3-2-2 Ground Water Level and Ground Water Quality

(1) Ground Water Level

According to the existing soil report, the capillarity pressure (piezometer level) of the principal underground aquifers that occur in the west bank zone of the Nile River fluctuates by the effects of changes in the water level of the Nile, seepage water from the canal, water drawn from wells, leakage from the water supply pipes and sewer pipes, and is reported to reach its highest in December and lowest in July and August.

The ground water level of this Project area is likely to be about 1 to 3m below ground because of the following reasons.

- According to existing soil report, ground water level is about 0.8 to 2.8m below ground.
- The water level of the Nile River has been stable for a long period, (according to the data observed by the Ministry of Public Works and Water Resources between 1984 and January 1988, the water level is almost constant (AD + 16.7 to 17.0m) at the southern end of Roda Island between March and December and changes wildly in January and February, and the difference between the highest high-water level and the lowest low-water level is about 1.8m).
- There is no large well in the Project area.
- Water is constantly supplied from the canal that runs along the side of the Project area.
- There is no large scale underground construction work in the vicinity.

(2) Ground Water Quality

According to existing soil data, the quality of ground water seems to be roughly as follows.

- Sulphate content, total SO3 : about 0.1%
- Chloride content, total CL : about 0.1 to 0.2%
- pH : about 8.0 to 8.5

3-2-3 Temperature and Rainfall

Although the climate in Egypt as a whole is a desert climate, it may be subdivided by area into a Mediterranean climate, Pacific climate, Nile Delta climate, and Continental Desert climate.

Generally it is fairly cold in Winter and extremely hot in summer. Greater Cairo belongs to the Sub-tropical climate, but because of the characteristic of the Nile Delta climate, the difference in temperature between day and night is large.

According to existing recorded data the mean annual temperature of Greater Cairo is 21.8°C, with the Winter (November to March) mean temperature being about 16°C, the Summer (May to September) mean temperature being about 21°C, and the maximum Summer temperature being 40°C to 45°C. The temperature fluctuation between day and night is extreme.

The mean annual precipitation in the areas along the Mediterranean Sea is around 190mm, while in the Greater Cairo area it is about 25mm. Precipitation in some areas is the locally concentrated heavy downpour type, which sometimes causes damage. The humidity is quite low, the annual mean being 53% with the lowest mean of 40% in May and the highest, 62% in November.

Sandstorms occasionally sweep across Cairo City from the west in March and April. The wind speed is around 9m/sec on average. Mist occurs about 11 days in a year in Cairo City, ordinarily in the early Spring and early Summer.

3-3 Infrastructure Conditions

3-3-1 Omrania West

(1) Dwelling

Most buildings in this Project area are dwellings while there are only a few shops.

The buildings are 4 to 6 stories high, and although the columns, beams and slabs are made of concrete, the walls are made of concrete bricks which may not have adequate strength.

Judging from the new buildings under construction, the foundation work is considered to be mat (no pile) foundation. In this case, great care is necessary when excavating near these foundations in order to construct vertical pits and lay pipes.

(2) Road

1) Roads between Port Alexandria and the project site

Port Alexandria is located approximately at the boundary where the hilly zone meets the Nile Delta zone, and the project area is connected to Alexandria by the two major trunk roads; Desert Road and Agriculture Road.

Of the two, Desert Road has the following characteristics and is usually used in transporting construction materials and equipment.

- The road width and the median strip are wider.
- The distance is shorter by a few tens of km.
- The traffic volume is smaller.
- It has neither a flyover nor a bridge.
- The road has very few intersections with branch roads, and seldom passes through cities and towns.
- The road surface is well paved.

- There is little danger of cattle and donkeys crossing the road.

2) Roads around the project area

The Project area is connected with Pyramid Road and King Faisal Road which are the trunk roads of Greater Cairo. The roads are wide and paved for their entire lengths.

3) Roads within the Project area

The road widths within the project area are as shown in Table 3-3. With the exception of Orouba Street, all other roads are paved. The state of congestion on each road is as follows.

a) Amina Mohamed Street

The street is considerably congested due to heavy traffic of automobiles, horse drawn carts and pedestrians.

b) Talatiny Street

- Traffic of automobiles, horse drawn carts and pedestrians is relatively light in the section between Orouba Street and Amina Mohamed Street. Only a few cars are parked and a small amount of waste is discharged on the roadsides.
- The section between Amina Mohamed Street and Zomor Canal Street is crowded with many small shops lining both sides of the street, and traffic of automobiles, horse drawn carts and pedestrians is heavy. Also, many cars are parked along the street.

c) Hospital Street

- Traffic of automobiles, horse drawn carts and pedestrians is relatively light in the section between Abdo Mansour Street and Taameer Street. Only a few

cars are parked and very little waste is discharged on the roadsides.

- The section between Taameer Street and Zomor Canal Street is crouded with many small shops lining both sides of the street and traffic of automobiles, horse drawn carts and pedestrians is heavy. Also many cars are parked along this street.

d) Orouba Street

- Both sides of the street are lined with residential buildings 3 to 6 stories high. The street is narrow with hardly any sidewalk. The street is not paved and the road surface is considerably rugged.
- There is not much traffic or parking of automobiles and horse drawn carts during the day but a considerable number of private cars seem to be parked at night.

e) Khafraa Street and Fatma Roshdy Street

- Traffic condition is good as traffic of automobiles and pedestrians is light.

f) Zomor Canal Street

- The traffic condition is dense in the section between Hospital Street and Pyramid Street as the traffic of automobiles including buses and horse drawn carts is heavy because of the hospital and the aforesaid shopping center in Omrania West and also dangerous because the automobiles attempt to drive at high speed.
- The intersection of Pyramid Street and Zomor Canal Street demands a sharp angle of approach for automobiles and, in addition, the road width is narrow and the residential side is surrounded by a high wall while the canal side has a shoulder of only about 1m in width.

- There is a plan to install a sewer main of 1,200 to 1,800mm in diameter with an earth covering of about 1.2 to 5.2m in the approximately 920m long section between King Faisal Street and Talatiny Street under USAID.
- The traffic condition between Pyramid Street and King Faisal Street is good as the traffic volume of automobiles and pedestrians is light.

g) Street on the east bank of Zomor Canal

- The traffic condition is good as the traffic volume of automobiles and pedestrians is light.

h) Street on the south side of Tobacco Factory

- A temporary wooden fence is built along the boundary of the construction site of the tobacco factory.
- Only a farm road of about 2.5 to 5m in width exists on the south side of the tobacco factory where the water supply main line is planned to be laid.
- Giza City has formulated a plan to construct a road on the south side of the tobacco factory and has already acquired a 20m wide site between Zomor Canal and the railway on the south side of the temporary fence.

Table 3-3 Width of Each Road

Name of Road	Width
Amina Mohamed Street	Approx. 12m
Talatiny Street	" 24m
Hospital Street	" 25m
Orouba Street	" 7.5 to 10m
Khafraa Street	" 22m
Fatma Roshdy Street	" 13.5m
Zomor Canal Street	" 16m
Street on the East Bank of Zomor Canal	" 5 to 6m
Road on the south side of Tobacco Factory	" 2.5 to 5m

(3) Railway

1) The Cairo-Aswan Trunk Railway runs between the Nile River and Zomor Canal. The railway near the Project area has four tracks, and the distance between outer track beds is about 22.5m as shown on Fig.3-3. Track beds are about 2 meters higher than the farmland along the railway.

2) Its position is indicated by the distance from Cairo Central Station as the point of origin and clearly marked on the electric poles built along the railway.

3) Trains are driven by electrical locomotive but do not run at high speed. Train load seems to be approximately comparable to the train load of the Japanese Railways.

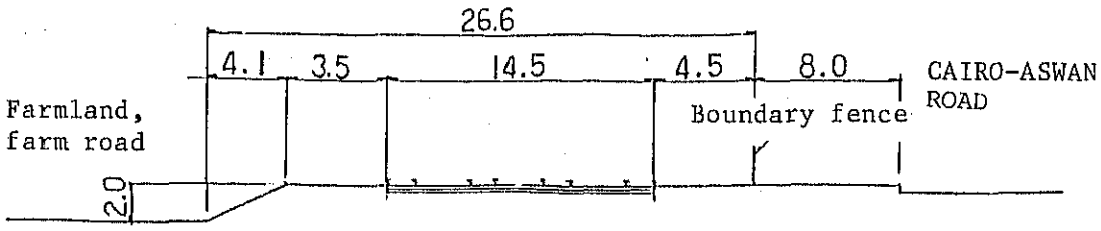


Fig.3-3 Cross Section of Railway

(4) Canal

1) Zomor Canal, for sending irrigation water to the farmlands (Baraguil, Bashit, Komel Ahmar, etc.) in the outskirts of Greater Cairo on the west bank of the Nile River, is built along the eastern side of the project area. The canal is of the dug-in type and has hardly any man-made slope protection work on either bank.

2) The cross section of the canal around the project area is roughly as shown on Fig. 3-4 and there is no plan for its improvement. The canal becomes completely dried up between the middle of January and the middle of February by the lowering of the water level of the Nile River.

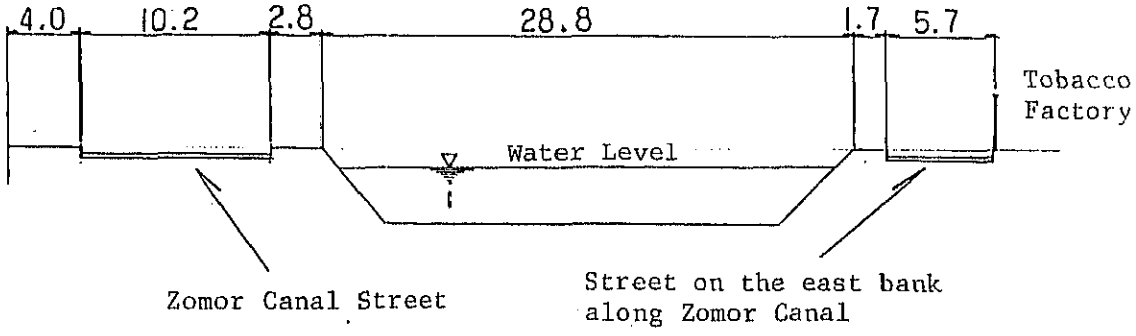


Fig.3-4 Cross Section of Zomor Canal

(5) Port

Port Alexandria is generally used as the port for landing construction materials and equipment shipped from Japan. Suez and Port Said are also available. Port Alexandria has the following characteristics.

- Being a open port it can be used freely.
- Many regular liners from Japan call at the port.
- Unloading can be executed without having to remain long in the port as excellent stevedoring equipment are available.

(6) Water Supply

1) Outline

Water is supplied to the project area from three water works, (one in Giza, in South Giza, and the well fields.) The quantity of water supplied to this area however is not sufficient. Although it is supplied to some extent to individual dwellings, those facing the narrow alleys and blind alleys must receive their supply from public water taps instead of from private taps. The ratio of dwellings supplied by private water taps is considered to be around 80%. The water supply pipelines to this area are 10 to 15 years old since their laying, and some of them were privately laid. The pipeline network is not in a closed system, and as some of the pipes are dead-ended, water pressure is not uniform. Additionally, the diameter of the pipes is not sufficient for the necessary quantity of water demand.

The types of pipe are mostly asbestos pipes which are no longer used in Japan because of reasons of health, but cast iron pipes are also used. Because of this, pipe connection is unsatisfactory which is the major reason of leakage.

The foregoing has given rise to the following problems which are causing a chronic water shortage. Also, as there are no fire hydrants, it is quite dangerous.

- The rate of leakage is reportedly as high as 40%.

- Water is sometimes not supplied to dwellings on the upper stories of buildings during daytime due to low water supply pressure.
- Water supply is frequently suspended particularly during the Summer season.
- Some of the dwellings have laid their own water supply pipelines which could involve technical problems such as leakage.
- The pipeline network is dead-ended so that water pressure is not uniform.
- Some dwellings are using ground water.
- There are no fire hydrants.

2) Depth at which the water main is buried

a) Depth at which the water main is buried

- The earth covering of the existing water main is inferred to be about 1.5m, based on the information received from General Organization of Greater Cairo Water Supply and the actually measured depth at the valve chambers.
- The existing water main that crosses over Zomor Canal near the intersection of Zomor Canal Street and King Faisal Street is of the aqueduct type, and the crown of the pipe is about 80cm higher than the ground surface.

b) Locations of branch pipes, earth covering thicknesses, etc.

- Accurate data on the locations of branch lines, earth covering thicknesses, types of pipe, leakage, etc, are not available.

(7) Sewer Facilities

1) Sewer pipeline

The main roads are provided with manholes and a sewer pipe network. Sewer pipe networks are developed on secondary roads, too, but as they were laid every time the urban district was expanded, the pipeline systems are not uniform. Also, as some of the sewer pipes were laid by the inhabitants at their own expense, it is possible that technical standards have not been observed.

There are manholes which protrude from the road surface or sewer pipes whose protective concrete is exposed above the ground surface. The percentage of sewer service among individual dwellings is considered to be around 94% according to the Report on the Improvement Project undertaken by the World Bank Loan, but judging from the fact that vacuum vehicles are still periodically sucking up sanitary sewage from manholes even on main roads, it seems that the sewer pipelines are not fully achieving their function. In places where the sewer service has not been extended, cesspits made of brick are provided on the road in front of residences, and sanitary sewage is disposed of by calling the vacuum vehicle. Some of the cesspits are overflowing over the road surface and quite unsanitary.

2) Amina Mohamed Pump Station

a) All sewage (including rain water) from Omrania West flows into this pump station.

b) The pump station is a booster station to convey sewage to Zenein Waste Water Treatment Plant and it began service in 1980. The quantity of sewage conveyed now is 250 to 300 liters/sec. (on average).

c) The pump station is located about 260m northward from Talatiny Street along Amina Mohamed Street, and the station is enclosed by a wall (of about 1.5m high). There is a road (about 9.7m wide) in the front (west side), a devastated farmland on the south and east, and residential buildings on the north.

d) Its facilities and equipment are as outlined below.

- Maker	:	AEG, West Germany
- Type of pump	:	Centrifugal pump (Type A 280 SG)
- No. of pumps	:	4 units (3 operation plus 1 stand-by)
- Operation of pump	:	Electrical Motor
- Motor capacity	:	74kw, 100hp
- Power specifications	:	3 phase 3 wire, 380V, 50Hz
- Start and stop	:	Manual operation by means of an on-off button in the local control panel
- Pump house	:	Concrete shed (8.4m x 9.9m)
- Manual chain block	:	1 set
- Grit and trash removing equipment	:	Nil
- Pump well	:	Circular shaped reinforced concrete basin

e) Grit and trash removing situation

The pump station does not have any mechanical equipment for removing grit and trash. The valve (manual) on the inflow pipe provided inside the premises is closed whenever it is necessary to drain the sewage in the pump well by a portable pump in order to remove sediment and trash manually. 5 workers spend about 2 or 3 hours to manually remove the sediment and trash (by scraping with a scoop) at night about twice a month. As there is only one pump well, the conveyance function of

this booster pump station must be stopped during the above work.

Sediment and trash removed as above are piled and left abandoned on the vacant lot adjacent to the pump station. This trash are mostly waste cloths, scrap papers and vinyl sheets.
Abandoned trash generates offensive odor and is the cause for the occurrence of mosquitoes and flies which are undesirable from the viewpoint of health.

Although the existing pump well has a rectangular opening (0.94m wide and 0.94m long) and a circular opening (0.60m in diameter), their dimensions are too small to allow installation of new grit and trash removing equipment.

3) Other existing sewer facilities

a) Sewage collected at Amina Mohamed Pump Station is pumped for about 2km to Aharam Pump Station located northwest of this booster pump, from where it is then conveyed to Zenein sewage treatment plant.

b) As Aharam Pump Station is overloaded now, sewage from Amina Mohamed Pump Station will probably be sent direct to the sewer box culvert which is being planned under USAID in the future.

(8) Commercial Power Supply and Telecommunications

1) Existing underground power cables

According to the Cairo Distributing Company of the project area, the condition of existing underground power cables is as follows.

a) Laying condition of power cables in the project area

Following three types of cables are buried.

Classification	Voltage	Type of cable	Burying method and buried depth
Low tension	380/220V 3 phase 4 wire	Armored cable for direct buried	Direct buried Minimum earth covering 0.5m Maximum earth covering 2.0m
Medium tension	10.5KV 3 phase 3 wire	- ditto -	Direct buried Typical portion: Minimum earth covering 0.8m Road crossing portion Minimum earth covering 2.0m
Hige tension	66KV 3 phase 3 wire	- ditto -	- ditto -

b) Protection of existing cables during excavation work

No regulation has been stipulated by the distributing company.

c) Commercial power on the project site

- There is a low tension distribution network in the project area.
- There is no distribution stations for the high tension distribution network in the vicinity of the proposed sites for jacking pits and receiving pits of the pipe jacking method.

d) Cost of commercial power supply

- As of now, electric rate is 30 LE/kw. The rate for 1989 and onward has not been determined yet as the electric rate has been rising sharply in recent years.

2) Existing underground telecommunication cables

According to Giza Exchange, which is the telephone office of the Project area, the laying condition of telecommunication cables is as follows:

a) Laying of new cables

Telecommunication cable laying work is under way in the Project area based on the local telecommunication network distribution line improvement project. The work is scheduled for completion by September 1988. The cable laying plan for the above project is as follows:

Laying Method:

Classification	Burying Method	Buried Depth
Secondary road	Direct burying	Minimum earth covering 0.8m Maximum earth covering 1.0m
Main road	Inside conduit pipe	Minimum earth covering 1.0m Maximum earth covering 1.25m
Road crossing (both on secondary road and main road)	Same as above	Same as above

Laying locations:

- Cables are buried under sidewalks, not under roadways.
- The standard buried location is under the sidewalk about 0.8 to 1.0m away from the dwellings.

b) Old cables

- Cables that have been laid about 30 years ago exist in the Project area, but no cable laying map is available.
- According to the memory of the personnel in charge of operation and maintenance, the buried depths and locations of the old cables are approximately the same as the new cables.

- About 20 local trunk cables are buried under the sidewalks on both sides of Pyramid Street, and their depths are estimated to be about 2.4m.

c) Protection of existing cables during excavation work

Giza Exchange has no regulation for protecting existing cables during excavation work.

