	-5,173	-5,514
2. MD cost			-119	-238	-357	-476	-595	-714	-833	-952	-1,071	-1,190	-1,309	-1,428	-1,547	-1,666	-1,785	-1,904	-2,023	-2,142	-2,261
3. Operation expense		-34	-120	-240	-400	-500	-702	-771	-840	-901	-953	-1,009	-1,076	-1,142	-1,192	-1,223	-1,254	-1,291	-1,322	-1,353	-1,284
4. Revenue							190	228	267	314	362	409	447	505	562	619	695	771	847	952	1,047
Total	-293	-620	-1,126	-1,650	-2,222	-2,794	-3,356	-4,370	-5,391	-6,430	-7,452	-8,409	-9,386	-10,305	-11,211	-12,102	-12,827	-13,566	-14,302	-15,034	-15,742
Total equity	604	2,956	5,789	8,663	11,485	13,444	15,120	16,717	18,030	19,200	20,650	22,015	23,360	24,417	25,330	26,261	27,327	28,272	29,223	30,203	31,173
Total liabilities & Equity	1,006	3,778	7,031	11,717	16,361	20,463	22,571	24,601	26,411	27,960	29,630	31,621	33,592	35,057	35,983	36,927	38,083	39,041	40,005	40,998	41,981

Table 5.8. Statement for Projected Balance Sheet (In case of 30-year-amortization with 10-year grace and 4.5 % p.a. interest as for foreign component)

(L.E. 1,000)

	1st Year	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th	14th	15th	16th	17th	18th	19th	20th	21th
Assets																					
Fixed assets :																					
Project in service		1,006	3,778	7,031	11,717	16,361	20,463	22,381	24,375	26,144	27,646	29,268	31,212	33,145	33,552	35,421	36,308	37,388	38,270	39,158	40,046
Depreciation (-)		34	94	112	160	160	142	69	69	61	52	56	67	67	49	31	31	37	31	31	31
Net fixed assets in service		972	3,684	6,919	11,557	16,201	20,321	22,312	24,306	26,083	27,594	29,212	31,145	33,078	34,503	35,390	36,277	37,351	38,239	39,127	40,015
Construction in service	1,006	2,806	3,347	4,798	9,804	4,262	2,060	2,061	1,840	1,563	1,674	2,000	2,000	1,474	918	918	1,111	919	919	919	919
Total	1,006	3,778	7,031	11,717	16,361	20,463	23,381	24,373	26,144	27,646	29,268	31,212	33,145	34,552	35,421	36,308	37,388	38,270	39,158	40,046	40,934
Current assets :																					
Cash & account receivable							190	228	267	314	362	409	447	505	562	619	695	771	847	952	1,047
Total assets	1,006	3,778	7,031	11,717	16,361	20,463	23,571	24,601	26,411	27,960	29,630	31,621	33,592	35,057	35,983	36,927	38,083	39,041	40,005	40,998	41,981
Liabilities																					
Long term debt (foreign loan)	402	822	1,242	3,054	4,876	7,019	7,699	8,380	9,127	9,689	10,253	11,068	11,884	12,443	12,606	12,770	12,893	12,940	12,987	13,035	13,084
Current liabilities																					
Total Liabilities	402	822	1,242	3,054	4,876	7,019	7,699	8,380	9,127	9,689	10,253	11,068	11,884	12,443	12,606	12,770	12,893	12,940	12,987	13,035	13,084
Equity																					
Central Government																					
Construction	604	2,990	5,917	8,903	11,885	14,004	15,632	17,260	18,603	19,867	21,241	22,615	23,989	25,055	25,960	26,865	27,886	28,792	29,698	30,604	31,510
Subsidies																					
1. Interest	377	754	1,131	1,508	1,885	2,262	2,639	3,016	3,605	4,194	4,770	5,334	5,885	6,424	6,950	7,463	7,964	8,452	8,921	9,370	9,799
2. MO cost							130	273	428	604	791	993	1,204	1,426	1,662	1,910	2,139	2,385	2,649	2,933	3,238
3. Operation expenses			119	238	357	476	595	714	833	952	1,071	1,190	1,309	1,428	1,547	1,666	1,785	1,904	2,023	2,142	2,216
Total	981	3,744	7,167	10,649	14,127	16,742	18,996	21,263	23,469	25,617	27,873	30,132	32,387	34,333	36,119	37,904	39,774	41,533	43,291	45,049	46,808
Retained earning																					
1. Interest	-377	-754	-1,131	-1,508	-1,885	-2,262	-2,639	-3,016	-3,605	-4,194	-4,770	-5,334	-5,885	-6,424	-6,950	-7,463	-7,964	-8,452	-8,921	-9,370	-9,799
2. MO cost							- 378	- 769	-1,174	-1,613	-2,064	-2,455	-2,855	-3,229	-3,615	-4,014	-4,276	-4,556	-4,854	-5,173	-5,514
3. Operation expenses			- 119	- 238	- 357	- 476	- 595	- 714	- 833	- 952	-1,071	-1,190	-1,309	-1,428	-1,547	-1,666	-1,785	-1,904	-2,023	-2,142	-2,261
4. Depreciation		- 34	- 128	- 240	- 400	- 560	- 702	- 771	- 840	- 901	- 953	-1,009	-1,076	-1,143	-1,192	-1,223	-1,254	-1,291	-1,322	-1,353	-1,384
5. Revenue							190	228	267	314	362	409	447	505	562	619	695	771	847	952	1,047
Total	-377	-788	-1,378	-1,986	-2,642	-3,298	-4,124	-5,042	-6,185	-7,346	-8,496	-9,579	-10,697	-11,719	-12,742	-13,747	-14,584	-15,432	-16,273	-17,066	-17,911
Total equity	604	2,956	5,789	8,663	11,485	13,444	14,872	16,221	17,284	18,271	19,377	20,553	21,706	22,614	23,377	24,157	25,190	26,101	27,018	27,963	28,897
Total liabilities & equity	1,006	3,778	7,031	11,717	16,361	20,463	22,571	24,601	26,411	27,960	29,630	31,621	33,592	35,057	35,983	36,927	38,083	39,041	40,005	40,998	41,981

