11.2.3 Prioritized IWs

(1) Prioritized IWs by the year 2020

The master plan gives priority to the following IWs in consideration of cargo forecast at each seaport, cost competitiveness against other transport modes by each route until its target year of 2020

Among the first class IW connecting major seaports and Cairo Capital Region (GCR), the master plan will focus on the following two IWs.

These two IWs shape major water-borne transport axes in Egypt, and can be effectively used for mass-transport of specific cargoes, because the terminals of these IWs, namely Alexandria, Damietta and GCR, generate and attract much of the cargo in the country.

- **Alexandria / Cairo IW (Beheiry and Nobaria Canals)**
- **Damietta / Cairo IW (Damietta Branch)**

In addition, the following new connection IW is also prioritized to supplement functions of Alex./Cairo IW, this new IW is expected to provide access to Kafr El Zayat (industrial estate) from Upper Nile and Alexandria.

- **A new canal** to connect Beheiry canal and Rosetta Branch **at Bolin**

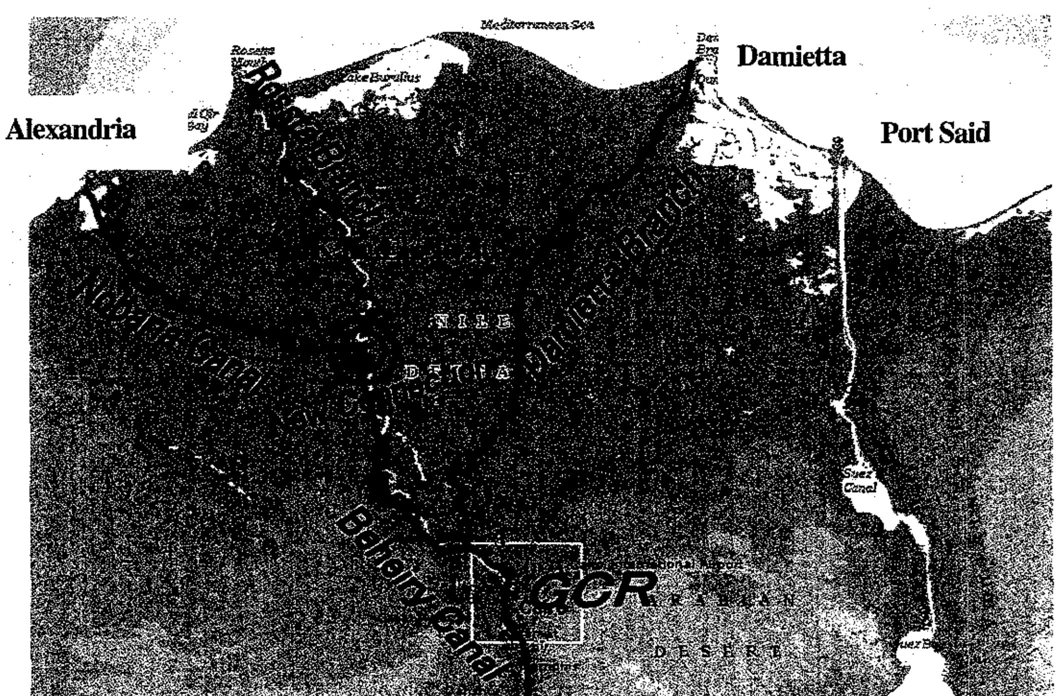


Figure 11.2.6 Prioritized IWs in Master Plan

(2) **Consideration of Approaches to promote IWT in the East Delta**
-IWT Route between Port Said and GCR -

As described in previous section (1), the master plan excludes IWT in the East Delta until the target year of 2020. In consideration of such target year, there are following reasons that it is still early to tackle the promotion of IWT in the East Delta:

➢ **Forecast of the overseas trade cargo through Egyptian major seaports** (see Figure 11.2.7 below)
As stated in Chapter 10, the volume of cargo handled at each port, the largest one is Greater Alexsandria Port followed by Damietta Port and Port Said.