3-3-2 Mounira West

(1) Dwelling

1) 3 to 6 story-high buildings closely line both sides of the streets. Their columns, beams and floors are made of reinforced concrete, and their walls are made of brick.

2) As the buildings were probably built by the residents at will, the authorities concerned are unlikely to have their design drawings.

3) The height of entrances and floor levels of each home is not uniform. A considerable number of the dwellings have entrance and floor levels built either extremely high or extremely low. This must be kept in mind in determining the height of road and height of sewer pipe.

4) The frontage of each home is narrow.

(2) Road

1) The widths of main roads in the north-south direction of this area are about 4 to 5m, and most of these roads are straight with the exception of a few dead-end roads. The roads in the east-west direction are mostly narrow secondary roads, a considerable number of them being dead end roads.

2) The roads are unpaved and extremely rugged, with some portions being extremely high or extremely low.

3) Garbage, trash, etc., is littered over the roads and therefore extremely unsanitary.

4) As inhabitants (including children) are numerous in number, thorough attention must be paid to secure their safety and passage during the construction work.
However, as it is the inhabitants' fervent wish to have the water supply and sewer facilities improved, it is unlikely that there will be any complaints that will become a hindrance to the work.

5) Although there are many shops (including stalls) along the main roads in the vicinity, there are no schools, hospitals or state run stores in this area. Privately run stores are also scarce.

6) Passage and parking of automobiles is relatively sparse.

(3) Railway

A single track siding to the grain silo that branches off from the Cairo-Aswan trunk railway runs on the east side of this area in a north-south direction. Actual usage of this siding however is infrequent.

(4) Water Supply

Water is supplied to each dwelling from the distributing pipes along the main roads and secondary roads, but pipe diameters are not large enough for the necessary quantity of water supply. Pipes have not been laid in narrow alleys and blind alleys so that dwellings in such areas must receive water from the public water taps.
The rate of dwellings supplied by private water taps is considered to be about 30%, and the water supply situation in

this district is worse than in Omrania West.
As with Omrania West, the following problems have arisen.

- The rate of leakage is reportedly as high as 40%.
- Water pressure is low during the daytime so that water sometimes does not reach the taps of dwellings on the upper stories.
- Water supply is frequently suspended particularly during the summer season.
- Some dwellings have laid their own distributing water pipes at their own expense which could involve technical problems such as leakage.
- The pipeline network is dead-ended so that the water pressure is not uniform.
- Some dwellings utilize ground water.
- There are no fire hydrants.

(5) Sewer facilities

Small sewer pipes and cesspits are buried in almost all of the roads. The number of cesspits already installed in this area is reportedly about 2,000.
As the small sewer pipes were laid at will by private individuals, it is unlikely that the authorities concerned have their data. Sanitary sewage is seen overflowing from cesspits and flowing over the road surface which is quite unsanitary.
At present, many vacuum vehicle are sucking up sanitary sewage from manholes. The inhabitants are charged for draining of sanitary sewage by vacuum vehicle at a rate of 15 to 30 LE per service call. The above situation is considered to be tantamount to a total lack of sewer facilities.

(6) Commercial Power Supply and Telecommunications

It is judged that the power line is not underground but aerial. There is an underground telecommunications network which is connected to a few dwellings.

CHAPTER 4
CONTENTS OF THE PROJECT

CHAPTER 4 CONTENTS OF THE PROJECT

4-1 Objectives and Contents

Omrania West is suffering from water supply and sewer facilities which are deteriorated and deficient in functional performance and capacity.

In respect to water supply; various deficiencies including inadequate pipe diameters and leakage cause major water shortages and some inhabitants have to rely on public taps for their water. There are no fire hydrants even in densely populated areas.

In respect to sanitary drainage; sanitary sewage is overflowing at some places due to lack of uniformity of pipeline network and insufficient capacity of sewer main and branch lines.

As stated in Chapter 3, existing water supply and sewer facilities are fraught with problems, and if left alone, it is possible that it would become difficult to maintain the basic necessities of life and physical health of the inhabitants.

This Project aims to improve the living environment of the inhabitants in terms of health and sanitation by remedying the deficiencies of the water supply and sewer facilities and so upgrade the urban function of Giza City.

4-2 Evaluation of the Request

The contents of the request by the Egyptian Government was for the development of urban infrastructure such as water supply and sewer facilities in Omrania West and Mounira West.

On the basis of the request, the basic design study team as sent by JICA, confirmed and discussed the contents and examined the feasibility of the implementation of the request with the Egyptian

officials. The team examined the condition of existing water supply and sewer facilities in Omrania West and Mounira West, and on the basis of data and information collected locally, considered it appropriate to construct the following facilities in Omrania West and to provide the necessary materials and equipment, as outlined in items (1) through (6) below.

At the time of the field survey, the study team submitted a draft proposal for construction of water supply and sewer facilities to the Egyptian officials for their consideration (refer to Appendix VIII, Field Report).

In formulating the Project the study team considered the effect on Omrania West in terms of required construction period, safety and workability, its economic and technological impact and the operation and maintenance of the facility.

In addition the study team not only considered the current condition of water supply and sanitary drainage in the project area and the urgency for improvement but also the projects conformity with existing facilities and the suitability of the Project with related projects (i.e. OECF Loan Project, West German Waste Water Project, West Bank Waste Water Project (USAID), etc.).

The study team judged that Japan's grant aid cannot be planned for Mounira West under the present conditions as it must be coordinated with USAID sewer project which is already scheduled but for which details are unknown. Accordingly, this basic design study will only include detailed technical recommendations for implementing the water supply and sewerage facilities improvement in Mounira West.

(1) The proposed project area shall therefore be in Omrania West 58.82ha in area.

(2) A route of about 4.7km shall be for the water supply main line and a route of about 2.2km for the sewer main line. The proposed routes are shown on Figs. 4-1 and 4-2.

(3) 1 sedimentation basin with 2 channels with grit and trash removing equipment will be constructed at the Amina Mohamed pump station. In order to construct the sewer inlet pipeline, a part of the boundary wall of the Amina Mohamed pump station will be removed and later restored.

(4) Materials for water supply and sewer branch pipes will be provided only to areas where water supply and sewer facilities have not yet been installed. The extended laying length of the branch lines will be about 10.5km for water supply and about 3.5km for sewer drainage.

(5) 2 high pressure jet cleaning vehicles and 2 vacuum vehicles will be provided for cleaning sewer pipelines.

(6) Phase I, the sections of the water supply and sewer facilities to be improved or constructed and the materials and equipment to be provided on a priority basis, and the reasons for giving priority them are as follows. The proposed construction sites are as shown on Figs. 4-1 and 4-2.

Outline of Phase I works	Reasons for giving priority
1 Water supply facilities	
1) Construction of a water supply main line (about 1.8km) between King Faisal Street and Talatiny Street	- A sewer main line by USAID Project is planned for about 920m from King Faisal Street along Talatiny Street. The consturction would not overlap with the construction work under this project. Unless the work on this section is executed in Phase I, the overall construction period cannot be kept.
2) Construction of an aqueduct in the section crossing over Zomor Canal	- Can ensure overall construction period and cost saving
3) Connecting work (at 3 points) on existing and new distributing main lines	- The method of working under low water pressure will be used in connecting workin order to

	prevent troublecaused by muddy water infiltration and suspension of water supply. A special connecting machine and technical staff will be brought form Japan. The execution of all connecting work on main lines in Phase I will ensure smooth execution and construction cost reduction.
4) Jacking work at the intersection of Pyramid Street and Fatma Roshdy Street	- Smooth execution of work and construction cost reduction can be expected.
5) Provision of materials for branch pipes (4.9km)	- Quick improvement of services and its effects can be expected. The area for provision is densely populated. For the installation work to be executed by the Egyptian side, advice, counsel and cooperation can be obtained as necessary from Japanese consultant and contractor engaged on this Project.
2 Sewer facilities	
1) Construction of sewer main (about 0.8km) around Amina Mohamed pump station and partial removal and restoration of the boundary wall of Amina Mohamed pump station	- Quick improvement and its effects in sections where shortage of flow capacity is prominent can be expected.
2) Construction of sedimentation basins at the aforesaid booster pump station.	- Quick improvement and its effects can be expected.
3) Provision of materials for branch pipes (1.3km)	- Quick improvement and its effects can be expected. The area has a high public interest. For installation work to be executed by the Egyptian side, advice, counsel and cooperation can be obtained as necessary from the Japanese consultant and contractor engaged on this Project.
4) Provision of sewer pipeline cleaning equipment	- Quick improvement and its effects can be expected.

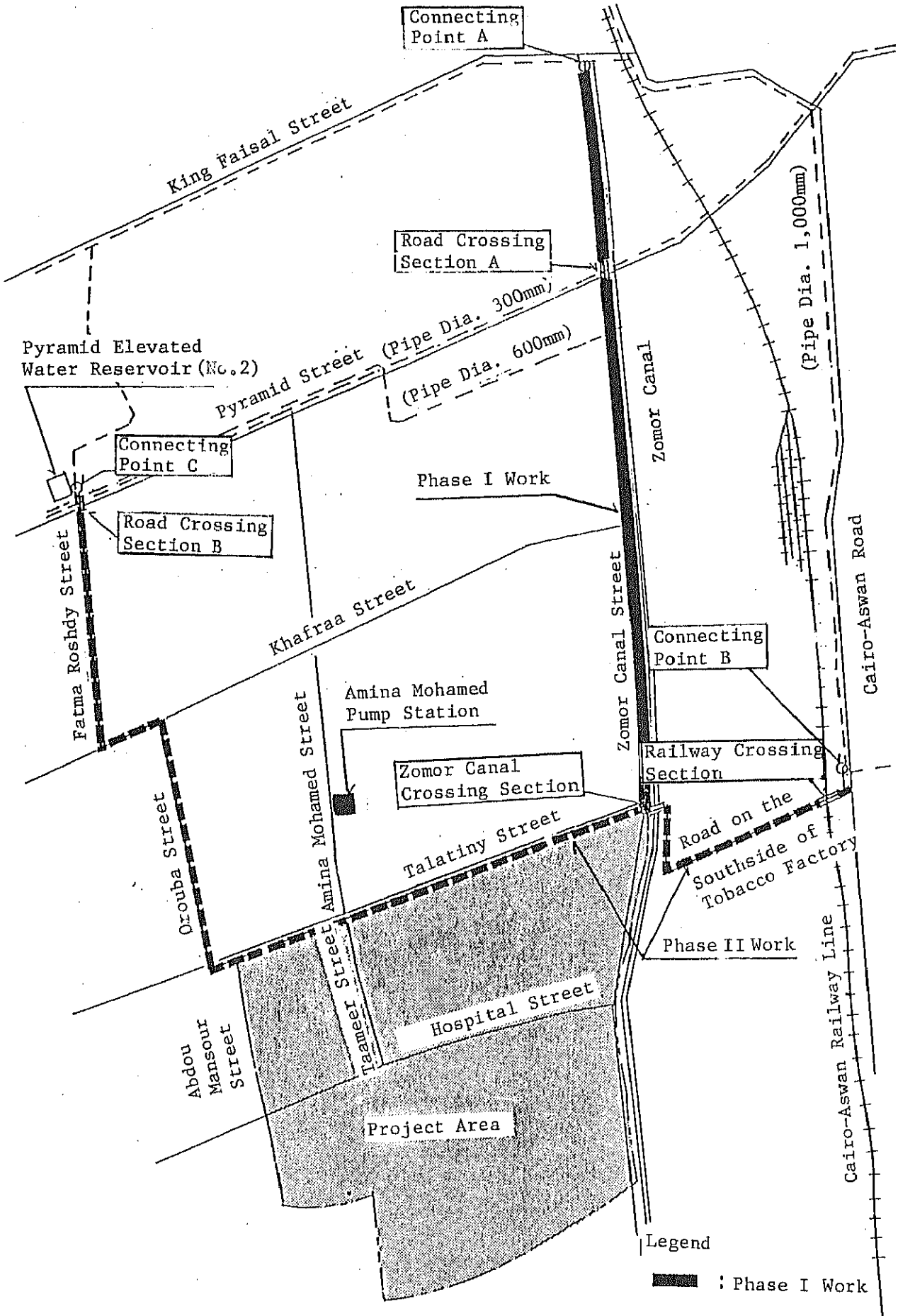


Fig. 4-1 General Layout of Water Supply Main Line

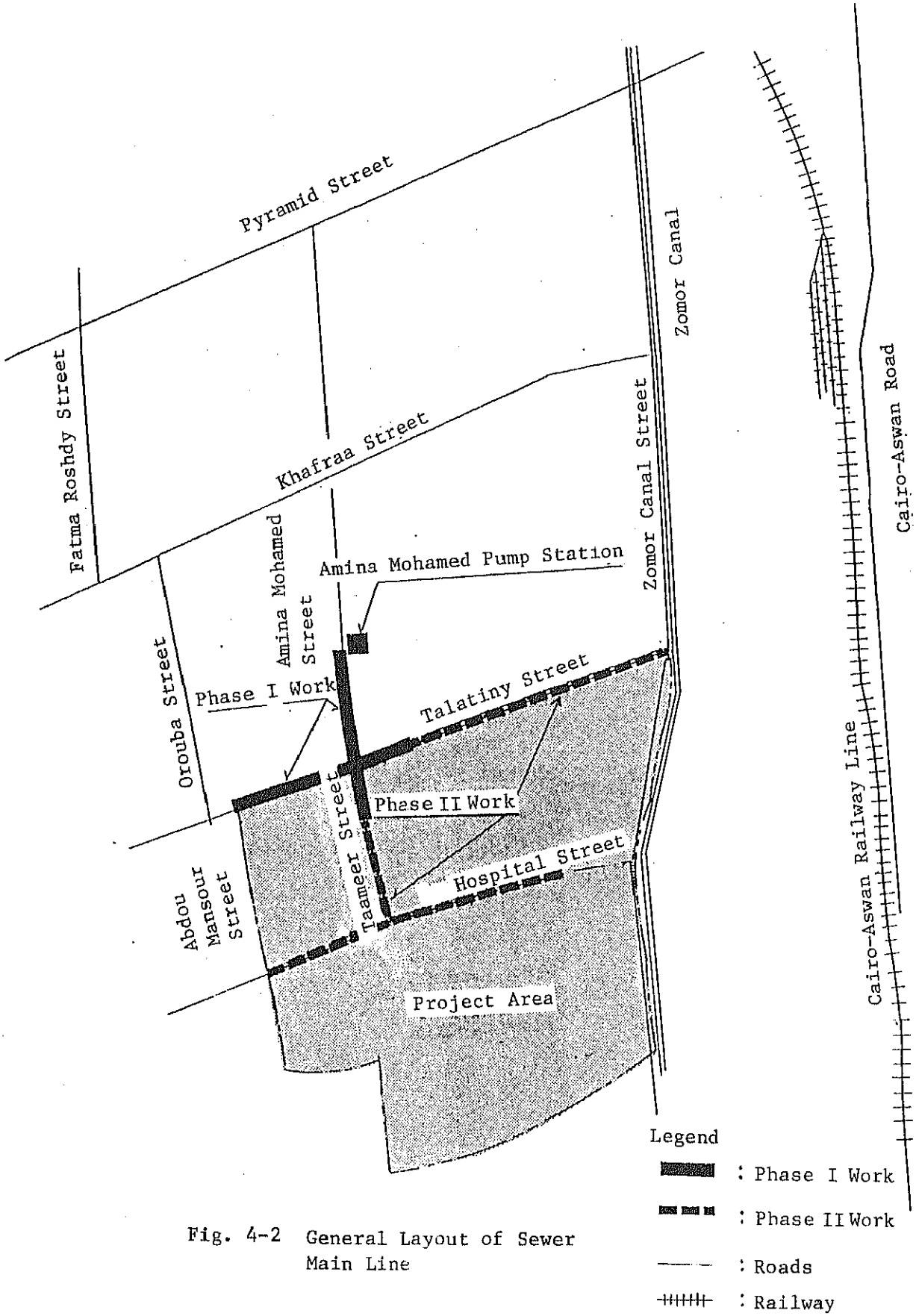


Fig. 4-2 General Layout of Sewer Main Line

4-3 Outline of the Project

4-3-1 Implementation of the Project

Giza City will be responsible for the proper implementation of the work under this project. Upon completion of construction, General Organization for Greater Cairo Water Supply and General Organization for Greater Cairo Sanitary Drainage will undertake maintenance and operation.

4-3-2 Basic Schemes for Planning the Project

(1) This Project will be undertaken on the basis of Giza City's Omrania West Upgrading Project Report financed by World Bank Loan.

(2) The area to be covered by the Project will be 58.82ha in Omrania West, Giza City, Giza Governorate.

(3) The planned forecast year will be set at year 2010.

4-3-3 Summary of the Project

The water supply and sewer main line construction plan and the materials and equipment provision are as summarized below.

(1) The water supply main lines are planned as follows.

1) The water supply main lines will be arranged beneath main roads. Their extended length will be about 4.7km.

2) The following construction method and pipe material specifications of water supply main lines will be used;

a) Road crossings on Pyramid Street (at 2 sections)

- Construction method : Jacking method
- Pipe material specifications : 600mm diameter ductile cast iron pipe for jacking method
- Length : 87m and 90m

b) Railway crossing (at 1 section)

- Construction method : Sleeve pipe jacking method
- Pipe material specifications : Sleeve pipe for will be 1,200mm diameter centrifugal reinforced concrete pipe. Water supply pipe will be 600mm diameter ductile cast iron pipe.
- Length : About 30m

c) Zomol Canal crossing (at 1 section)

- Construction method : Aqueduct method
- Pipe material specifications : 600mm diameter steel pipe for waterworks
- Length : About 19m

d) General sections other than the above:

- Construction method : Open cut method (standard earth covering 1.2m)
- Pipe material specifications : 600mm diameter ductile cast iron pipe
- Length : About 4.5km

e) For appurtenant facilities of water supply main line, butterfly valves, sluice valves, air valves, wash-out valves and fire hydrants will be installed.

(2) The sewer main lines will be planned as follows:

1) Sewer main lines will be arranged beneath main roads. Their extended length will be about 2.2km.