the social democratic goal. Any assets of the project which would be established by the fund should, therefore be ultimately imputed to the state.

(b) For the project itself, in this regard, the necessitiated financing is limited for the expense directly and actually required to operate the project. i.e. MO cost and management and administartion cost. In addition, if any others must be taken into account, the interest as for foreign component must be charged for the project. The relation of the state and project area is likely 'house-renter and tenant". The latter should have the obiligation to pay some as the least house-rent for the former. The same can be said for the depreciation of the foreign portion of the project cost, if the financing capability in the project might be able to bear it.

(c) The rate of interest would, if the project might be able to bear its payment as to foreign component, be applied 4.5% p.a. which is referred to mid. of the lpwest level on interest rate in case of birateral lending agency.

(d) The statements for income and cash-flow should, consequently, be consolidately made the entry in one format. They are so closely combined in the project, since the prospective income sources are merely from the government subsidy and sewer-charge, that the individual statement for each of them is apparently uncalled-for.

(e) The statement for balance of payment should, however, be entirely covered the flow and/or movement of the project account. The coverage would be set its term up to the year 2005 as ordained by the Scope of Work.

As for the possible and/or proposed charege for sewer, for which absolutely nonentity at the present in not only the Study Area but also the entire of A.R.E. are assumingly reckonned referring to the present relation in/between the volume of potable water supply and the record of charge-collection on it. (Rfere to Appex. Table.V-27) The construction cost for transh facilities and sucking cost of sewerage are also referred to the possible and/or proposed sewer-charge. The comparison between the depreciation of transh and the sewer-charge would particulary be taken into account. In the meantime, the National Organization for Potable Water and Sanitary Drianage (NOPWASD) of A.R.E is now studying introduction of a sort of sewer-charge. * The study conducted

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* Information given at the meeting with Gen. Hazan El Abd, Chairman of NOPWASD, on August 29th 1984.

by NOPWASD is also regarded in the computation.(Details, refer to Appendix 5.6.).

Acoording to the principle of the " willingness to pay ", another essential factor in seeking the possible and/or proposed sewer-charge consists in the condition of private income and household income. The basic salary or wage in the Study Area seems to be not high, but it affords the qualifiable privilege as a sort of incentive wage system. (Refer to the marginal of Appex. Table V-10). Also, as a common specific in living throughout the A.R.E., the household income is composed of multi-lateral sources. (Refer to Appex. Table V-12) Furthermore, among the household expenditure, the payment for utilities concerned is minor. i.e. 6.4% if included public transportation and medical care. (Refer to Appendix 5.6. and Table V-23).