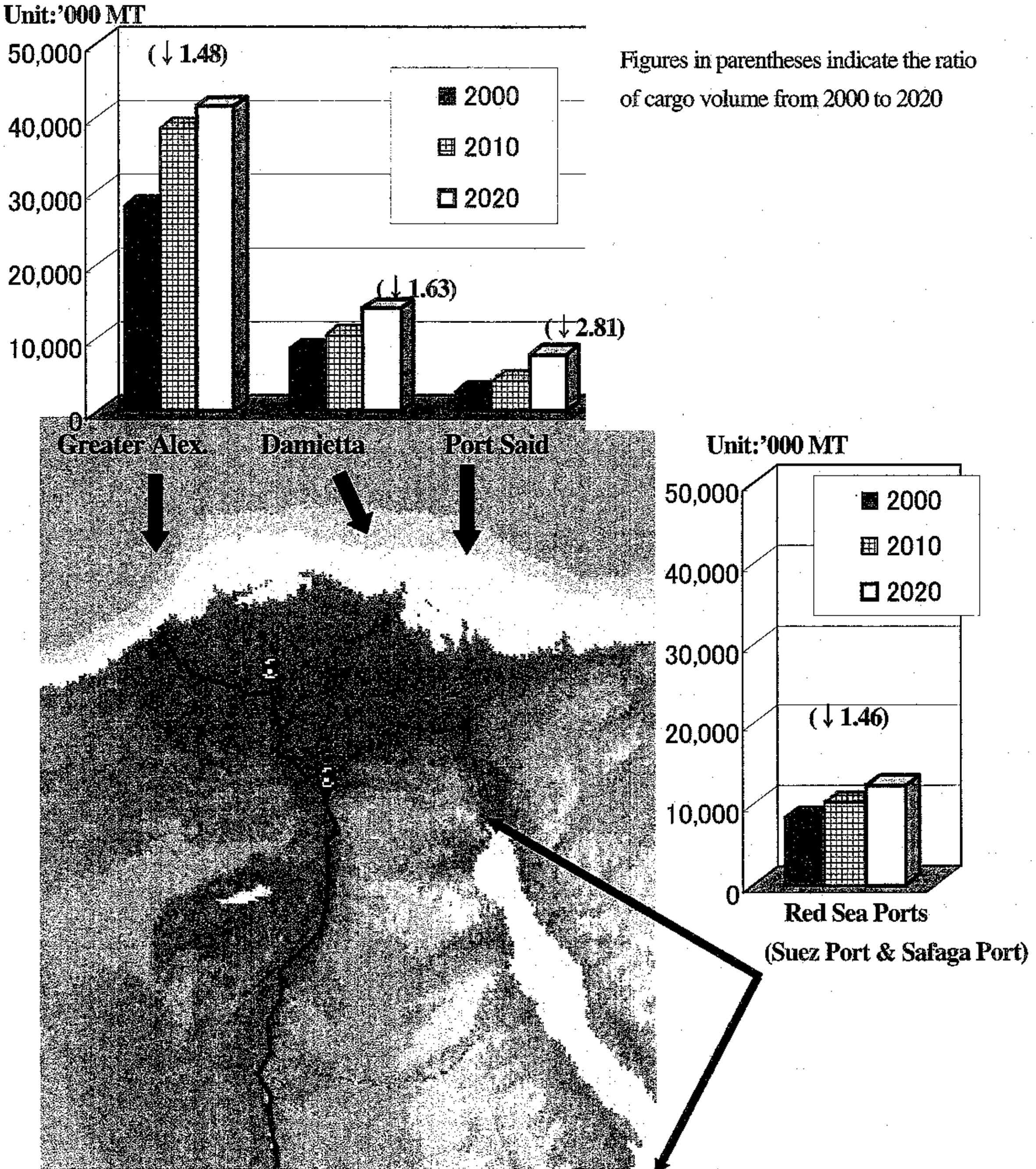


Figure 11.2.7 Forecast Cargo Volume in Egyptian Overseas Trade via Egyptian Seaports

The cargo throughput at Port Said is only about one-tenth of that at Greater Alexandria Port, and therefore, there is much difference of cargo throughput among these three ports at present. By 2020, the cargo via Port Said is forecasted to increase, however its cargo volume still amounts to below one-five of that at Greater Alexandria Port.