2) The entire sewer main lines will be executed by the pipe jacking method. Jacking length of each extension will be about 100 to 150m.

3) Pipe diameter of sewer main lines will be 1,200mm, and the pipe material to be used will be centrifugal reinforced concrete pipe.

4) Existing sewer pipes will be connected to the new sewer main lines inside the manholes.

(3) The following facilities will be installed at the existing Amina Mohamed Pump Station:

1) Sedimentation basin : 2 channels (about 1.8m wide x 11.0m long x 5.5m deep)

2) Automatic grit removing equipment : 1 unit (travelling sand pump)

3) Automatic trash removing equipment: 2 units (Rake type trash removing)

4) Appurtenant equipment : 1 set

(4) Provision of water supply branch pipes will be planned as follows:

1) Area for provision : Of the areas which do not receive water supply service at present.

2) Extension of pipes to be provided: 11.5km

3) Pipe diameter : 100 to 400mm

4) Pipe material and fittings : PVC pipe and PVC fittings and valves, etc.
Diameter: 100 to 300mm

5) Pipe material and appurtenant equipment : Ductile cast iron pipe and ductile cast iron fittings and valves, etc.
Diameter: 400mm

(5) Provision of sewer branch pipes will be planned as follows:

1) Area for provision : Of the areas where sanitary sewage is not drained into existing sewer facilities at present.

2) Extension of pipes to be provided : 3.9km

3) Pipe diameter : 175 to 375mm

4) Pipe material : Vitrified clay pipe

(6) Provision of sewer pipeline cleaning equipment will be planned as follows:

1) High pressure jet cleaning vehicles : 2 units

2) Vacuum vehicles : 2 units

CHAPTER 5
BASIC DESIGN

CHAPTER 5 BASIC DESIGN

5-1 Water Supply

5-1-1 Basic Design Policy

The basic design of water supply will be made using criteria from the following:

- Omrania West World Bank Loan Project
- West German Project Report
- Request by Egypt
- Results of JICA Field Survey

(1) This Project will be formulated to construct water supply main lines and ancillary equipment for the benefit of residents in the Project area who suffer shortage of water supply, curtailment of supply service hours and drop in water pressure due to insufficient capacity and deteriorated functions of the existing facilities. The main objectives are upgrading the functions of water supply facilities and improving the living environment in the area.

(2) This Project covers a 58.82 ha area in Omrania West under the improvement plan of the World Bank Loan Project. Section 5-3, basic design drawing (EGU-G-01) shows this project area.

(3) The Project will be designed by establishing routes, depth of pipes, etc. that will least interfere with the existing underground services (water supply and sewer facilities, electricity and telecommunication).

(4) Connection of the water supply main lines under this Project with the existing branch lines will be so designed that the latter's functions will be recovered and improved.

(5) This Project will be formulated with the assumption that the required volume of water and planned water pressure will be secured when Embaba Water Works, South Giza, has been improved and expanded by 1992 as per the West German Project Report.

(6) This Project will, in principle, conform to Japanese applicable technical standards. However, since major materials are to be locally supplied, the strength of materials, shape and size of fittings for connection with existing and future facilities, etc. will be designed to conform to Egyptian standards.

(7) This Project will take into full consideration the present financial situation of Giza City and will be designed to facilitate operation, maintenance and management of the water supply facilities which Giza City will transfer to the Greater Cairo General Organization for Water Supply upon completion, as well as reduce the cost and labor required for such operation, maintenance and management.

(8) This Project will be formulated so that technology such as the pipe jacking method will be transferred to Egypt and construction equipment and materials will be locally supplied as much as practicable.

(9) In conducting this Project, efforts will be made to obtain understanding and cooperation from residents in the Project area regarding the execution of the construction work.

(10) This Project will be formulated so that it will ensure safety of existing infrastructure, buildings, and residents and cause the least interference with residents' daily lives and commercial activities.

5-1-2 Study of Design Conditions

The design conditions for the water supply main lines will be based on conditions used for the World Bank Loan Project and the West German Project Report. These conditions are as follows:

(1) Water Supply Main Lines

Table 5-1 shows the design conditions for the water supply main lines.

Table 5-1 Design Conditions for Water Supply Main Line

Item	Design conditions	Basis
1. Main lines		
1) Planned year for water supply main line project	2010	World Bank Loan Project
2) Project area	58.82 ha	"
3) Planned service population	175,460 persons	"
4) Planned daily maximum water supply	200 lit/capita/day	"
5) Planned total water supply	406.2 lit/sec (175,460 x 0.2 = 35,092m^3/day)	"
6) Planned water supply per ha	6.9 lit/ha.sec (35,092/58.82 = 596.6 m^3/ha.day)	"
7) Pipe line	Closed network	"
8) Type of pipes	Ductile cast iron pipe except Zomol Canal crossing point where steel pipe will be used	"
9) Pipe diameter	600mm	"

Item	Design conditions	Basis
10) Design flow velocity	0.75 - 1.5 m/sec	World Bank Loan Project
11) Branch head loss	Approx. 3 m max.	"
12) Supply pressure	Approx. 20 m max.	"
2. Ancillary equipment		
1) Equipment for connection with existing pipe lines, for wash-out, etc.	Butterfly valves will be installed	"
2) Ridge sections on main line	Air valves will be installed	"
3) Valley sections on main line	Wash-out valves will be installed	"
4) Spacing of fire hydrants	150m spacing	"

As mentioned earlier (see Section 2-2-1), water to the Project area will be supplied from Giza, South Giza and Embaba Water Works, and Zuri and Aharam well field. Since their combined capacity is expected to be improved to 1,182,500 m^3/day by 1992 as per the West German Project Report, assumption will be made that there will be no problem to the planned volume of water supply and water pressure in the area on the West side of the Nile including the served area under this Project.

(2) Selection of Type of Pipes

a) Types of pipes subject for study

For the water supply main line, following types of pipes have been studied:

- PVC pipe
- Cast iron pipe
- Asbestos pipe

- FRP pipe
- Steel pipe for water service
- Ductile cast iron pipe

b) Type of pipe selected

Ductile cast iron pipe has been selected for the following reasons:

- Both PVC pipe and cast iron pipe are designed for a pipe diameter of less than 300mm and cannot be used for the water supply main line (with a pipe diameter of 600mm).
- Asbestos pipe will not be used because it causes health hazards is fragile and lacks durability.
- FRP pipe is not produced in Egypt. If it is to be supplied from Japan, it will become more expensive than ductile cast iron (about 10% higher) due to freight and packing costs.
- Steel pipe for water supply is not produced in Egypt. If it is to be supplied from Japan, it will become more expensive than ductile cast iron (about 40%) due to freight and packing costs.
- Ductile cast iron pipe has proven its performance in applications, and is superior in workability, safety, durability and economy. Since Egypt produces straight pipes (in a regular length of 6m), requirements can be met locally. This local supply will contribute to Egypt's economic development and creation of job opportunities. For these reasons, ductile cast iron pipe will be used.

(3) Study of Pipe Diameter

For a pipe diameter of 600mm, its suitability has been evaluated as follows:

1) Flow velocities

- Volume of water supply

  (Q) = 406.2 lit/sec = 0.4062 m^3/sec

- Cross section

  $(A) = \frac{\pi}{4} d^2 = \frac{\pi}{4} \times 0.6^2 = 0.2827\ m^2$

- Flow velocity

  $(V) = \frac{Q}{A} = \frac{0.4062}{0.2827} = 1.44$ m/sec < 1.5 m/sec

Consequently, flow velocity along the pipe is 1.44 m/sec which will satisfy the required flow velocity (0.75 - 1.5 m/sec) under the World Bank Loan Project.

2) Head loss

- Formula (Williams & Hazen)

- Flow velocity coefficient (C) = 110

- Hydraulic gradient

$$(I) = 10.666 \times C^{-1.85} \times D^{-4.87} \times Q^{1.85}$$

$$= 10.666 \times 110^{-1.85} \times 0.6^{-4.87} \times 0.4062^{1.85}$$

$$= 10.666 \times \frac{1}{5978} \times \frac{1}{0.08310} \times 0.1889$$

$$= 4.06\ \%$$

- Pipe line length (ℓ) = 1,500m

- Head loss $(H_f) = 1{,}500 \times \frac{4.06}{1{,}000} = 6.09$m

3) Water pressure at terminal of water supply branch in the served area

- Design water level in existing Pyramid elevated water reservoir (No. 2) : AD + 52.19m (design water level by 1990 according to the West German Project Report)
- Ground height : AD + 20m
- Head loss of main line : 6.09m
- Head loss of branch pipe: 3m
- Required water pressure : 20m (required water pressure based on World Bank Loan Project)
- Water supply pressure
  (P) = 52.19 - 20 - 6.09 - 3 = 23.1m > 20m

Consequently, water supply pressure with a pipe diameter of 600mm will satisfy the required water supply pressure (more than 20m) under the World Bank Loan Project and is considered reasonable under the circumstances. No excess reserve is available.

5-1-3 Basic Plan

(1) Route Plan

1) Proposed Pipe Line Route

a) The proposed route for the water supply main line is as shown in Section 5-3, basic design drawing (EGU-W-01). This route was established based on the World Bank Loan Project, incorporating the requirements of Egypt and carefully studying results of the field survey.

The route revealed the existence of dwellings and a tobacco factory in the following two sections.

- The section between Khafraa and Talatiny streets
- The section between Zomor Canal and Cairo-Aswan road

Under this Project, the route was changed to a more feasible one.

b) Horizontal pipe route in each section is as follows:

① Zomor Canal Street

North side from Khafraa street:

Pipes will be laid on the opposite side to the canal. (The area along the canal is the proposed site for installation of sewer lines under USAID.

South side from Khafraa street:

Pipes will be laid along the canal. (No sewer lines will be installed under USAID. Moreover, few existing services are in this area.)

② South side of tobacco factory:

Pipes will be laid about 5m on the south side from the wooden temporary fences along the proposed site for factory building. (Laying pipes in the center part of the proposed site for road construction would possibly interfere with foundation works for an elevated bridge crossing the railway. Giza City plans to build this bridge.)

③ West side of tobacco factory:

Pipes will be laid near the center of the street along the east bank of Zomor Canal.

④ Cairo-Aswan road:

Pipes will be laid near the footpath along the railway. (Traffic on this road will not be seriously affected.)

⑤ Talatiny street:

Pipes will be laid on the side of Hospital street. (On the south side of the proposed area.)

⑥ Orouba street:

Pipes will be laid near the center of the road. (The road is narrow and existing sewer pipes run on both sides.)

⑦ Khafraa street:

Pipes will be laid on the Talatiny street side. (There are many existing underground services on the other side.)

⑧ Fatma Roshdy street:

Pipes will be laid on the Zomor Canal side. (Few existing underground services are on this side.)

2) Facilities and construction

a) Ordinary sections

Except for the three crossing points for the Zomor Canal, Pyramid street and railway, facilities and their construction method in ordinary sections will be as follows:

① Facilities and construction

Facilities to be installed comprise of butterfly valves, air valves, wash-out valves, fire hydrants and fittings for connection with existing and

future branch pipes. Concrete valve chambers will be provided for valves and fire hydrants, and concrete thrust blocks will be installed at the bends and branching points. For detailed construction, refer to Section 5-3, basic design drawing (EGU-W-05 to 08).

② Type of pipe and connection method

Ductile cast iron pipes will be used. Straight pipes in regular size will be obtained in Egypt while fittings, short pipes and valves will be supplied from Japan. Pipes will be jointed by a generally used method, (push-on T-type joint).

b) Zomor Canal crossing section

① Facilities and construction

Self-supporting aueduct will be used for the section crossing the Zomor Canal because work under this method is easy to undertake, economical and because aqueducts are easy to maintain and control. The aqueduct section will be about 19m and will be located about 8m upstream from the upstream edge of the existing bridge. The aqueduct will be an integral simple construction, fabricated by welding 600mm diameter steel pipes. The aqueduct will be provided with an air valve, and will be protected with a fence to prevent pedestrians from using the aqueduct. For foundation work, piles will be driven in, to prevent settling, deformation, etc., thereby securing safety. For these foundation piles, precast piles of reinforced concrete will be used.

Expansion joints will be used near the support to absorb contraction and expansion of the aqueduct due to temperature. Flexible joints will be used

to absorb uneven settling that will occur between pile supported foundations and directly embedded portions.

In Zomor Canal street, Talatiny street and the area on the side of the tobacco factory, a butterfly valve chamber fitted with a wash-out valve will be installed in each position (total 3 positions) near points close to the aqueduct.

② Type of pipes and painting

Steel pipes will be used and painted in the following manner:

- Internally tar epoxy coat will be applied to more than 0.3mm thick.
- Externally zinc primer coat, rubber chloride base coats (2), silver rubber chloride finish coats (2) will be applied.

c) Section crossing Pyramid street (on the side of Zomor Canal street)

① Location

Under USAID, a sewer main line (1,200 to 1,800mm in pipe diameter) will be laid on the Zomor Canal street. Since its proposed route runs on the Zomor Canal side, the pipes for the water supply main line under this Project will be laid on the opposite side of the canal to keep clear of this sewer line.

Pipes will be laid by jacking method in the section crossing Pyramid street to prevent obstructions to traffic and to protect existing underground services. This method has been selected also because steady progress in work can be expected. The section covered will be about 87m.

The depth of the pipe was set at about 3m, taking into account the depth of the sewer main line to be laid under USAID, depth of existing services and ground height in the vicinity. The position of both the jacking and receiving pits was established, taking into consideration the width of the road, gradient of access roads, safety to vehicular and pedestrian traffic, and securing of passages for such traffic. For further details, refer to Section 5-3, basic design drawing (EGU-W-03). The jacking pit will be located on the bus terminal side where the road is wider, and the receiving pit will be built on the El Talatiny street side.

② Facilities and construction

The butterfly valve chamber to be constructed in the pit will be provided with a wash-out valve because the pipe line runs deep and thus inverted siphon is used in the jacking section. For details, refer to Section 5-3, basic design drawing (EGU-W-07).

③ Type of pipes

Ductile cast iron pipes for jacking method will be used. These pipes will be supplied from Japan because they are not manufactured in Egypt.

d) Section crossing Pyramid street (on elevated reservoir side)

① Location

The proposed route will be established on the east side (the Zomor Canal side) of the access road (Fatma Roshdy street), taking into account topographical features in the vicinity, location of dwellings and shopping areas, the location of

access roads to dwellings, the status of public land and nearby vacant lots, and the position of existing underground services. The position of pits is set to ensure safe and smooth flow of vehicular traffic from Pyramid street to access roads. The jacking pit is located on the side of the existing elevated water reservoir to minimize the effect of construction work on residents' daily lives and commercial activities.

② Facilities and construction

Facilities and their construction will be the same as those for the section crossing Zomor Canal street.

③ Type of pipes

Ductile cast iron pipes for jacking method will be used.

e) Section crossing railway

① Position

The pipe line will cross the railway at a point 9.0m from the distance-mark (No.14/01) on the Cairo Central Station side. The pipe will cross the railway at a right angle to the latter in the shortest length.

② Facilities and construction

For the railway crossing section, the sleeve pipe jacking method will be used to secure safety of trains. This method has already been used in Egypt and is also employed under USAID. As a condition for approval on the use of the jacking method, the State Railway has requested that they

supervise the execution of the work for this section.

The jacking pit will be located on the tobacco factory side where a spacious plot of land is available. The pit will be protected by sheathing work with sheet piles. The receiving pit will be installed in a stock yard owned by Giza City for road materials and located along Cairo-Aswan road. Because elevated power cables run over this site, sheathing for the receiving pit will be provided by joining plates in the pit according to the depth of excavation. For the portion above the ground, liner plate method will be used as a sheathing method requiring no work space.

A butterfly valve chamber will be installed in each of these pits, and a washout valve will be installed on the tobacco factory side where ground height is low.

③ Material

Ductile cast iron pipes will be used for the water main, while 1,200mm-diameter centrifugal reinforced concrete pipes will be used as the sleeve pipes as is the case with sewer lines.

f) Connection with existing water supply lines

The water supply main line will be connected with existing water supply lines in the following 3 points, using a method of working under water pressure. This is because suspension of water supply from existing water lines (a pipe diameter of 800mm to 1,000mm) for connection with the new water supply main line would have a large scale effect. Moreover, if this suspension of water supply should run for

several days, muddy water may possibly be supplied from the pipes when water service has been resumed.

① Connection in Cairo-Aswan road
② Connection at intersection between King Fisal street and El Zomor Canal street
③ Connection near Pyramid elevated water reservoir No.2

g) Connection with existing branch pipes

The water supply main line to be constructed in Talatiny street with existing branch pipes will be connected based on the World Bank Loan Project. For details, refer to Section 5-3, basic design drawing (EGU-W-05).

h) Connection with future branch pipes

① Project area

Points of connection between the water supply main line to be constructed in Talatiny street and future branch pipes as well as pipe diameter for such connection will conform to the World Bank Loan Project.

Connection points will be provided with valves and flange cover to facilitate connection work for future branch pipes which will be laid by Giza City. For details, refer to Section 5-3, basic design drawing (EGU-W-06).

② Route outside Project area

Ancillary equipment including air valves and fire hydrants will also be installed on the section of the water supply main line from its connection with existing water supply lines, 3 connecting

points as described in f) up to the project area under this Project. It is expected that provision of such ancillary equipment will make it possible to easily, functionally and economically implement improvement of branch lines in the neighboring areas and will also facilitate effective use of the water supply main line.

(2) Longitudinal Plan

1) Earth cover

As the standard overburden, earth cover will be to a thickness of 1.2m so that ancillary equipment such as valves, air valves and fire hydrants will not extend above the ground surface. For unpaved areas, a minimum earth cover of 0.7m will be provided to facilitate future pavement, along with consideration to undulations of the ground surface.

2) Profile

Ground is virtually flat except for undulations in unpaved portions, Pyramid street and the railway crossing. Therefore, the longitudinal plan will be nearly level except for the sections crossing the main road, railway and canal.

Wash-out valves will be installed in the sections crossing Pyramid street and the railway because pipe jacking method to be employed in these sections results in an inverted siphon construction deeper than standard earth cover. An air valve will be installed on the aqueduct over the Zomor Canal. For points where the water supply main line crosses existing asbestos pipes, the water supply main line will be laid in inverted siphon construction because asbestos pipes are old and fragile.