In connection of cash-outflow reckonned in the statement, the operating expense or the account payable, e.g. expense for salary or wage, should be prepared in accordance with the possible and/or proposed management fuction, where the most desirable operation would be economically and technically suggested, for which the following section 5.4.2. of the Chapter entitled Mnagement Fuction precisely discusses.

The summary of computation in which the above conditions are incorporated is as the follows.

(a) An appropriate and reasonable sewer-charge might be LE 5.61 p.a. per capita, at 1984 price.
(b) Additional LE 3.91 p.a. per capita would be required to subsidize sewer-charge, which is just equivalent to the present level of NSG budget for sewerage.
(c) The assumed cash-flow would be turned from deficit to surplus at the 20th year in case of the yearly account and at the 45th year in case of the accumulated account. After launching the project, respectively, if the depreciation for the portion of foreign component might be disregarded (if regarded, the deficit would terminate at the 68th year in the latter case).

5.3. ECONOMIC ANALYSIS

5.3.1 Scope

The works assigned upon the economic analysis are to appraise the contribution of the project in return for spending capital, material and manpower which are the resources of the state and the people. The analysis should, therefore, be processed at the base of national economy. To meet the foreign component, for instance, the domestic component must be appraised at the base of international dealing. Accordingly, tax and subsidy of the domestic component should be excluded from the calibration, since they are merely transference of the monetary asset in/ between the state and the people. The same approach to the calibration should be applied in case of the benefit.

The appraisal also requires the analysis to diversify the domestic component by capital equipment, labour and others such as management and administration (MA) expenses, respectively, which should have different actual value individually from the point of view of international level, at the basis as border-price in other words. To meet such requirement, a conversion factor is prevailingly adapted. In the Chapter, the conversion factors for them quot the figures circumspectly prepared and precisely computed by the World Bank in corporation with the Institute for National Planning of A.R.E.. The figures, however, are computed in 1982 so that the re-examination must be needed to adapt. (Details, refer to Appex. 5.7)

The prerequisite conditions for OCC and the project-life as well as the targeted-year necessary for working out of B/C, NPV and Economic Internal Rate of Return (EIRR) are as the same as in case of the financial analysis. In addition, taking into account of the difference of interest by endogeneous fund and exogeneous one, the consolidated computation of the project cost multiplying domestic and foreign components with their individual interest, i.e. domestic 13% and foreign 4.5 %, should be processed and be confronted to the project benefit too. The consolidated computation is also conducted in the sensitivity analysis as for the optimum plan.

5.3.2. B/C, NPV, EIRR

Comuptation for the cost versus the benefit at the base of economic account indicates the concluded indices of B/C, NPV and EIRR as the following Table 5 - 9 . (Details, refer to Appex. Table V-34 to V-36).

Table 5 - 9

Concluded Indices
of the Economic Analysis

	B/C	NPV *	EIRR
Scheme 1	0.59 (0.19)	(-) 9,611 (- 14,702)	8.77 (- 0.52)
Scheme 2	0.59 (0.22)	(-) 10,273 (- 15,451)	8.72 (0.44)
Scheme 3	0.55	(-) 12,613	8.75

* LE 1,000

Remarks : discounted at 13%.
figures in ( ) are the assumed indices at the precedent stage of the project.

5.3.3. Sensitivity Verification

Computation for the sensitivity analysis is precessed in accordance with the methodological approach in the same case of the financial analysis. Namely, the oscillated conditions are ranged from (±) 5% to (±) 15% by 5% cutting-input for both of the cost and the benefit, respectively. The concluded key-indices of the sensitivity analysis are such as shown in Table 5-10 (For details refer to Appendix Tables V-37 to 39).