➢ **IWT Route between Port Said and GCR**

As for the transportation of cargo from/to Port Said, the following 3 alternative routes were examined as possible solutions to realize this IWT in Chapter 10.

	Route	Type of Barge
Alt.1 Costal Route	Port Said – (Mediterranean Sea) – (Damietta Branch) – Cairo	Coastal / River barge
Alt.2 Costal Route (with transshipment)	Port Said – (Mediterranean Sea) – (Damietta Branch) – Cairo	Coaster & River Barge Transshipment at Damietta Port
Alt.3 Ismailia Canal Route (via Suez Canal)	Port Said – (Suez Canal) – ***(Ismailia Canal)*** – Cairo	River Barge

In case of alternative 1 and 2, the transport of cargo by sea and Damietta Branch via Damietta Port will be less competitive with road transport. On the other hand, the route to pass through the Suez Canal and the IW via Ismailia seems to be well competitive with road transport (see Chapter. 10 for detail).

Regarding this alternative 3, however, there are some problems left unsolved. Namely, one is the problem as to whether it should be allowed for barges to pass through the Suez Canal, and the other is the problem as to whether considerable investment should be carried out to improve the existing canal for barges' navigation.

For caution' sake, Manzara Lake route which connects Port Said with Cairo via the lake and Damietta Branch, this route of IWT also seems to be questionable in view of cost-benefit effectiveness due to physical conditions of the Lake such as unstable water depth and sedimentation. Examination of this IWT route is described in Appendix-11.1

Further Approaches to promote IWT in the East Delta

In the long-term beyond 2020, cargo throughput at the ports of the East Delta will further increase without fail. Because there will be the shift of port cargo from west to east when the handling volume of Greater Alexandria Port will reach its capacity of the port.

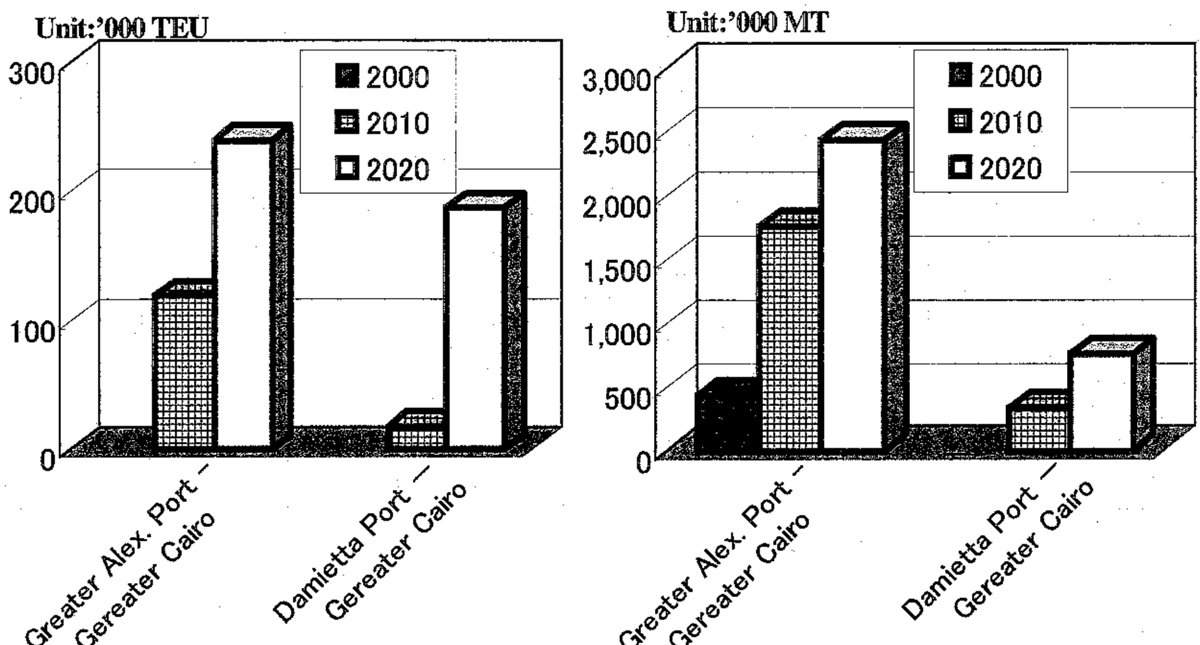
Meanwhile, above-mentioned problems have close relation with government policies on the use of the Suez Canal, the irrigation plan in the eastern part of the Delta, and the investment program of the nation as a whole, it will not be easy to arrive at the agreement among the related government agencies in the near future. For this reason, the study team excluded Ismailia canal from the detailed examination in the master plan.