(3) Ancillary facilities

Ancillary facilities such as valves and air valves will be provided based on requirements of the World Bank Loan Project. These facilities will be installed as follows by further using applicable standards in Japan as reference (Japan Water Works Association: "Design Criteria for Water Works Facilities").

1) Sluice valve

Sluice valves will be installed at points of connections and branches between the water supply main line and existing water lines. Butterfly valves will be used for pipes of more than 400mm in diameter and sluice valves for those of less than 400mm according to the World Bank Loan Project. For material, ductile cast iron will be used.

2) Wash-out valve

Wash-out valves will be installed in lower pipeline sections including depressed points and valve chambers provided in jacking pits. The pipe diameter of washout valves will be made 100mm.

The elevation of wash-out pipes is lower than the design high water level of Zomor Canal (AD + 19.25mm), making natural drainage impossible. Therefore, drain pits will be installed for drainage. Water will be drained to sewer manholes except for water to be drained to Zomor Canal.

3) Air valve

Air valves will be installed to the following specification:

- Air valves will be installed in raised portions of the pipe line and elevated sections such as the aqueduct.

- For the valve type, double orific type will be used because the pipe diameter is 600mm.
- The valve to be installed on the aqueduct will be protected with a steel cover to prevent theft.

4) Fire hydrant

Fire hydrants will be installed to the following specifications:

- Fire hydrants will be installed at intervals of 150m near the intersection of the main and secondary roads to increase the scope of their application as much as possible. Fire hydrants will be of double orific type with a capacity of 10 to 15 liters/second.
- Fire hydrants will also be installed on the route beyond the served area of the project, taking their requirement into consideration.

5-2 Sewer Facilities

5-2-1 Basic Design Policy

The basic design of the sewer facilities will be made using criteria from the following:

- Omrania West World Bank Loan Project
- Request by Egypt
- Results of JICA Field Survey

(1) This Project will be formulated to construct the sewer main line (pipe diameter: 1,200mm) in areas where no sewer facilities exist and in the served area where residents suffer from detention, clogging and overlow, etc. of sewage due to insufficient capacity and deteriorated functions of the existing facilities. Under this plan, grit and trash removing facilities will also be constructed in the existing pump stations to upgrade the functions of the existing sewer facilities and improve unsanitary living conditions.

(2) This Project covers a 58.82ha area in Omrania West based on the World Bank Loan Project. Section 5-3, basic design drawing (EGU-G-01) shows this Project area.

(3) This Project will be designed by establishing routes, depth of pipe, etc. that will least interfere with existing services (water supply and sewer facilities, electricity and telecommunication).

(4) Connection of the sewer main line under this Project with existing sewer lines will be designed so that the functions of the overloaded existing sewer lines will be recovered and improved.

(5) Design criteria to be applied to this Project plan will in principle conform to technical standards in Japan. Due consideration will be given to the design of the planned

facilities so that they will interface with the existing facilities and existing specifications.

(6) This Project plan will be drawn up by fully understanding the difficulties that Giza City has in cleaning sewer pipelines, and the need to provide facilities that are easy to maintain and manage and will improve work environment, increase efficiency and save costs and labor.

(7) This Project will be formulated so that technology such as the pipe jacking method will be transfered to Egypt and that construction materials and equipment will be locally supplied as much as practicable.

(8) In conducting this Project efforts will be made to obtain understanding and cooperation from residents in the Project area regarding the execution of the construction work.

(9) This Project will be formulated so that it will ensure safety of existing infrastructure, buildings and residents, and will not interfere with residents daily lives and commercial activities.

5-2-2 Study of Design Conditions

(1) Sewer Main Line

The design conditions for the sewer main line will be based on the conditions used in the World Bank Loan Project and will be as follows:

Table 5-2 Design Conditions for Sewer Main Line

Item	Design conditions	Basis
1) Target year	2010	World Bank Loan Project
2) Project area	58.82 ha	"
3) Planned service population	175,460 persons	"
4) Design maximum sewage discharge	200 lit/capita/day	"
5) Coefficient of roughness	0.013	"
6) Design flow velocity	0.6 - 1.3 m/sec	Greater Cairo General Organization for Sanitary Drainage
7) Formula for flow velocity	Ganguillet-Kutter formula	"

(2) Sedimentation Basin

Design conditions for sedimentation basin will be as follows.

Table 5-3 Design Conditions for Sedimentation Basin

Item	Design conditions	Basis
1) No. of channels	2	Japan Sewage Association "Guide-line and Manual of Sewage Facilities Design"
2) Sewage inflow	1.1 m^3/sec	World Bank Loan Project
3) Average flow velocity in sedimentation basin	0.25 - 0.35 m/sec	Japan Sewage Association "Guide-line and Manual of Sewerage Facilities Design"
4) Particle size of removed grit	More than 0.2mm	"

(3) Selection of type of pipe

As will be described later (Section 5-4-2, (2) Construction Method), long distance pipe jacking method (about 100 to 150m jacking length) will be used in laying sewer pipes. As for the type of pipes for jacking method, the following pipes can be considered:

a) Types of pipes studied

- Clay pipe
- Ductile cast iron pipe
- Steel pipe
- Prestressed concrete pipe
- Centrifugal reinforced concrete pipe

b) Type of pipe selected

Centrifugal reinforced concrete pipe has been selected for the following reasons:

- Clay pipe is generally used for small diameter pipe lines and cannot be used for large diameter (1.2m) pipe lines under this Project.
- Ductile cast iron pipe is superior in durability and strength but its high cost compared with other types of pipes (about 1.7 times) precludes its use for this Project.
- Steel pipe has problems in durability due to corrosion and is more expensive than concrete pipe (about 1.9 times).
- Prestressed concrete pipe is manufactured in Egypt but cannot be used for this Project for technical reasons because one piece of pipe is as long as 6.15m. Such a lengthy pipe has never been used for long distance jacking method in Japan and the use of this pipe would also increase the size of pits.
- Centrifugal reinforced concrete pipe can be supplied in Egypt, is low in cost and has extensively been used. With the short unit length of pipe, the size of pits can be reduced. There is technically no problem in using this pipe.

5-2-3 Basic Plan

The basic plan for the sewer facilities will be formulated based on the present status and expected future problems of the existing sewer facilities, basic design policy and results of the field survey.

(1) Design of sewer pipe line

The following is a flow chart of the basic plan for the sewer pipe line:

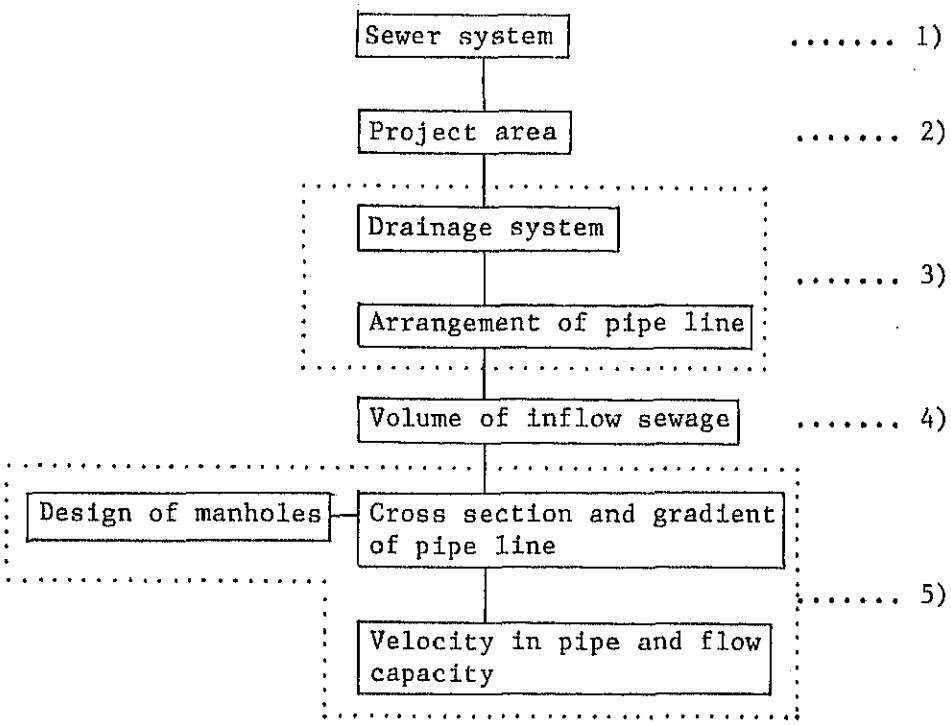


Fig. 5-1 Flow of Basic Design for Sewer Pipe Line

For 1) to 5) in above Fig. 5-1, a detailed description will be given below.

1) Sewer system

A combined system will be used as the sewer system. However, storm sewage will be ignored because precipitation is extremely small with a monthly average of only 2mm.

2) Project area

The Project area is the 58.82ha area as shown in Section 5-3, basic design drawing (EGU-G-01).

3) Study of drainage system and pipe line arrangement

The existing sewer pipe lines in the Project area are affected by insufficient capacity of pipes and their lowered functions for the reasons given below. Fig. 5-2 shows a drainage flow chart of the existing sewer facilities.

- The drainage system of the existing sewer pipe lines is not systematically arranged because public and private sewer lines have been laid in a complicated, disorderly manner.
- The diameter of main pipe lines, ranging from 300mm to 500mm, is too small for the required drainage capacity. Moreover, because the drainage system has not been laid under a systematic, coordinated plan, there are many lines where sewage flow concentrates.

To increase and improve the capacity and functions of the sewer pipe lines in the Project area, the existing drainage system will be improved as shown in Fig. 5-3.

The drainage district will be divided into 4 major sub-districts and a main line (a pipe diameter: 1,200mm) will be installed in each sub-district to handle the amount of sewage discharge in that area. Fig. 5-4 shows the drainage system desired for the sewer pipe lines. The reasons for selection of the pipe diameter will be given later.

4) Study of inflow sewage volume

a) Design target year and design population

To calculate design inflow sewage volume in the Project area, the target year will be set at 2010 as is the case with the World Bank Loan Project and the planed serviced population will be set at 175,460.

b) Design per capita daily maximum sewage discharge

In Egypt, 200 liters is generally used as design per capita daily maximum sewage discharge when sewer facilities plans are drawn up. This design value will also be applied to this Project.

c) Area of drainage district

The sewage drainage district will be limited to the served area under this Project. It covers an area of 58.82ha.

d) Design hourly maximum sewage discharge

The design hourly maximum sewage discharge per unit area can be obtained from the following expression:

$$\text{Design maximum sewage discharge per unit area } (m^3/sec/ha) = \frac{\text{Domestic sewage discharge + infiltration}}{24 \times 60 \times 60 \times \text{area of drainage district}} \times \alpha$$

$$= \frac{\text{Design per capita daily max. sewage discharge} \times \text{design population}}{86{,}400 \times \text{area of drainage district}} \times \alpha$$

where design per capita daily max. : 200 lit/capita. day
design population : 175,460 persons
area of drainage district : 58.82ha
α (allowance coefficient) : 2 (World Bank Loan Project)

The design maximum sewage discharge obtained from the above is $0.0138 m^3/sec.ha$ (13.8 liters/sec.ha).

e) Inflow sewage

The quantity of sewage flow into pipe lines (Q) can be determined from the following formula:

Q (m^3/sec) = design maximum sewage flow ($0.0138 m^3/sec$) x draining area coverage of pipe line (ha)