As indicated in the Table 5-10 , the computation brings forth the simular result as in case of the financial analysis. Namely, Scheme 2 should suggest to be finally selected of as the optimum plan. To reconfirm the suggestion, as discussed in 5.3.1. in this section, the concluded indices of Scheme 2 should be re-examined by the con-

Table 5 - 10

Concluded Key-Indices of the Sensitivity Analysis

As for B/C

		Scheme 1	Scheme 2	Scheme 3
Cost(-)10%	Benefit(±) 0	0.66	0.65	0.61
" 0	" (-)10%	0.53	0.53	0.50
" (+)10%	" 0	0.54	0.53	0.50
" 0	" (+)10%	0.53	0.64	0.61
" (+)10%	" (-) 10%	0.48	0.48	0.45
" (-)15%	" 0	0.69	0.68	0.65

As for EIRR

Cost(-)10%	Benefit(±) 0	9.58	9.52	9.45
" 0	" (-)10%	7.98	7.95	8.08
"(+)10%	" 0	8.05	8.02	8.14
" 0	" (+)10%	7.98	9.45	9.39
" (+)10%	" (-)10%	7.23	7.25	7.48
" (-)15%	" 0	10.02	9.52	9.84

solidated computation involving/multiplying different interest by domestic and foreign component, respectively, in the project cost. The indices are that B/C shows 0.51 and EIRR indicates 8.73.

5.4. INSTITUTIONAL ARRANGEMENT

5.4.1. Legal Arrangement

There are two aspects must be especially considered to arrange the legal matter in supporting the project and in securing its operation. The one is law, ordinance, resolution etc. which would support and guarantee the project from the point of view of legal aspect. The other is publicity of the project, through which inhabitants in the project area would be able to recognize the necessity and/or importance of systematic sewerage function.

The publicity, public advertisement in other words, is absolutely needed, since inhabitants in the project area have no experience of systematic sewer facilities and their effectiveness at all. For maiantenance/operation and management/ administration of sewer system, even for construction itself, they should completely

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° Law No. 93/1962 : drainage of liquide waste
° Resolution No. 649/1962 : drainage of liquide waste metrials. Ministry of Housing and Utilities
° Law No. 38/1967 : public sanitation
° Resolution No. 134/1967 : public sanitation. Ministry of Housing and Utilities
° Resolution No. 134/1968 : public sanitation : Ministry of Housing
° Law No. 31/1976 : public sanitation
° Law No. 27/1978 : organization of public sources of potable water and water for human use
° Law No. 48/1982 : protection of the river Nile and water-course of the spots
° Resolution No. 8/1983 : protection for the river Nile and water-course from pollution

understand the reason why needed and the function how operated, otherwise they might hesitate to pay for the sewer-charge and might spoil the facilities.

Conceptually, the same may be able to say in the legal aspect. The files of law for sewerage and drainage of A.R.E. show various laws and/or resolutions as indicated in the marginal. For instance, the order to prohibit immoderate discharge of liquide waste is definitely proclaimed even in the old law issued two decades ago. The inhabitants seem, however, to pay almost no attention for the order and to immoderately strew foul wastewater filled in backet without hesitation on the open street. The reason why is that they have had no systematic sewer facilities yet in one hand and they have had almost no knowledge about the importance and the necessaity of the facilities in the other hand. In this regards, the publicity to inhabitants might be necessary even on the legal aspect, too.

In general, the existing laws and/or resolutions would be sufficient to promote the project and secure the facilities or system. Fot the details, however, some regulations should be additionally required at the Governorate level.

(1) For scrapping and burying disused transh.

The transh located within the sewer networks should be scrapped and buried during certain period after the completion of the system. There is fears of collapse of ground or cause of disease in the disused transh with no maintenance.

(2) For preferential easement to develop the sewer system.

The authorization for preferential easement of land and/or right-of-way acquisition necessary for development and ensurance of the sewer system should be required. A sort of penal regulations in case of violation for the system should be arranged, too.

(3) For enforcement maintaining touristic environment.

From the point of view of not only mere natural value as healthy resort area but also monetary value as tourism industry, the equipment of sewer system should be obligated to furnish with the project area, particulary in resort coast. Accordingly, a clarification such as definition and guide-line for maintaining level of touristc environment should be arranged.

(4) For regulation of discharging waste water quality.

Aside of the general restriction proclaimed in the existing laws or regulations

for discharging waste water quality, a sort of regional regulation on it in relation with the specific characters of areal behavier in living and industry should be required. It is apprehended that a condensed liquide disposal together with unhygienic elements, which are often generated from not only industrial activities but also even medical cares, would cause impediment to the facilities and the operation of sewer system, particulary in the treatment plant. (as for the desirable conditions for the treatment plant, refer to the Chapter Three 3.6 and 3.7)

5.4.2. Management Function

Figure 5 - 3 would clarify the desirable structure of management and administration of the project under the optimum plan, Scheme 2. The Table 5-11 is placement of personnel with duties. The allocation of budget by job and by classification, of which is already incorporated in the statements for cash-flow and balance of payment, are summarized as shown below. The allocation is reckonned except an occasional part-timer if any.