As for the route between Port Said and GCR, it will be vitally important to further examine to find out the desirable solutions for coping with the increasing cargo volume and facing above problems.

(3) Target Cargo between Dekheila Port and GCR

As identified in Chapter 10, the types of "target cargo" are classified into container cargo, bulk and break-bulk cargoes. Definite commodities of "target cargo" are as follows:

Maize, Wheat, Coal/Coke, Timber, Cement, Iron/Steel products, Sugar, Fertilizer, Molasses, Soybean and Containers



(a) Container　　　(b) Conventional Cargo (Bulk and Break-bulk)

Figure 11.2.8 Traffic Volume Allocated to IWT on Prioritized IWs (between Greater Alex. and GCR, Damietta and GCR) source: Table 10.2.49

Above Figure 11.2.8 shows IWT traffic volume of container and conventional cargoes respectively. As for IWT cargo from/to El Dekheila Port, the master plan focused on only container transportation by new-type river/costal barges. Regarding conventional cargo, in the master plan, it is considered that bulk cargo such as grains couldn't be handled by barges at Dekhila due to a lack of proper facilities (grain silos etc.). However, there is a good possibility that break-bulk cargo will be handled by barges at Dekhila in the near future.

11.2.4 Major Premises of the Master Plan

The master plan was formulated based on the following premises.

(1) Water Supply to IWs in the Delta Area

It was assumed that the volume of water to be distributed to IWs in the Delta would not be reduced as a result of irrigational needs, and therefore, present pattern of seasonal fluctuation in water depth would not appreciably change in future.

Therefore, present water level of IWs will be maintained. Consequently, water depths of target IWs are estimated as 1.8 m or 2.3 m (see Table below).

Scope of IWs In Master Plan	Estimated Water Depth	Note
Alex./Cairo IW	1.8 m	Among differences between LWL(*) and bed level(**) in the stretch of Janakless (61 km Lock) to Nahda (100 km Lock), minimum depth is applied.
Damietta/Cairo IW	2.3 m	Designed water depth used for the "Damietta Branch Rehabilitation Project" is applied.

*LWL (low water level)s are estimated based on monthly records for past 60 months.

** Bed levels are obtained by JICA's cross-sectional survey in 2002.

The master plan examines an integrated study of new barge system with improvements of IW infrastructures on the basis of above hydrographical conditions.

(2) Policies of the Egyptian Government

It was assumed that the government of Egypt places great emphasis on environmental preservation and energy conservation and is prepared to adopt the necessary policies to improve the present situation.

11.3 IWT Infrastructure Improvements

11.3.1 Infrastructure Improvements on Alexandria/Cairo IW

(1) General

The master plan focuses on Alexandria/Cairo IW as one of major river-borne transport axes in Egypt, however it has some problems to be solved in order to promote IWT activities. Among its problems, the first half of this section summarizes the following physical issues in view of barge navigation.

- Waterway such as cross-sections and alignment
- Locks
- Navigation aids
- Bridges and Ferry passing
- Obstacles on navigation

In the later half of one, improvement measures are examined for solutions of above issues.