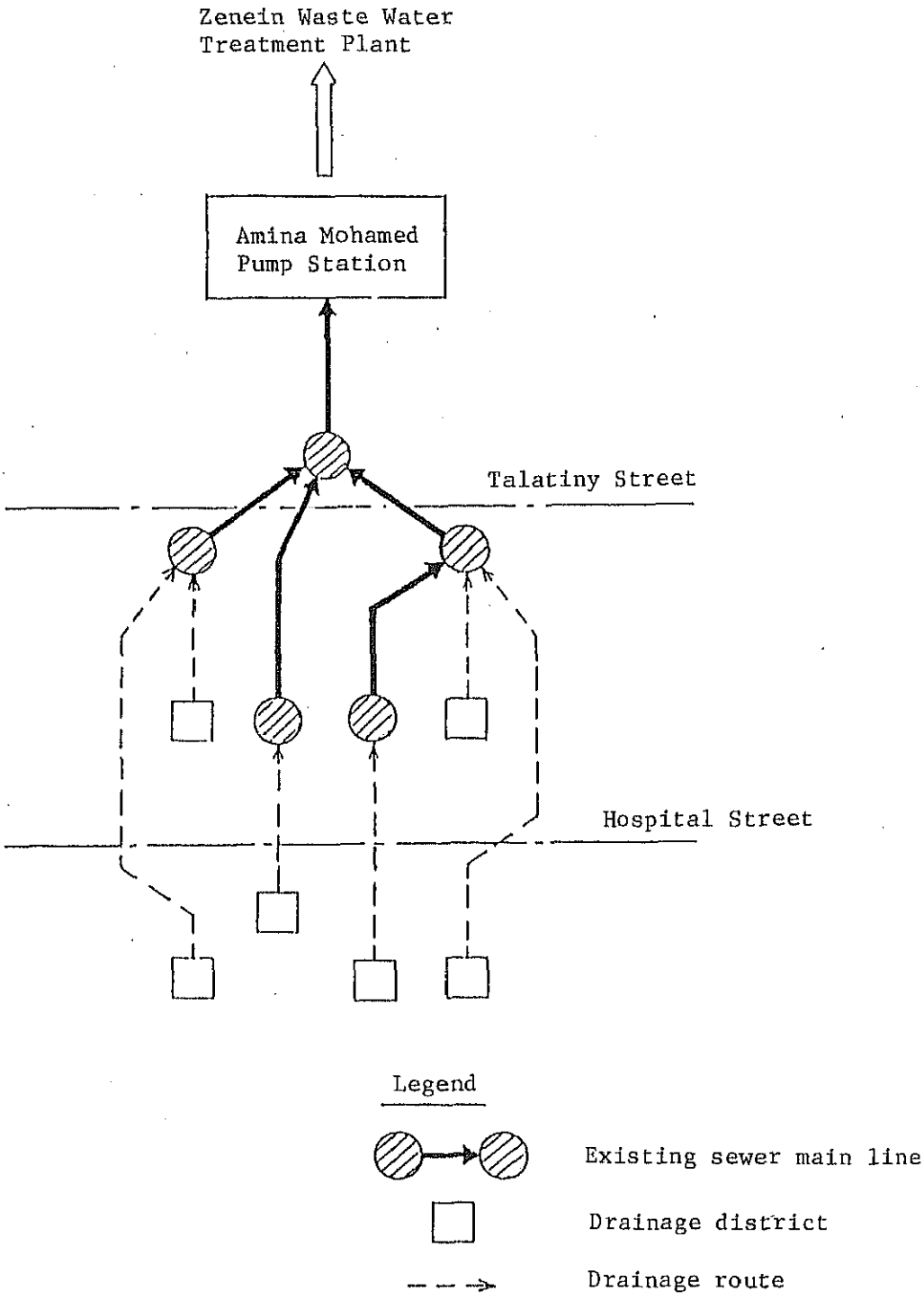


Fig. 5-2 Drainage Flow Chart of Existing Sewer Facilities

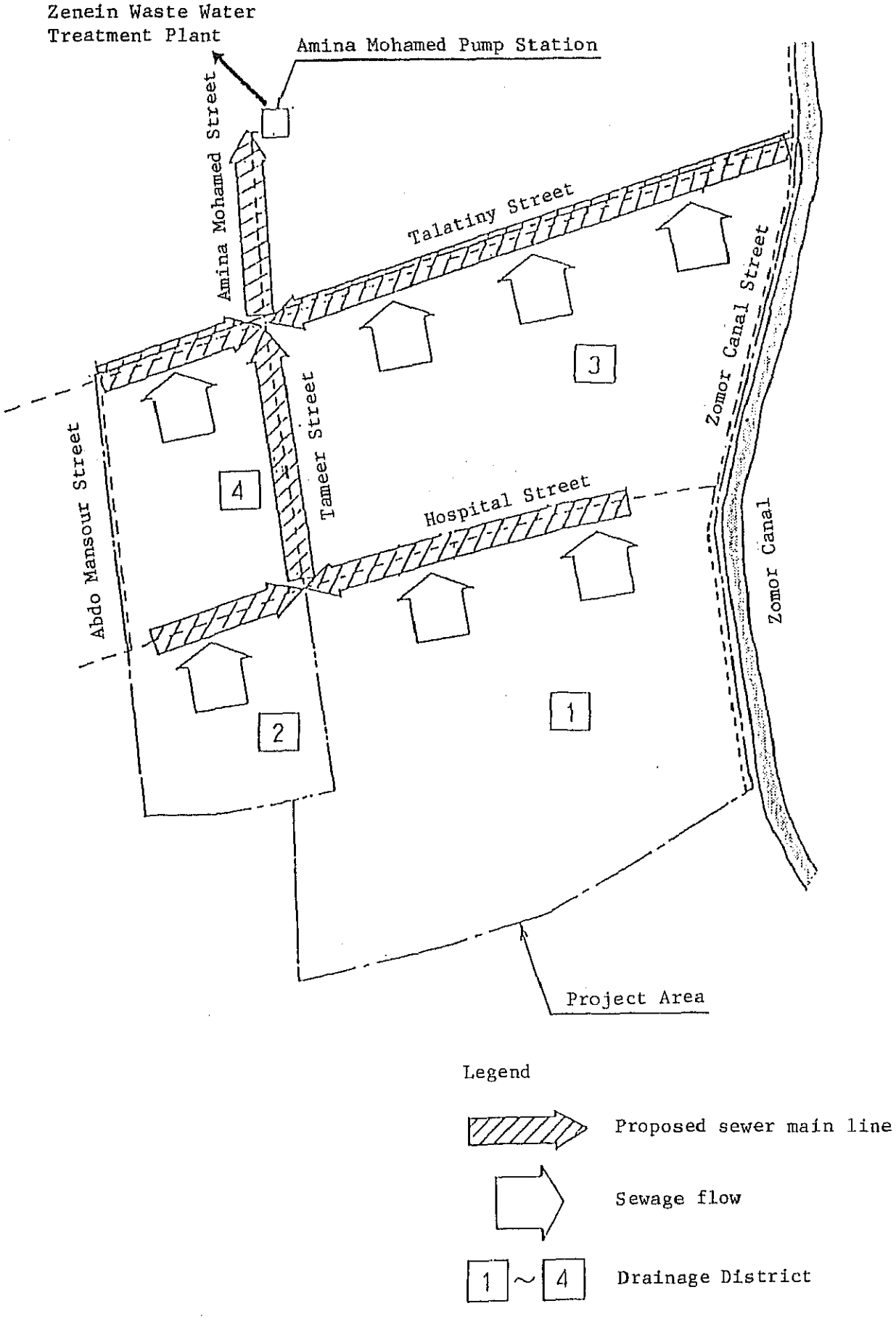


Fig. 5-3 Drainage System Chart of Proposed Sewer Facilities

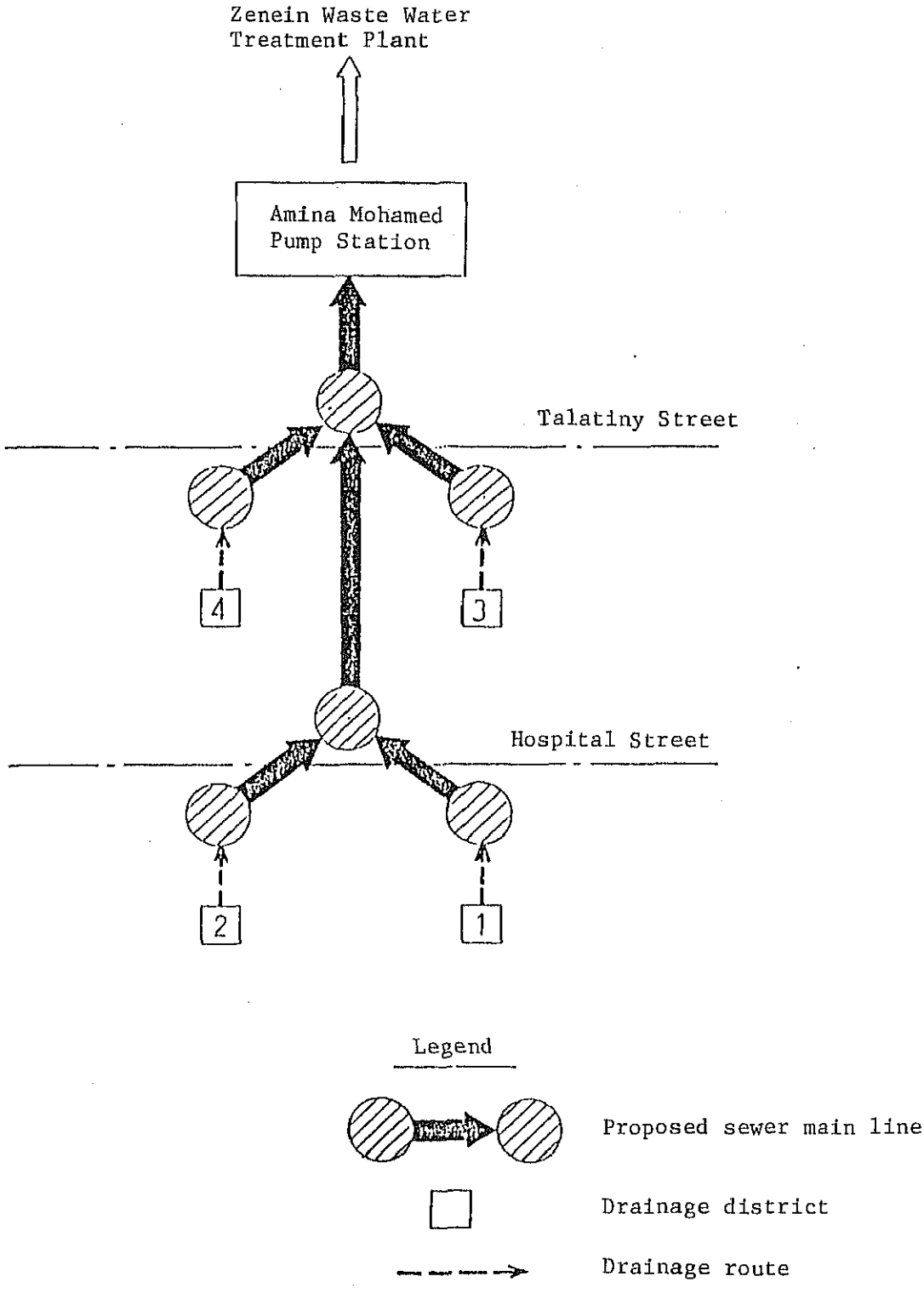


Fig. 5-4 Drainage Flow Chart of Proposed Sewer Facilities

5) Design of pipe line

a) Manhole

① Spacing of manholes

The standard spacing of manholes will be established according to the following table:

Table 5-4 Standard Spacing of Manholes

Pipe dia (mm)	Less than 300	Less than 600	Less than 1,000	Less than 1,500	More than 1,650
Max spacing (m)	50	75	100	150	200

Source: Japan Sewage Association "Guideline and manual of Sewage Facilities Design"

The maximum spacing of manholes will be set at 150m because the pipe diameter of the sewer main line under this Project is 1,200mm. Manholes will be located, taking into consideration the available space on the road, road width, vehicular and pedestrian traffic, existing underground services, access to dwellings and shops, and points of connection of existing pipes to the main line under this Project.

② Construction of manhole

Taking into account the size of incoming and outgoing pipes, the inner dimension of the manhole will be determined from the following formula and will be as shown in Section 5-3, basic design drawing (EGU-S-03).

$$B = D + 2(t + 100)$$

where B: inner dimension of manhole (mm)

D: inner diameter of incoming (outgoing) pipe (mm)

t: wall thickness of incoming (outgoing) pipe (mm)

For a construction drawing of the manhole, refer to the attached basic design drawing (EGU-S-03). The manhole will be lined with blue brick to protect the structure against corrosion due to harmful acids produced by sewage.

b) Check on cross section, gradient, velocity and flow capacity of pipe lines

To study the cross section, gradient, velocity and flow capacity of pipe lines, following Ganguillet-Kutter formula will be used:

$$V = \frac{23 + \frac{1}{n} + \frac{0.00155}{I}}{1 + (23 + \frac{0.0015}{I}) \times \frac{n}{\sqrt{R}}} \times \sqrt{RI}$$

$$Q = W_A \times V$$

where V : velocity (m/sec)
I : gradient
R : Hydraulic mean depth (m) (W_A/W_P)
W_A: flow area (m^2)
W_P: wetted perimeter (m)
Q : flow rate (m^3/sec)
n : coefficient of roughness

c) Study on pipe diameter

① Required minimum pipe diameter and length

Fig. 5-5 is the route map of sewer pipelines and drainage areas allocated to each pipeline. Table 5-5 shows the design sewage volume, pipe diameter and discharge capacity of each pipeline calculated on the basis of the design conditions described previously and the flow velocity formula mentioned above. Fig. 5-6 shows the required minimum pipe diameter and the length of each pipeline.

② Selection of pipe diameter

As shown in Table 5-5, pipe diameter as calculated ranges between 400 and 1,200mm. In this facilities plan, however, the pipe diameter shall be the required maximum diameter of 1,200mm for the following reasons.

- The pipe jacking method will be employed in laying pipes under this project. If pipelines of different diameters were adopted, jacking machines adaptable to each different diameter would be required, which would result in an increase in the number of machine models and machines as well as the cost of work. Furthermore this may lead to a delay in procurement of piping materials and work schedule as the work would become more complicated.

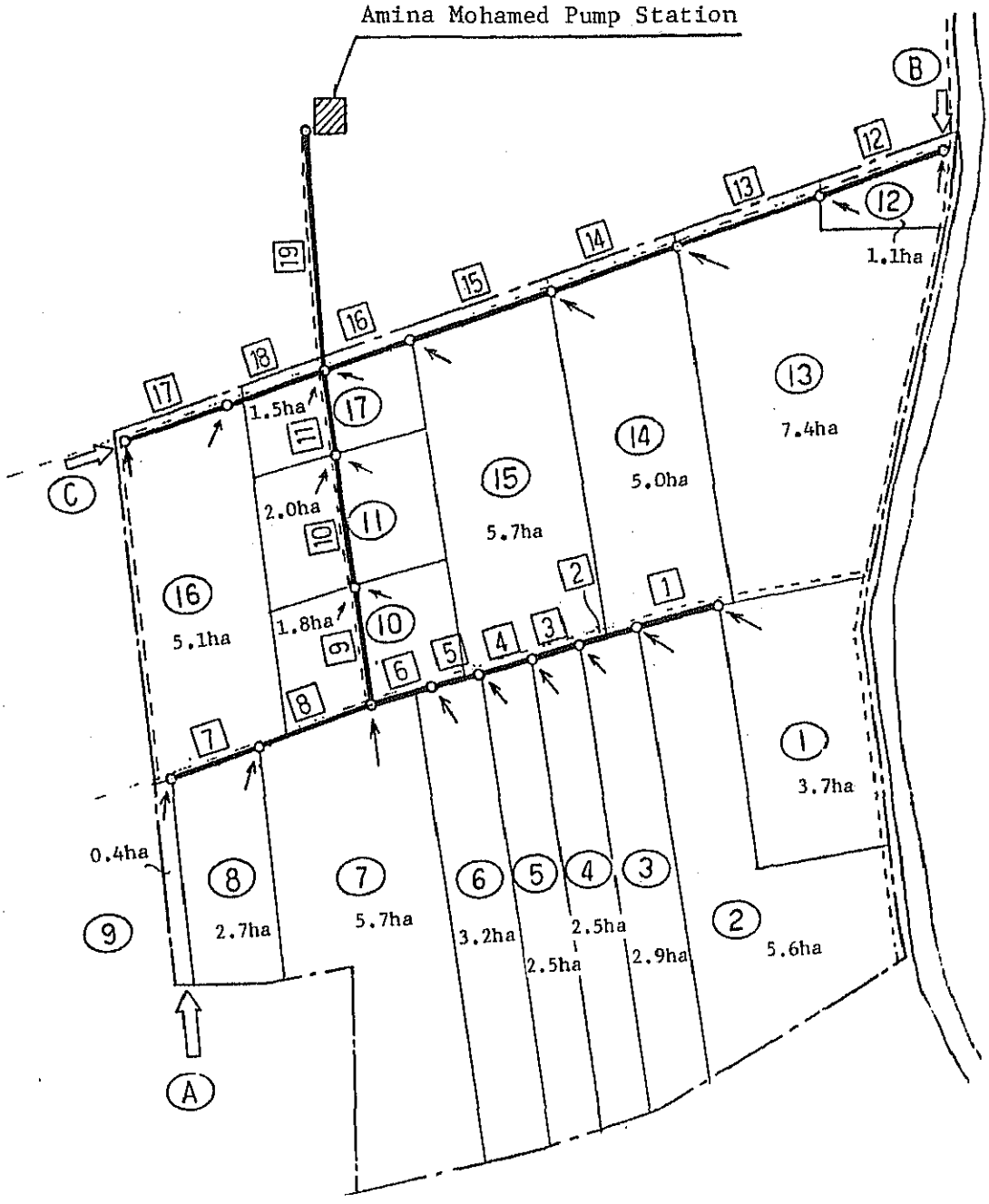
Also, if small diameter pipes for the jacking method were employed, the long distance jacking method would not be employable in the light of workability and the machine models to be adopted, which would result in a jacking length and an increase in the number of jacking and receiving pits. This may lead to an increase in the cost of work and a delay in the work schedule. It may require detouring and protective works on existing underground services. Furthermore, it may also have a greater adverse impact on the inhabitants nearby, on traffic, etc.

Comparison of construction costs between using a pipe diameter of 1,200mm (Case Ⓐ) or using three pipe diameters of 600,900, and 1,200mm (Case Ⓑ), shows that the cost of Case B is about 10% higher than that of Case Ⓐ. Since pipes for the jacking method with diameters of 600mm or smaller cannot be procured in Egypt, they were excluded from the comparison.

- In consideration of having an Egyptian manufacturer producing reinforced concrete pipes for the jacking method (according to Japanese Standards and the design drawings), it is necessary to minimize the variety of pipe diameters to simplify the wofk, secure the predetermined delivery schedule and reduce the costs.

- In consideration of the pipeline cleaning situation on the West Bank of the Nile River including Giza City where cleaning is mainly done manually, the pipe diameters must be made large enough to let the man enter the pipe for cleaning.

The gradients, pipe bottom heights and earthcovering thicknesses of the pipelines under this project are as shown Section 5-3, basic design drawing (EGU-S-02).



① ~ ⑰ : Drainage district

Ⓐ ~ Ⓒ : Inflow of sewage from outside the project area

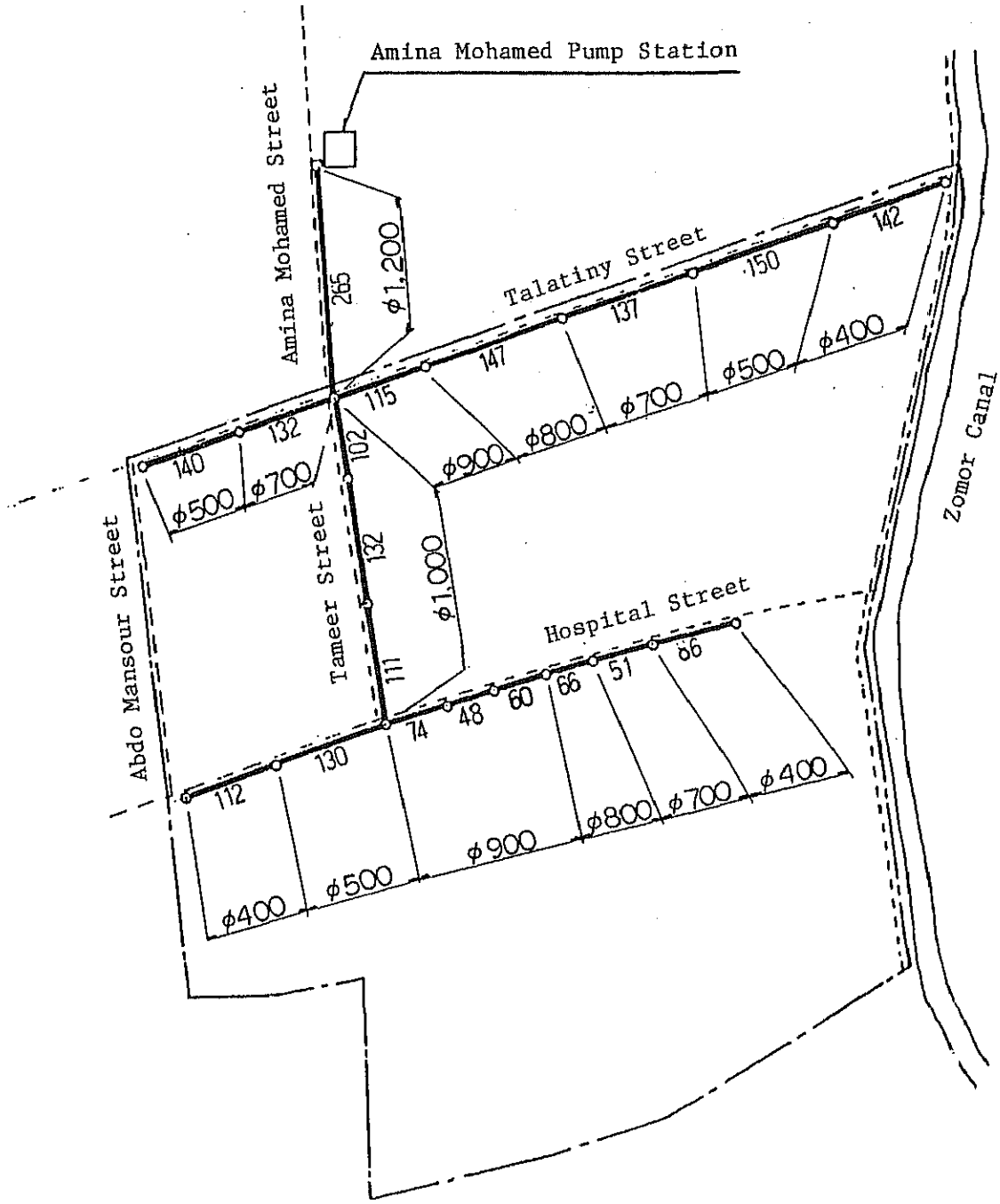
[1] ~ [19] : Route No.

: Inflow of sewage from existing pipes into the proposed sewer main line

Fig. 5-5 Route Nos. and Drainage District Allocation of Proposed Sewer Main Lines

Table 5-5 Design Sewage Volume, Pipe Diameter and Discharge Capacity of Pipe

Route No.	Extension Length (m)	Drainage District		Qty. of Sewage Inflowing from Outside the District (m^3/sec.) ①	Design Qty. of Sewage (m^3/sec.) Drainage area (ha) x 0.0138m^3/sec/ha + I	Pipe Dia. (mm)	Flow Rate (m^3/sec.)	Remark
		District No.	Area (ha)					
1	86	①	3.7		0.051	400	0.052	
2	51	①, ②	9.3		0.128	700	0.131	
3	66	①～③	12.2		0.168	800	0.175	
4	60	①～④	14.7		0.203	900	0.223	
5	48	①～⑤	17.2		0.237	900	0.241	
6	74	①～⑥	20.4		0.282	900	0.289	
7	112	⑨	0.4	Ⓐ 0.019	0.025	400	0.038	
8	130	⑧, ⑨	3.1	Ⓐ 0.019	0.062	500	0.064	
9	111	①～⑨	29.2		0.403	1,000	0.427	
10	132	①～⑩	31.0		0.428	1,000	0.458	
11	102	①～⑪	33.0		0.455	1,000	0.486	
12	142		-	Ⓑ 0.040	0.040	400	0.042	
13	150	⑫	1.1	Ⓑ 0.040	0.055	500	0.062	
14	137	⑫, ⑬	8.5	Ⓑ 0.040	0.157	700	0.161	
15	147	⑫～⑭	13.5	Ⓑ 0.040	0.186	800	0.199	
16	115	⑫～⑮	19.2	Ⓑ 0.040	0.305	900	0.318	
17	140		-	Ⓒ 0.065	0.065	500	0.070	
18	132	⑯	5.1	Ⓒ 0.065	0.135	700	0.139	
19	265	①～⑰	58.8	Ⓐ～Ⓒ 0.124	0.935	1,200	0.957	
Total	2,200							



Pipe dia. (mm)	Length (m)
400	340
500	420
700	320
800	213
900	297
1000	345
1200	265
計	2,200

Fig. 5-6 Required Minimum Pipe Diameter and Length of Proposed Sewer Main Lines

(2) Sedimentation Basin

1) Layout plan for facilities

To improve existing Amina Mohamed Pump Station, secure its functions, increase its maintenance and management efficiency and improve environmental conditions in this area, the following facilities will be installed:

a) Sedimentation Basin : 2 channels

b) Grit removal equipment : Automatic (1 unit)

c) Trash removal equipment: Automatic (2 units)

d) Ancillary equipment : Gates, etc.