It should be prerequisitely noted that the placement hesitates to discuss the problem whether the project should be deal with other water resources activities as the one integrated organization or not. Also, the budget allocated in this section is strictly limited in the " Head Office " concerned and excludes the direct cost of construction and maintenance of the project development.

(1) Allocation of budget, by job and classification.

(Classified level)	(Basic monthly salary)	(No. of persons)
Manager	LE 170	1
Assistant Manager	150	1
Division Chief	130	3
Section Chief	110	10
Officer (as level)	90	15
Assistant Officer (as level)	70	3
Worker	50	12

Remarks : salary assumed referring to Appex. Table V-10

(2) Total p.a. budget for the proposed " Head Office ".

Personnel Salary	LE 47,640	(40%)
Management and Administration (including incentive-wage and/or fringe benefit)	LE 47,640	(40%)
Fixed Expense (including rent/maintenance of offices if any)	LE 23,820	(20%)
p.a. total	LE119,110	(100%)

Remarks : structural composition is referred to Appex. Table V - 10 and V - 40

Figure 5.3.

Outline of Structure
for Sewer-System Organization

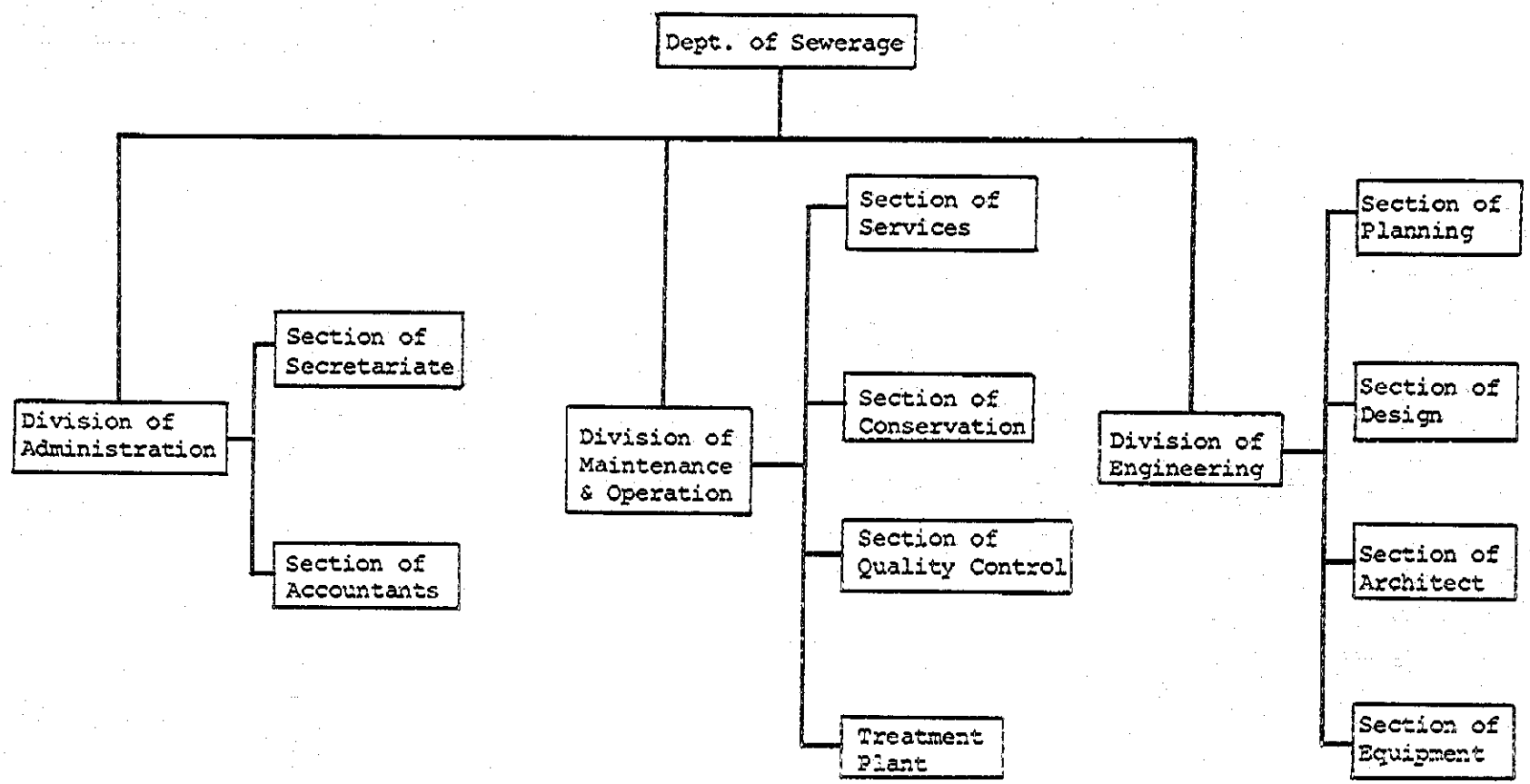

Table 5 - 11

Personnel Placement and Duties

(Job Category)	(Classification)	(No. of Persons)	(Duties)
General Management & Administration	Manager	1	Coverage for all functiom of the Dept. in charging final responsibility
	Assist. Manager	1	Assist Manager for the details of the Dept.'s activities
Engineering Division	Division Chief	1	Coverage for physical development of planning & construction
Planning Section	Section Head Technician	1 1	Coverage for planning with examination for application/construction of sewer facilities
Design Section	Section Head Designer Draftman	1 1 1	Coverage for design with examination of equipment & materials
Architectonic Section	Section Head Architect Technician	1 1 1	Coverage for civil engineering with examination & inspection of technical aspect
Equipment Section	Section Head Assist. Engineer Technician	1 1 1	Coverage for equipment including electoric concerned
Maintenance & Operation Division	Division Chief	1	Coverage for maintenance & operation
Treatment Plant	Section Head Technician Worker	1 2 12	Coverage for maintenance & operation of treatment plant with continuous data/information collection
Quality Control Section	Section Head Technician	1 1	Coverage for continuous collection, investigatioon and analysis of sewer & water in treatment plant
Conservation Section	Section Head Technician	1 2	Coverage for maintaining sewer system with collection of damage/violation data
Services Section	Section Head Assist. Accountant Clark	1 1 1	Coverage for accounting sewer-meter with publicity activities on sewer system

Administration Division	Division Chief	1	Coverage for administrative & secretariat works