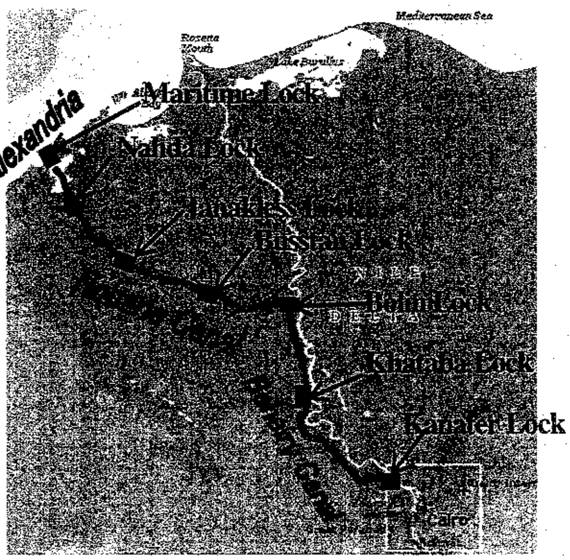
(2) Issues to be resolved

(2)-1 Waterway (Cross-Sections and Alignment)

Basic infrastructures of Alexandria/Cairo IW are Beheiry and Nobaria Canals, this sub-section summarizes its dimension in view of hindering from safe and smooth navigation. In the study, cross-section sounding survey was carried out in all length of this IW, at an interval of approximately 1 km, thus dimensions of this IW are estimated based on such survey mainly.

This IW is divided into 6 stretches by locks as shown in following figure. So that, issues of water-level (depth) and width of IW are outlined by stretches. Here, water-depth is the difference between LWL (Low Water Level) and bed levels. LWL depends on water discharges and intakes with the pattern of seasonal fluctuation. In the master plan, its pattern would not appreciably change in future: LWL is estimated based on the past 60 monthly records from 1996 to 2000.

All cross-sections by the sounding survey, above estimations of LWL are attached in Appendix 11-2.



➢ **Beheiry Canal**

- Stretch from Kanater (Entrance) Lock to Khataba Lock

In this stretch, it is estimated that water-depth and width of IW are adequate to the navigation of new-type barges. Because navigable wide of IW ranges from 70 m to 80 m with water-depth of 2 m, and navigable width is about 50 m with water-depth securing even 2.5 m.

♣ Stretch from Khataba Lock to Bolin Lock

It is also estimated that the dimension of this stretch is adequate from the point of view of navigation. This stretch is navigable width of about 70 m with depth of 2 m. With water-depth securing 2.5 m, navigable width of this stretch is nearly 50 m.

➢ **Nobaria Canal**

Going down the Noubaria Canal, cross-sections change to severe conditions, namely shallower and narrower than upstream stretches.

♣ Stretch from Bolin Lock to Busstan Lock

Navigable width of this stretch is estimated at 50 m with water-depth of 2 m, except for some of cross-sections. In these exceptional sections, it is difficult for some barges with full-draft to smoothly navigate because water-depth is estimated at 1.8 m for the low-water period.

♣ Stretch from Busstan Lock to Janakless Lock

In this stretch, it is estimated that navigable width almost secures 50 m with water-depth of 2 m. In some of cross-sections, such exceptional sections cannot meet the standard of 1st class IW as navigable width of 35 m.

♣ Stretch from Janakless Lock to Nahda Lock

A lot of cross-sections cannot meet water-depth of 1.8 and navigable width of 35 m. Here depth of 1.8 m means maximum draft of barges that the standard of 1st class IW prescribes. While standard width is 35 m. Consequently, it is difficult for barges with full-draft to smoothly and safely navigate in this stretch.

♣ Stretch from Nahda Lock to Maritime (End) Lock

This stretch consists of IWs in the Maruyt Lake, and in both ends of the Lake. A lot of cross-sections also cannot meet above water-depth of 1.8 and navigable width of 35 m. Therefore, all year round, it is almost certain that some barges with full-draft cannot navigate in these sections, because water level in the Lake is controlled as a constant level throughout the year.

Typical cross-sections in above 6 stretches are shown in Figure 11.3.1

As a result of cross-sections survey, minimum water-depth is estimated at 1.8 m which is measured in a lot of cross-sections from Janakless Lock to Maritime (End) Lock, namely downstream stretches of Nobaria Canal dose not meet the standard of 1st class IW (see Figure 11.3.1). In terms of security of efficient navigation, these stretches can hinder existing barges from smooth and safe navigation.

Therefore, in Alexandria/Cairo IW, examinations of improvement measures will mainly focus on Nobaria Canal.