Installation of the sedimentation basin will remove grit of particle size over 0.2mm and coarse suspended matter in sewage. This will reduce deposits of sand in pump wells and distribution pipes, prevent wear and malfunctions of pipe lines, pumps and sewage treatment facilities, improve their operation, maintenance and management efficiency, and reduce costs.

For the layout of sedimentation basin facilities, refer to Section 5-3, basic design drawing (EGU-S-06).

2) Design of sedimentation basin

The sedimentation basin will basically be designed according to the "Guideline and Manual of Sewage Facilities Design", of Japan Sewage Association.

a) Dimensions of sedimentation basin

For structural outline of the sedimentation basin, refer to Section 5-3, basic design drawing (EGU-S-05). Its rough principal dimensions are as follows:

- Effective water depth: H = about 1.2m
- Effective length : L = about 5.2m
- Effective width : W = about 3.6m

b) Setting design sewage flow

All sewage in the Project area will flow into this pump station. The design sewage flow in the target year is $0.94m^3/sec$. However, sewage flow for the purpose of designing the sedimentation basin will be set at $1.1m^3/sec$. This is based on the assumption that about the $0.2m^3/sec$ additional sewage will flow from the vicinity of Amina Mohamed Pump Station (a drainage area of about 20ha) because the same conditions as in the Project area is considered to be applicable to this neighboring area.

c) Study of average velocity

For the average velocity of flow in sedimentation basin, about 0.3m/sec is considered standard. Sedimentation basins are generally designed so that flow velocities will fall within a range of 0.25 to 0.35m/sec.

The average velocity is obtained from the following formula:

$$V = \frac{Q}{W \times H}$$

where V: average velocity (m/sec)
Q: incoming sewage flow (m^3/sec)
W: effective width of basin (m)
H: effective water depth of basin (m)

The actual velocity is as follows.

$$V = \frac{Q}{W \times H} = \frac{1.1}{3.6 \times 1.2} = 0.25\text{m/sec}$$

Therefore this velocity is considered appropriate for this Project.

d) Detention period

The detention period in the sedimentation basin has a substantial effect on removal of grit and coarse suspended matter in sewage. The detention period of about 30 to 60 seconds is generally considered standard although this varies depending on the size of sedimentation basins and their relative importance in the entire sewage treatment system.

The detention period is calculated by the following formula:

$T = L/V$

where T: detention period (sec)
L: effective length of basin (m)
V: average flow velocity (m/sec)

In this sedimentation basin, the detention period for sewage can be calculated as follows:

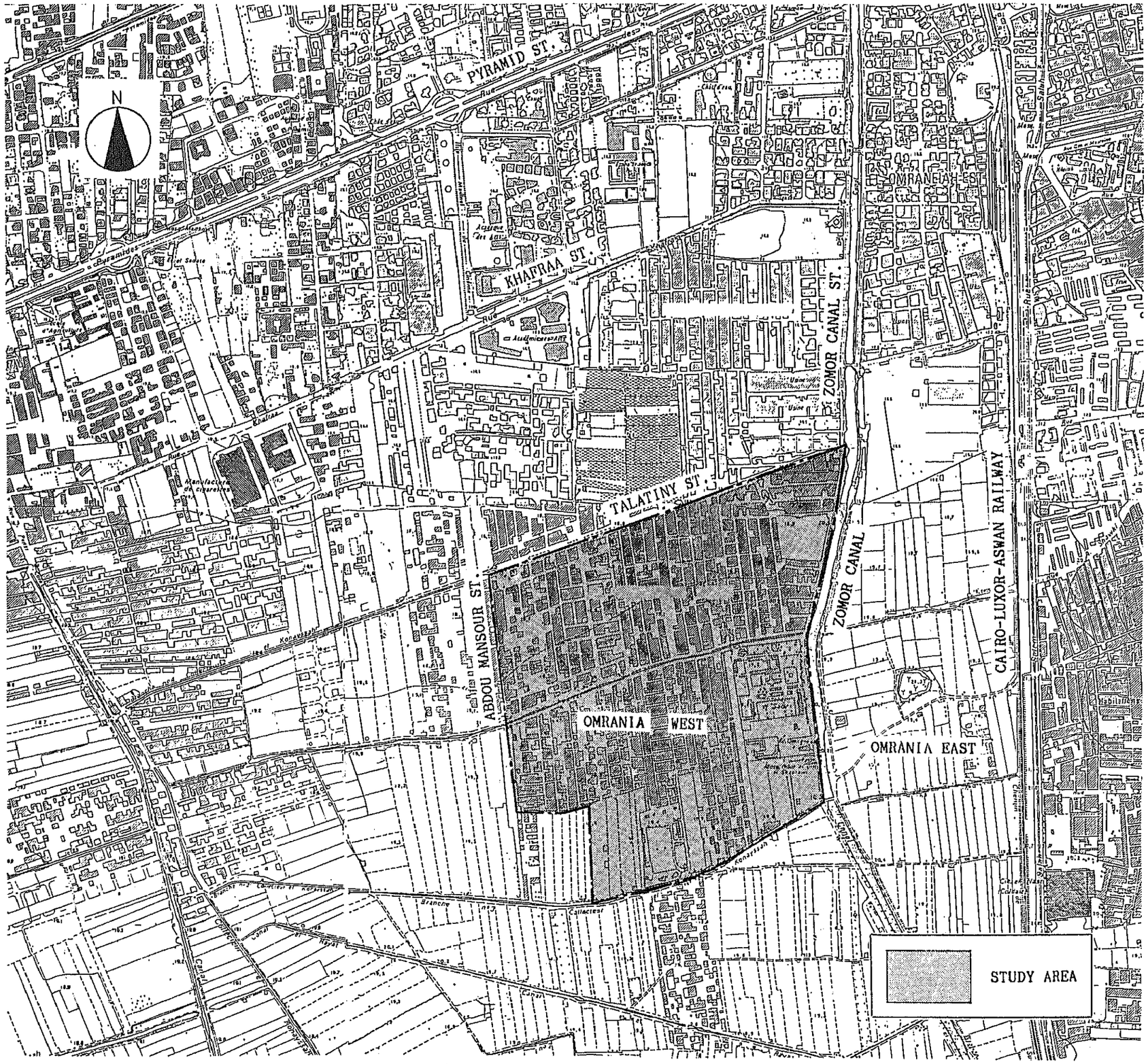
$T = L/V = 5.2/0.25 = 21$ (sec)

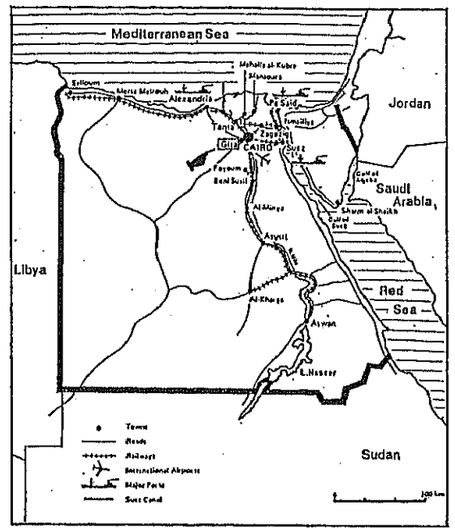
This is lower than the standard value. However, considering the available space for the construction of this sedimentation basin is limited and the design incoming sewage flow is small, it was confirmed in consultation with the Greater Cairo General Organization for Sanitary Drainage, Egypt, that this detention period is acceptable.

5-3 Basic Design Drawings

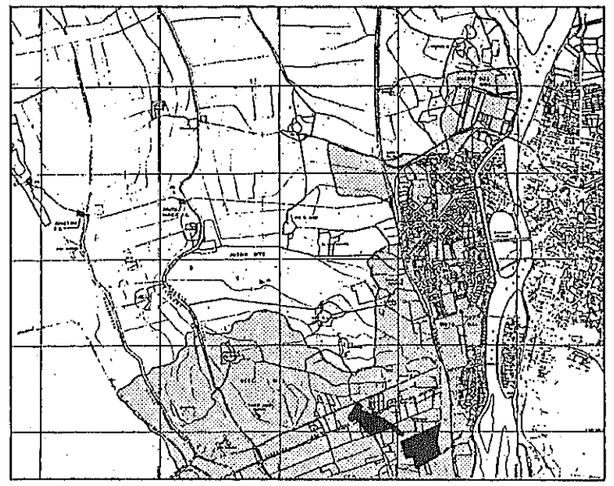
The area of this Project and the general arrangement of water supply and sewer main lines are as shown in the basic design drawing EGU-G-01 and G-02 respectively. Contents of the basic design of the water supply and sewer facilities are as follows:

- For contents of the basic design of the water supply facilities, refer to attached drawings EGU-W-01 to 08.
- For contents of the basic design of the sewer facilities, refer to attached drawings EGU-S-01 to 06.



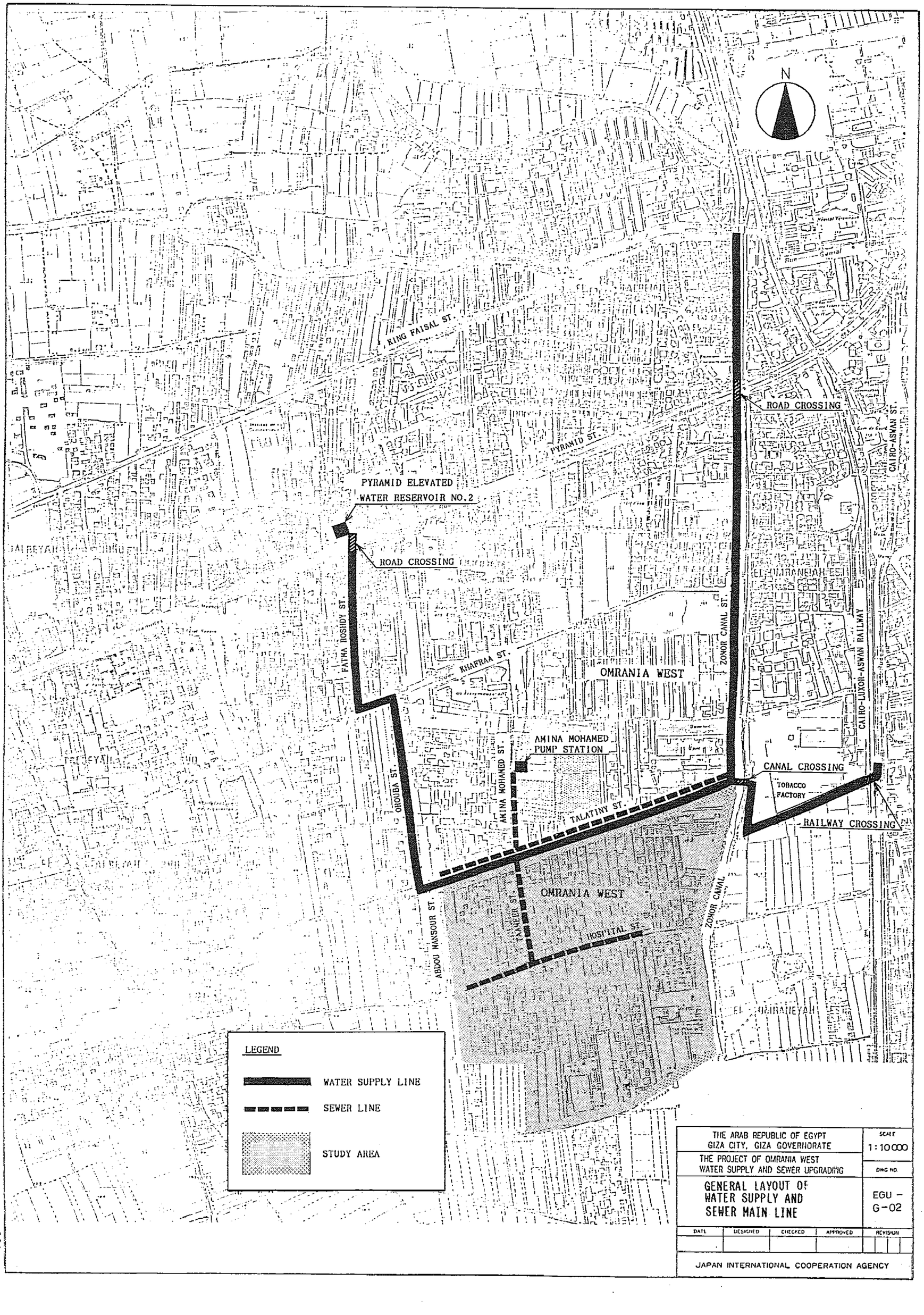


THE ARAB REPUBLIC OF EGYPT



GIZA CITY

THE ARAB REPUBLIC OF EGYPT GIZA CITY, GIZA GOVERNORATE				SCALE 1:10000
THE PROJECT OF OMRANIA WEST WATER SUPPLY AND SEWER UPGRADING				DWG.NO.
LOCATION OF STUDY AREA				EGU - G - 01
DATE	DESIGNED	CHECKED	APPROVED	REVISION
JAPAN INTERNATIONAL COOPERATION AGENCY				



THE ARAB REPUBLIC OF EGYPT GIZA CITY, GIZA GOVERNORATE	SCALE 1:10000
THE PROJECT OF OMRANIA WEST WATER SUPPLY AND SEWER UPGRADING	DWG NO.
GENERAL LAYOUT OF WATER SUPPLY AND SEWER MAIN LINE	EGU – G-02

DATE	DESIGNED	CHECKED	APPROVED	REVISION

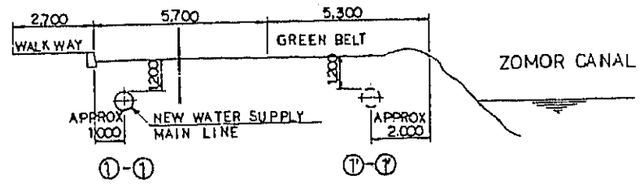
JAPAN INTERNATIONAL COOPERATION AGENCY

5-3-1 Water Supply

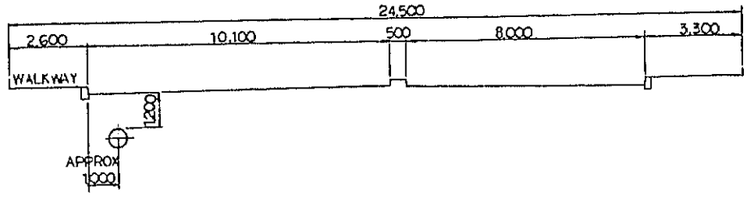
GENERAL PLAN S=1:5,000

LOCATION OF NEW WATER SUPPLY MAIN LINE S=1:100

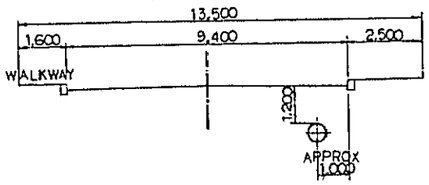
SECTION ①-① (①'-①')
(ZOMOR CANAL ST.)



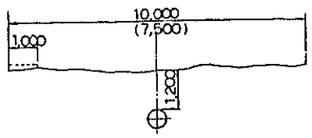
SECTION ②-②
(TALATINY ST.)



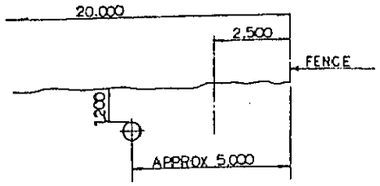
SECTION ③-③
(FATMA ROSHDY ST.)



SECTION ④-④
(OROUBA ST.)