Accountants Section	Section Head	1	Coverage for budget/ finance/settlement of accounting, with supervision of charge collection
	Budget Officer	1	
	Assist. Accountant	1	
Secretariate Section	Section Head	1	Coverage for documentation/personnel placement/ payment/welfare of the Dept.
	Personnel Officer	1	
	Legal Officer	1	

5.5. Socio-Environmental Outlook

The most obvious impact of the project will be the improvements expected in the public health of the residents of El-Arish and its surrounding areas through the provision of the new sewerage system. All the wastewaters currently infiltrated into the ground will be shut off and collected by the sewers, and finally treated at the treatment plant to the level acceptable to the environ and reuse purpose, thereby the danger of the groundwater contamination that has already become a deplorable level will be greatly reduced. All the sewage treatment plant effluent will is planned to be reused for irrigation of crops or other purposes as required and no effluent will be directly discharged either to the Wadi or the sea. On account of this, it is expected that the overall environmental impact of the sewerage system will be positive.

Presently the agricultural production is essentially limited to only rainy season operation in the project area. The project will provide a sewage treatment plant which can produce a quantity of some 20,000 m^3/day new water source for irrigation and possibly for industrial purposes. The estimated quality of the treatment plant effluent shows that its characteristics may not cause significant adverse effects to the crop growing, if the treatment plant is properly operated and suitable crops are selected for sewage reuse.

The quality of the treated sewage effluent is important both for the health of farmers in contact with it and for particular application for which it is used. Although the treatment plant effluent is in general safer than the raw sewage, care must be taken to protect the health of farmers from the possible risks. The possibility of transmitting certain parasites or dieases through cattle that gaze on pastures irrigated with the treated sewage should be investigated when the proposed experimental farm is made available.

Since the sewage treatment plant construction site is selected at an isolated area several kilometres removed from the residential and commercial districts of the city, the impact to environ by the treatment facilities will not be significant. Construction activities of the treat-

ment plant may not affect to the nearby farmers and residents. Noise and vibration to be caused by the excavations, pillings, construction equipment may not be untolerable level in view of the isolated location of construction.