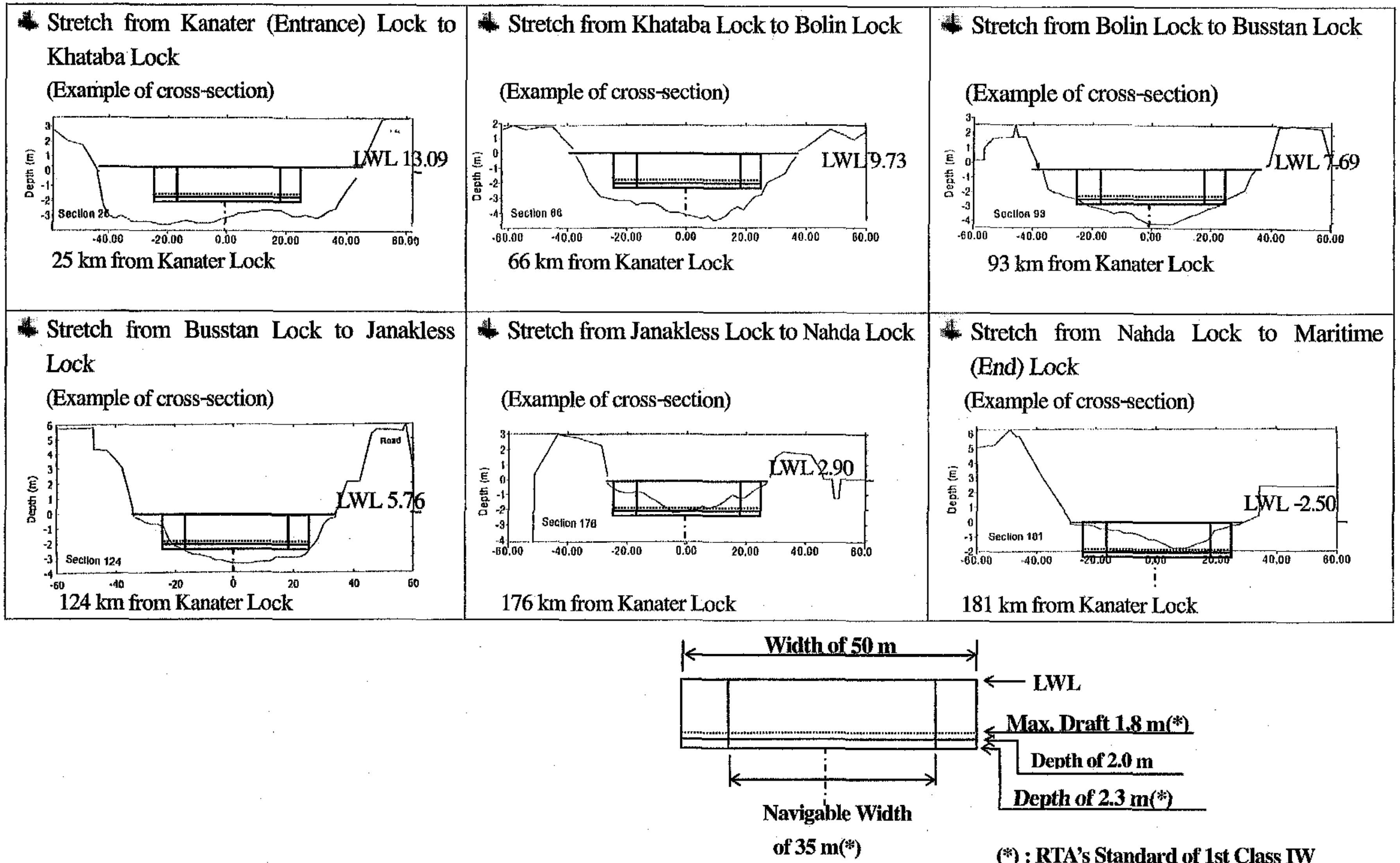


Figure 11.3.1 Examples of Typical Cross-Sections in each Stretches

➢ **Alignment of Alexandria/Cairo IW**

It is estimated that there are no hindrances of this IW's alignment such as bend radii except for a few points, because this IW is man-made canal and almost straight. At a few exceptional points, the canal meanders with some bends, most of bends are over 1,500 m in radius. In such large bends, it is unlikely that these easy bends will result in obstacles on navigation because flow velocities are controlled with small speed for irrigation purpose. Meanwhile, the following two points are more sharp bends of less than 1,000 m in radius (each bend are indicated in Appendix 11.3).