SECTION ⑤-⑤



THE ARAB REPUBLIC OF EGYPT GIZA CITY, GIZA GOVERNORATE	SCALE
THE PROJECT OF OMRANIA WEST WATER SUPPLY AND SEWER UPGRADING	DWG NO.
WATER SUPPLY MAIN LINE - PLAN	EGU - W-01
DATE / DESIGNED / CHECKED / APPROVED	REVISION
JAPAN INTERNATIONAL COOPERATION AGENCY	

PLAN S=1:5,000

LEGEND

⋈	VALVE CHAMBER
⋈	AIR RELIEF VALVE CHAMBER
⋈	WASH-OUT VALVE CHAMBER
C1~C5	CONNECTION WITH EXISTING PIPE(TYPE 1~5)
FC	FUTURE CONNECTION

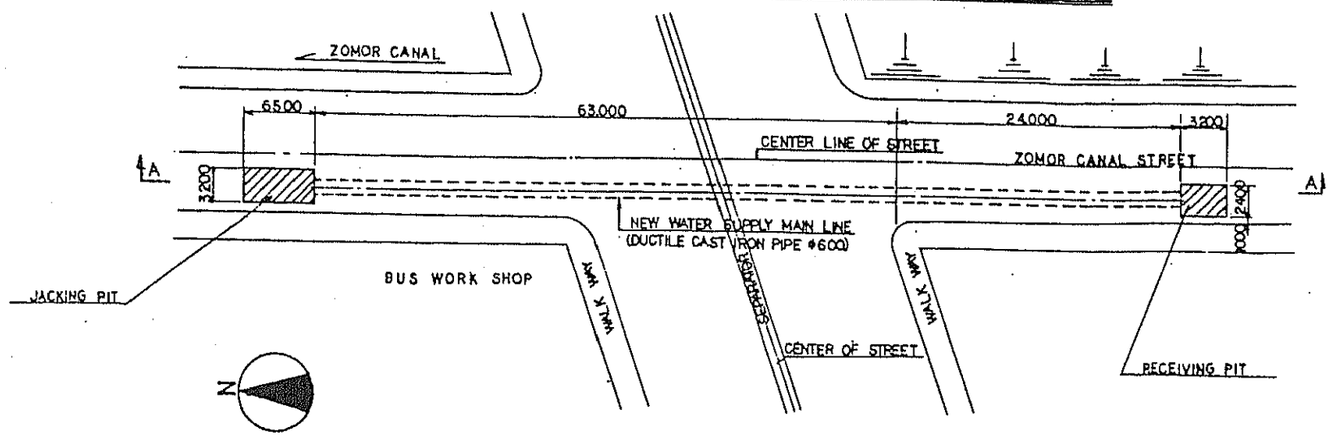
NOTE

(1) TYPICAL LAYOUT OF CHAMBERS AND CONNECTIONS ARE SHOWN ON THE DWG NO. EGU-W-05~08

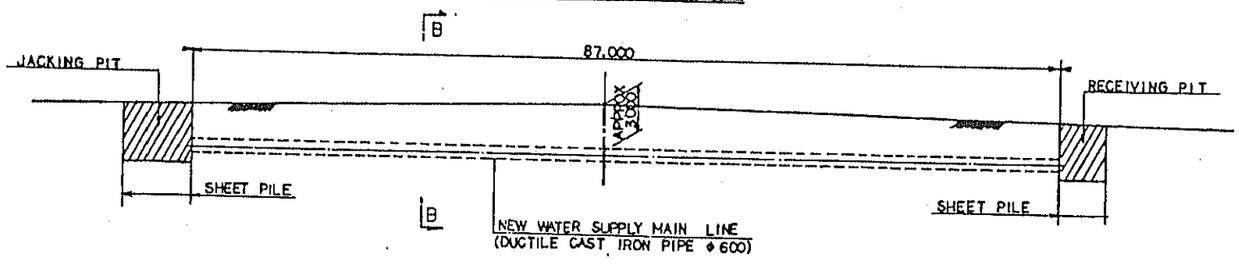
(2) FIRE HYDRANT SHALL BE PROVIDED ON THE NEW WATER MAIN PIPELINE AT EVERY APPROXIMATELY 150 METERS.

THE ARAB REPUBLIC OF EGYPT GIZA CITY, GIZA GOVERNORATE				SCALE
THE PROJECT OF OMRANIA WEST WATER SUPPLY AND SEWER UPGRADING				DWG.NO.
LAYOUT OF APPURTENANCES				EGU- W-02
DATE	DESIGNED	CHECKED	APPROVED	REVISION
JAPAN INTERNATIONAL COOPERATION AGENCY				

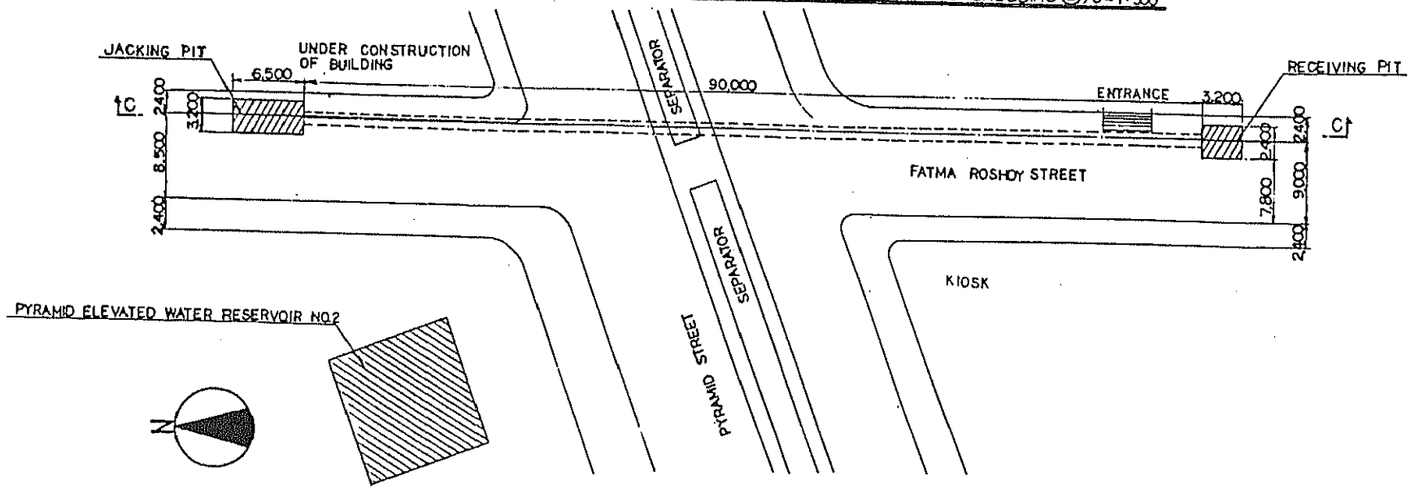
PLAN OF JACKING METHOD AT PYRAMID STREET (ROAD CROSSING Ⓐ) S=1:300



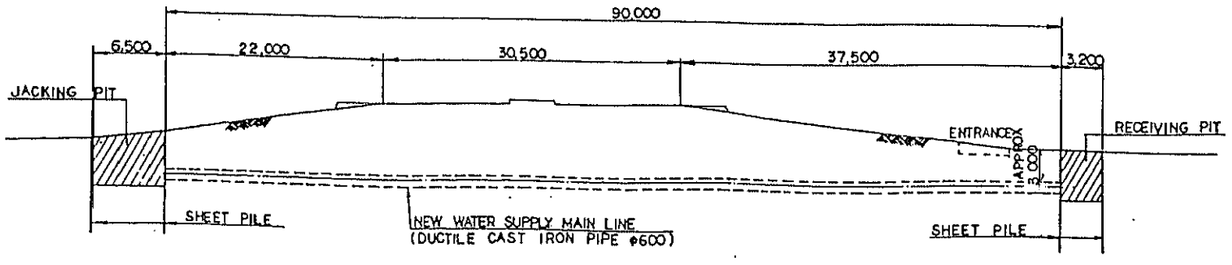
SECTION A–A S=1:300



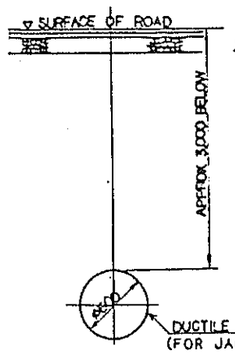
PLAN OF JACKING METHOD AT PYRAMID STREET (ROAD CROSSING Ⓑ) S=1:300



SECTION C–C S=1:300

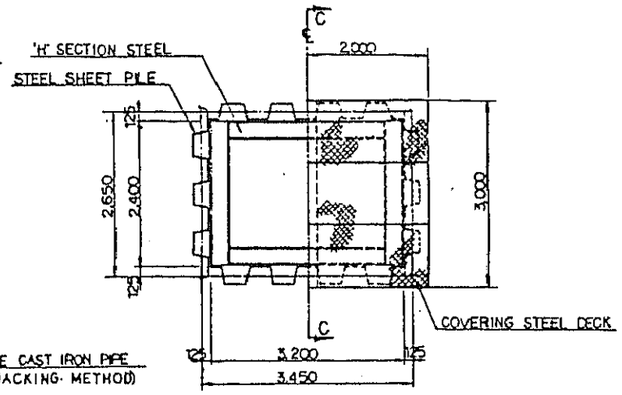


SECTION B-B

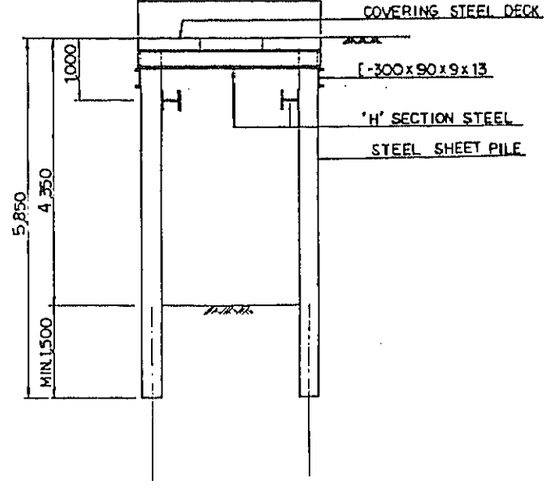


COVERING OF RECEIVING PIT S=1:50

PLAN



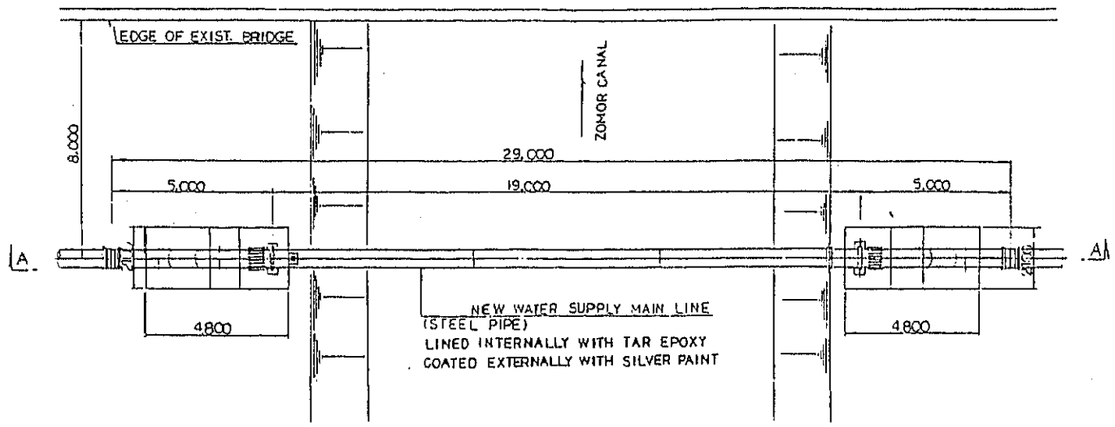
SECTION C-C



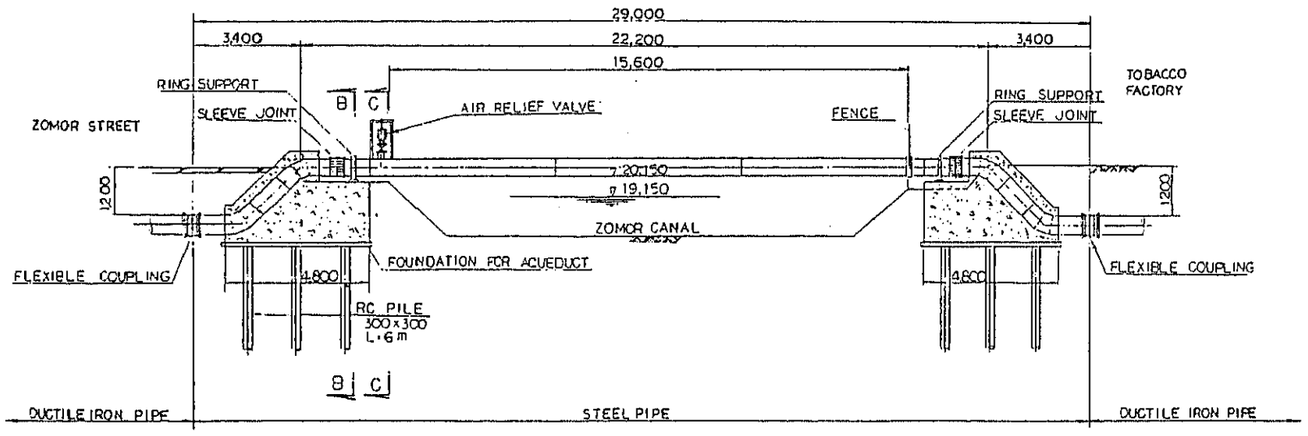
THE ARAB REPUBLIC OF EGYPT GIZA CITY, GIZA GOVERNORATE				SCALE
THE PROJECT OF OMRANIA WEST WATER SUPPLY AND SEWER UPGRADING				DWG NO.
CROSSING AT PYRAMID ST. - PLAN AND SECTION				EGU-W-03
DATE	DESIGNED	CHECKED	APPROVED	REVISION
JAPAN INTERNATIONAL COOPERATION AGENCY				

TYPICAL SECTION OF AQUEDUCT OVER THE CANAL S=1:100

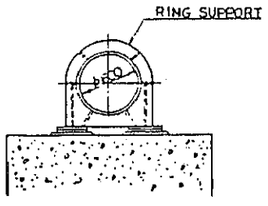
PLAN



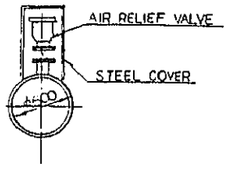
A-A SECTION



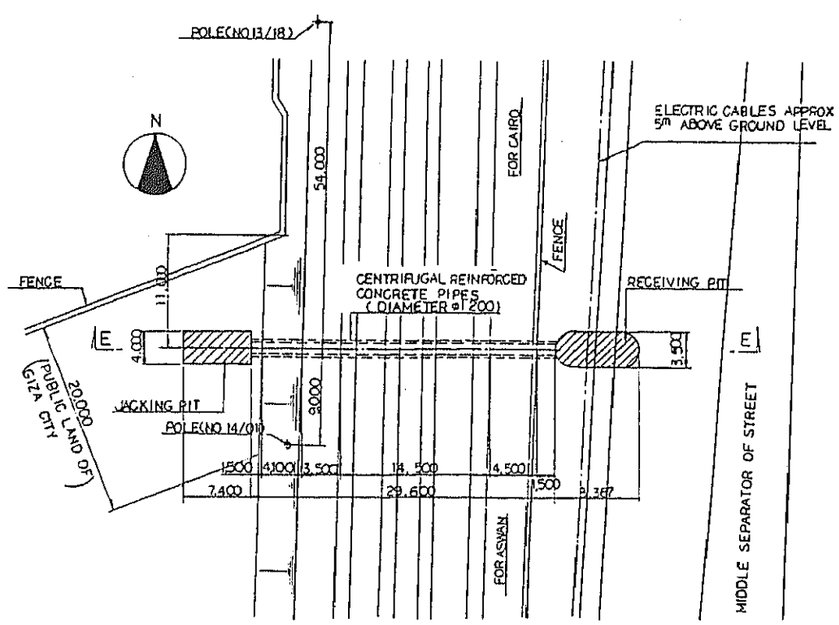
B-B SECTION S=1:30



C-C SECTION S=1:30

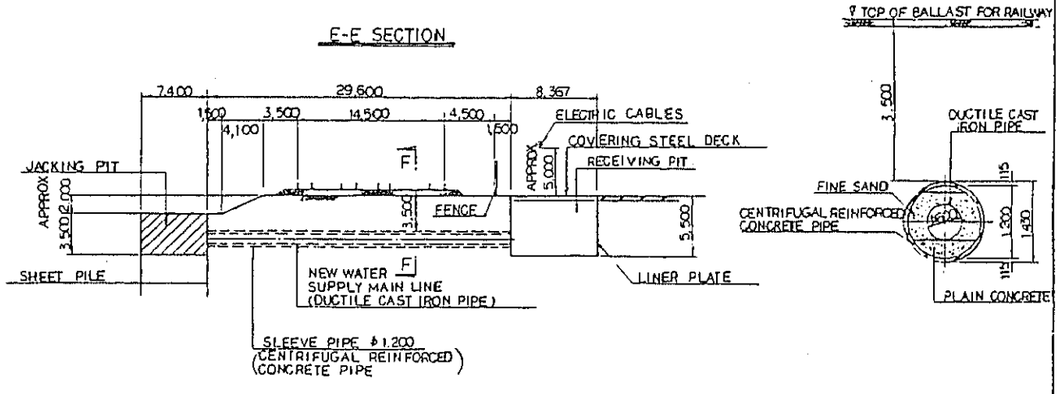


PLAN OF JACKING METHOD AT RAILWAY CROSSING S=1:300



F-F SECTION

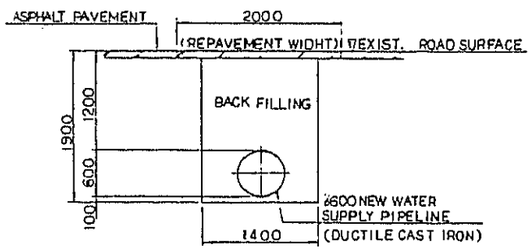
F-F SECTION S=1:50



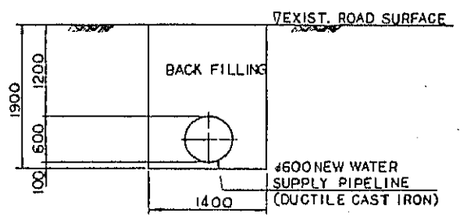
THE ARAB REPUBLIC OF EGYPT GIZA CITY, GIZA GOVERNORATE				SCALE
THE PROJECT OF OMRANIA WEST WATER SUPPLY AND SEWER UPGRADING				DWG. NO.
CROSSING AT CANAL AND RAILWAY - PLAN AND SECTION				EGU- W-04
DATE	DESIGNED	CHECKED	APPROVED	REVISION
JAPAN INTERNATIONAL COOPERATION AGENCY				

TYPICAL SECTION S=1:40

PAVED ROAD



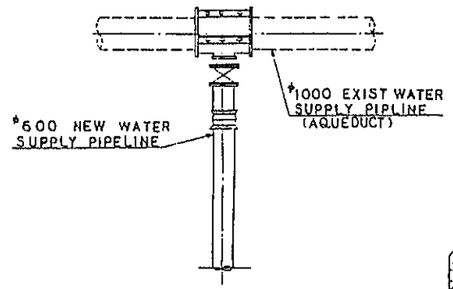
UNPAVED ROAD



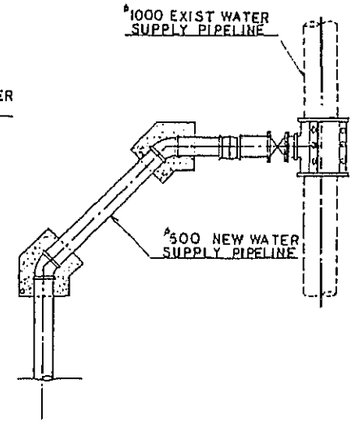
NOTE
1. SHEATHING WORK SHALL BE BY WOODEN SHEET OR TRENCH SHEET PILE

DETAIL OF CONNECTION S=1:100

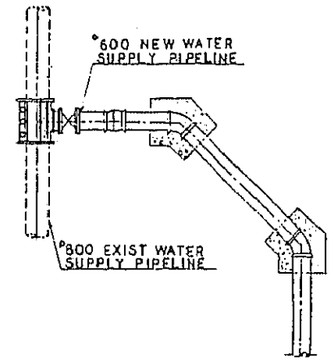
CONNECTION (A) (KING FAISAL STREET)