In planning and design of the treatment plant facilities, particular care must be taken to prevent and control unwanted and annoying odours, sound and vibration which might be originated in the treatment plant facilities.

In abating odours from the facilities, a consideration was given to the configuration of the plant facilities, locating such units as grit chambers and other odour creating facilities as far as practicable away from the residences or other facilities with due consideration on wind direction. Odour levels expected at the treatment plant site boundary have been found to be within acceptable levels.

In reducing the noise at the sources, consideration was given in planning and design of the facilities. Shielding and improving the muffling of combustion engines and compressors, restricting the operation of noise-producing equipment to certain hours of the day, and improving vibration characteristics of equipment are the major counter measures to reduce the noise level from the plant. In addition, the treatment plant site will be provided with solid barriers, planting of belts of trees and other vegitation receiving the effluent, and the use of sound-proof materials and shape of building exteriors, which are measures that reduce the propagation of sound.

Excavations for sewers and pumping stations throughout the project area will cause traffic interruption for several years, however, this problem can be avoided as much as possible by the well scheduled construction programmes. The excavations may also cause soil erosion, but such erosion will be limited by minimizing excavation on steeply sloping the land and by requiring reasonable soil conservation measures by the contractors.

In view of the above conditions, the overall environmental impacts of the sewerage system is expected to be positive.

CHAPTER-SIX

CONCLUSIONS AND RECOMMENDATIONS

Chapter Six

Conclusions and Recommendations

6.1. JUSTIFICATION

The proposed project for 1985 - 2005 represents the least cost alternatives to meeting El-Arish City's sewerage, drainage and water reuse needs, defined as improved sanitation for all the city's residents and tourists and an adequate treatment plant effluent arrangement for irrigation purpose. This feasibility study has confirmed this finding of the previous investigations and studies for these major elements of the project:

a) Sewer and pumping stations; For households with water connections should be provided with the least cost sewers and intermediate sewage pumping stations which removes both excreta and sullage. The system is proposed to commence its design and construction from 1985 and complete its First Stage Programme in 1992. The Second Stage construction is scheduled to start in 1993 and last until 2005. For the First Stage project a sewer network of 402.59 ha to serve 50,500 people at the end of 1992. By the end of 2005, the system is planned to cover a total area of 1,000 ha (including Masaid district) with an estimated served population of 150,000.

b) Sewage treatment and disposal; The proposed oxidation ditch sewage treatment plant, discharging the effluent to Jarada experimental farm land should be constructed. The plant effluent is planned to be utilized for irrigation of crops in the experimental farm lands to obtain experience and knowledge with regard to the effective reuse of the effluent for crop irrigation. For the experimental farm, totally 12 feddan land is required.

c) Stormwater drains; For Masaid district, a stormwater infiltration basin system is proposed, whereas for El-Arish district a stormwater transh system is proposed, to eliminate the stormwater stagnation in the area.

The First Stage Programme is estimated to cost L.E. 25,144,000 at the mid-1984 price level, of which L.E. 7,884,000 (31.4 %) represents foreign exchange costs. The overall project cost up to the end of 2005 is estimated to be L.E. 42,318,000 of which foreign cost is L.E. 10,808,000 or 25.5 per cent of the total cost.

The project has FIRR and EIRR of 9.47 per cent and 8.72 per cent, respectively.

6.2. RECOMMENDED ACTIONS

Detailed actions necessary to implement the project are described in Chapters Four and Five and associated Appendices. Several steps are essential if the project is to be successfully and efficiently implemented.

(a) The National Organization for Potable Water and Sanitary Drainage must approve the project.

(b) Approval of the project must be obtained from the agencies concerned, Arab Republic of Egypt.

(c) Project finance must be arranged by the North Sinai Governorate, from the Ministry of Finance for local currency costs and from international lending agency/agencies for foreign currency costs.

(d) The necessary changes in institutional responsibilities for the sewerage and drainage must be implemented as soon as possible to enable the North Sinai Governorate to control and implement the project.

(e) The North Sinai Governorate's organization must be modified and strengthened, with extensive training and retraining of staff.

(f) Preliminary steps must be taken towards acquiring the land necessary for the sewage treatment plant, pumping stations and farm land for water reuse.

(g) Necessary actions must be taken to implement a project for providing irrigation farm lands with auxiliary facilities as soon as possible so that the treated sewage of approximately 10,000 m^3/day can be effectively utilized.

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