CONNECTION (B) (CAIRO-ASWAN STREET)



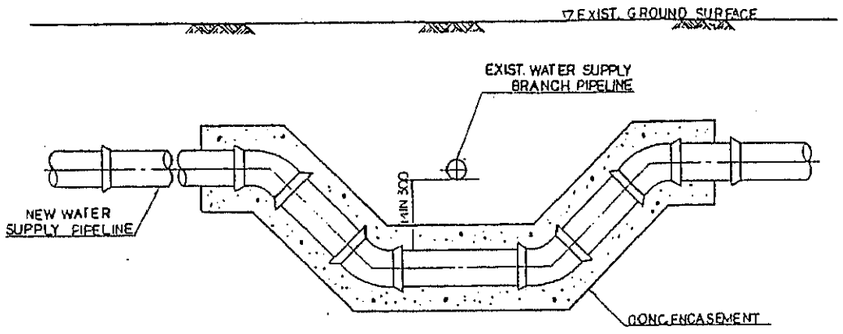
CONNECTION (C) (NEAR THE PYRAMID ELEVATED WATER RESERVOIR NO.2)



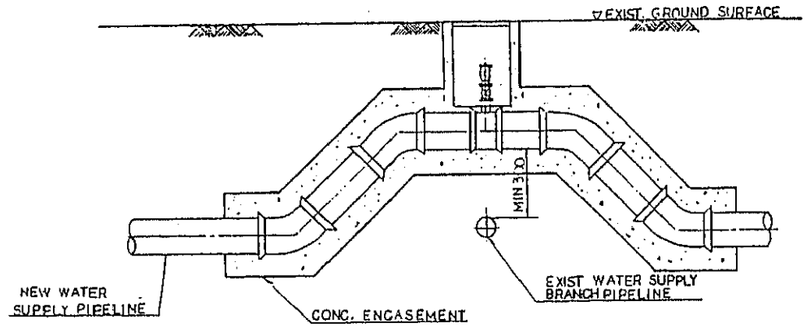
THE ARAB REPUBLIC OF EGYPT GIZA CITY, GIZA GOVERNORATE				SCALE
THE PROJECT OF OMRANIA WEST WATER SUPPLY AND SEWER UPGRADING				Dwg no.
CONCEPTUAL PLAN AND SECTION OF STRUCTURE(1/2)				EGU - W-05
DATE	DESIGNED	CHECKED	APPROVED	REVISION
JAPAN INTERNATIONAL COOPERATION AGENCY				

TYPICAL PIPE CROSSING OF EXIST. WATER MAIN PIPE S=1:50

TYPE A

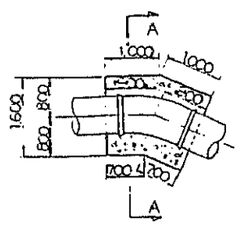


TYPE B

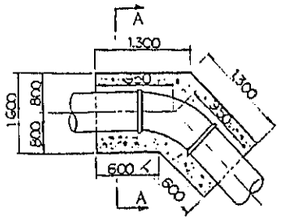


ANCHOR BLOCK STANDARDS S=1:50

INCASE OF 22 1/2° BEND

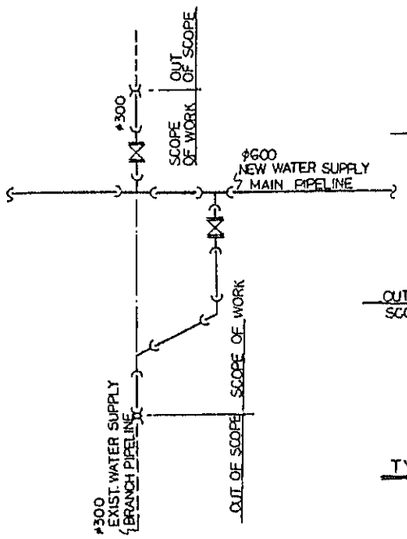


INCASE OF 45° BEND



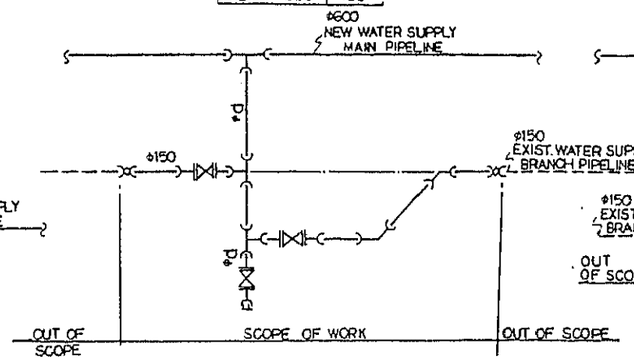
DETAIL OF CONNECTION

TYPE. C1

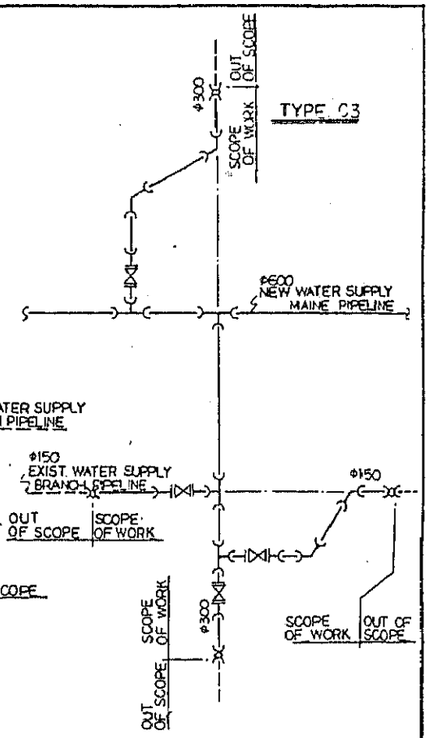


TYPE. C2 & C5

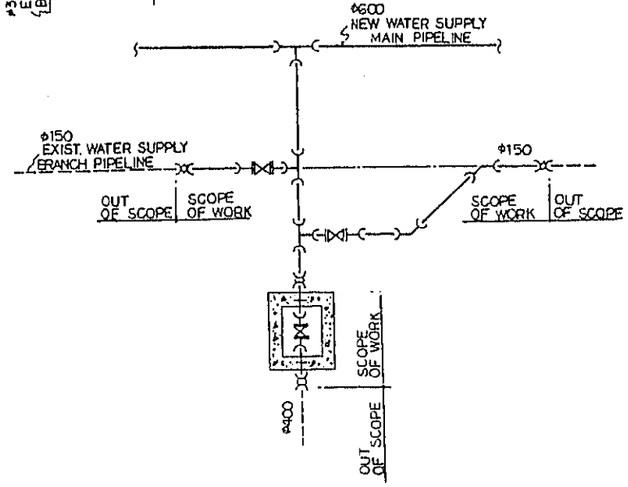
	C2	C5
d	200	150



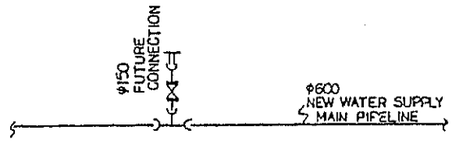
TYPE. C3



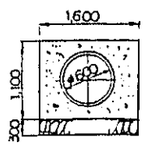
TYPE. C4



TYPE. FC



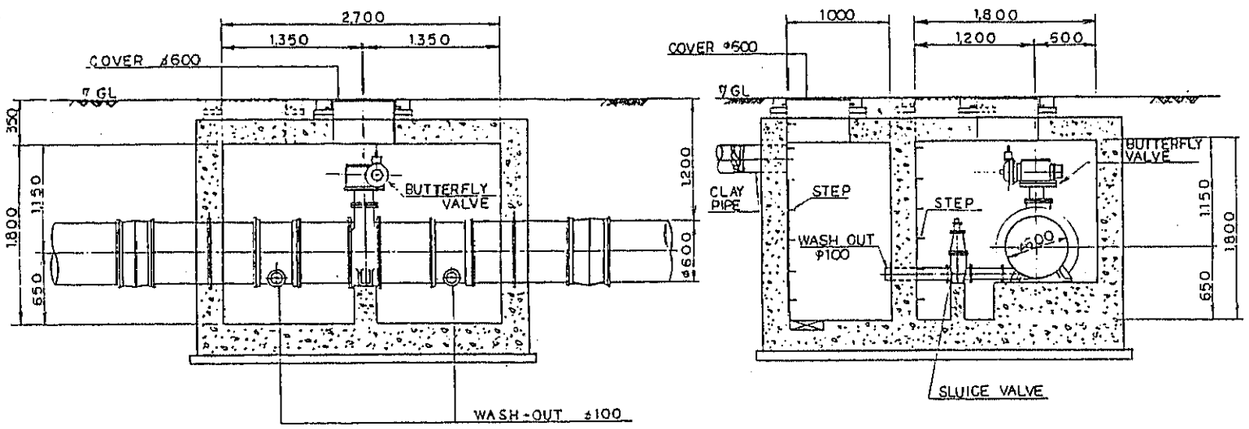
SECTION A–A



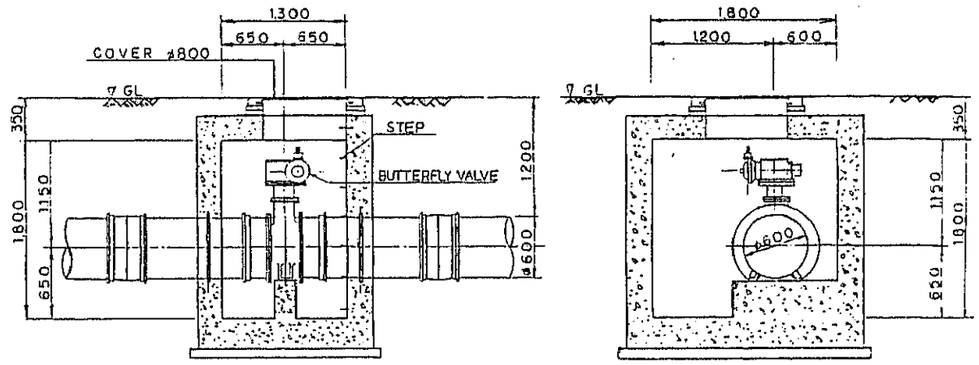
THE ARAB REPUBLIC OF EGYPT GIZA CITY, GIZA GOVERNORATE	SCALE
THE PROJECT OF OMRANIA WEST WATER SUPPLY AND SEWER UPGRADING	DWG NO
CONCEPTUAL PLAN AND SECTION OF STRUCTURE(2/2)	EGU – W-06
DATE / DESIGNED / CHECKED / APPROVED	REVISION
JAPAN INTERNATIONAL COOPERATION AGENCY	

VALVE CHAMBER S = 1:30

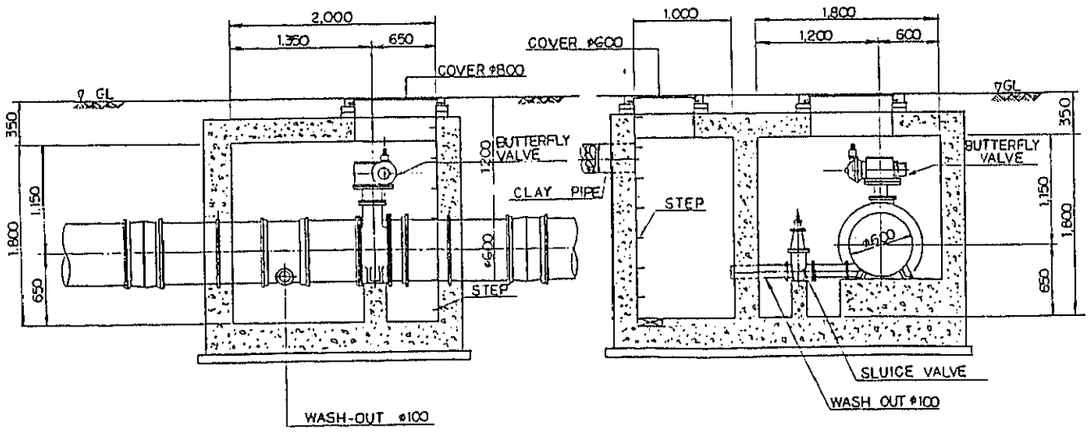
TYPE A



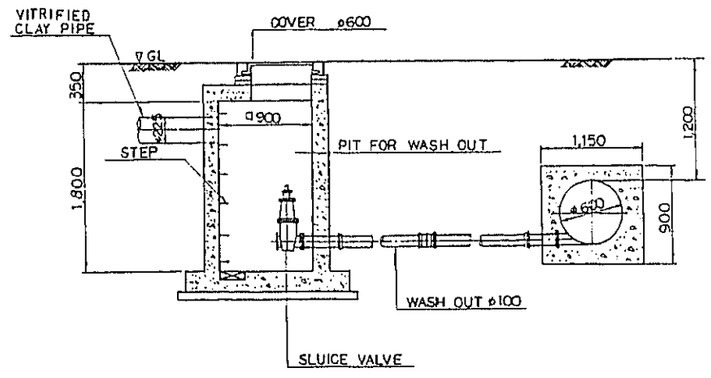
TYPE C



TYPE B



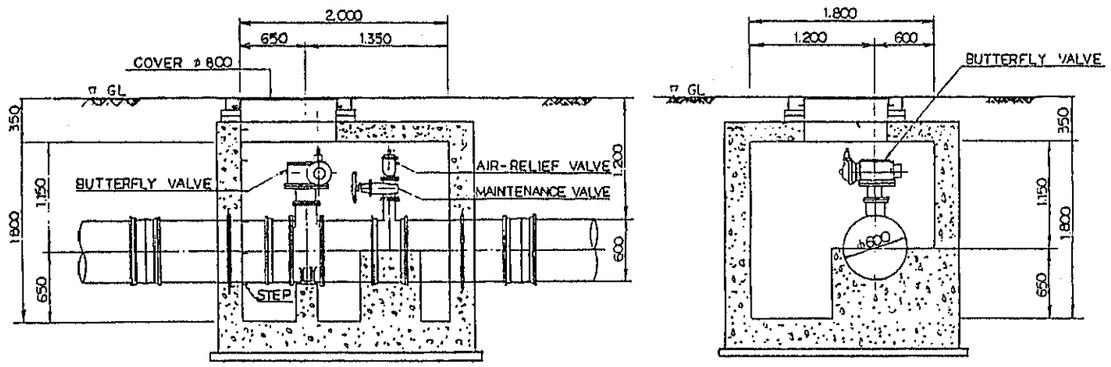
TYPICAL SECTION OF WASH-OUT



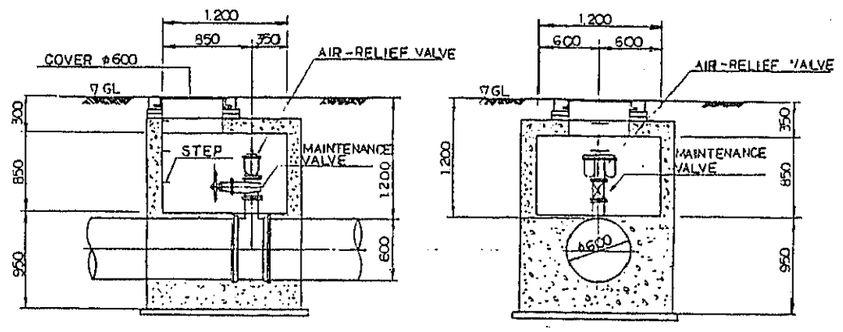
THE ARAB REPUBLIC OF EGYPT GIZA CITY, GIZA GOVERNORATE				SCALE
THE PROJECT OF OMPANIA WEST WATER SUPPLY AND SEWER UPGRADING				DWG NO.
STRUCTURAL STANDARD OF APPURTENANCES(1/2)				EGU- W-07
DATE	DESIGNED	CHECKED	APPROVED	REVISION
JAPAN INTERNATIONAL COOPERATION AGENCY				

VALVE CHAMBER S = 1 : 30

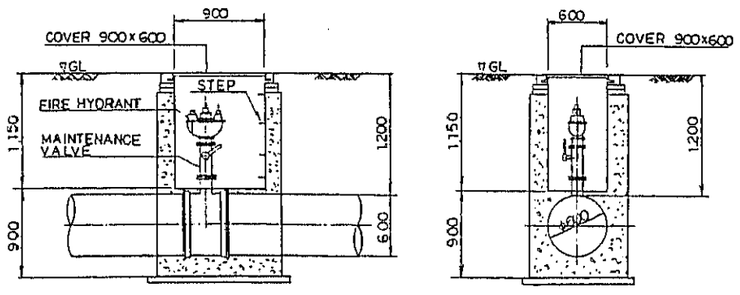
TYPE D



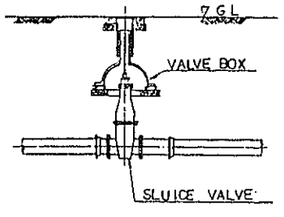
AIR-RELIEF VALVE CHAMBER S = 1 : 30



FIRE HYDRANT CHAMBER S = 1:30



VALVE BOX S = 1:30



THE AEAB REPUBLIC OF EGYPT GIZA CITY GIZA GOVERNORATE				SCALE
THE PROJECT OF OMRANIA WEST WATER SUPPLY AND SEWER UPGRADING				DWG NO.
STRUCTURAL STANDARD OF APPURTENANCES(2/2)				EGU- W-08
DATE	DESIGNED	CHECKED	APPROVED	REVISION
JAPAN INTERNATIONAL COOPERATION AGENCY				