- Upward side of the Bolin Lock (about 200 m from the Lock : bend radius is estimated at about 500 m)

- Upward side of the Nahda Lock (about 20 km from the Lock : bend radus is estimated at about 700 m)

Regarding former sharp bend, improvement measures will be comprehensively examined taking account of cross-sections of bends, barge operation methods and other factors such as navigation aids. Because a new connection canal is examined at same location, and barges' traffic is expected to increase and be complicated.

As for later bend, it is unlikely that this bend will hinder barges from safe navigation, because flow velocity is very small in this stretch between Janakless (61 km Lock) to Nahda (100 km Lock).

➢ **Bank Erosion in Alexandria/Cairo IW**

In this IW, it is pointed out that bank erosion/scouring is likely to occur due to navigation waves by barges. Its erosion becomes more obvious in downstream stretch rather than upstream one because downstream cross-sections are smaller than upstream one.

Namely, one of reasons for such erosions is insufficiency of width and depth of IW: narrower and shallower cross-sections are more affected by navigation wave. In these cross-sections with insufficiency of width, as a result of bank erosion/scouring, navigational conditions will have a change for the worse by bed-accumulation of scoured material.

(2)-2 Lock

Locks along IW basically hamper barges traffic. Along the Alexandria/Cairo IW, there are locks at 7 locations including the entrance lock at Qunatar and the end lock in Alexandria port. In particular along Nobaria canal, normal traffic is hampered by the presence of 4 locks.

This sub-section outlines existing problems with the following issues:

- Operation time of locks and the time needed for a barge's round trip
- Size (dimension) of locks
- Maintenance and Repair of locks
- Operation cycle-time of Locks

- **Operation time of locks and the time needed for a barge's round trip**

Presently, all the locks are closed and all barges are moored alongside the riverbank at night. Operation time of locks is basically only 10 hours from sunrise to sunset.

This daytime-based operational system of IW is responsible for the long round-trip time of barge transport. Transport by barges can not match road transport due to its much longer transport-time.

- **Size (dimension) of locks**

All locks in this IW except of Alexandria Small Maritime Lock have basic dimensions of 16 m x 116m, which allow simultaneous accommodating two existing twin-units of barge or a new-type twin unit. To be accurate, the utilizable length of lock chamber to accommodate barges is limited to 102 m and its width is 16 m in this IW.

Therefore, it is considered that length overall of new barge will be limited to 102 m as design criteria.

Maritime Lock in Alexandria Port was constructed in 1974 for the purpose of IWT to connect the port of Alexandria with Cairo through Nobaria and Beheiry Canals. This lock is equipped with two chambers, the one named Big Maleh of 116m by 16m and another named Small Maleh of 55m by 16m.

The big Maleh lock serves as daily use while the small lock for temporary use during maintenance of big lock. But, at the south side of the big Maleh, there exists the port railway/road bridge above the lock chamber. This restricts the open length of lock chamber to about 65 m due to the low level installation of the bridge which allow air clearance for passing barge of about 3.5 m air draft. Therefore, the big one lacks the length to safely accommodate barges laden with containers and break-bulk such as sawn timber.

The small Maleh lock has a width of 16 m but is only about 55 m long and therefore twin barge units of which an overall length is some 100 m have to be untied for passing through.

- **Maintenance and Repair of locks**

Inadequate maintenance and repair on lock gate may impose longer time of turn-around or serious interruption of barge transport operation. Most of the locks in the Cairo-Alexandria waterway have

an electrical installation for their operation. But, in some cases, the locks gates can not be fully opened because of an existence of silt deposits, stones or debris which are not removed from the gates recesses properly and regularly. Equipment required for this type of maintenance works is basically available but the personnel to operate it is not well organized.
In addition, inadequate guiding and protecting structures of locks and bridges may sometimes imply serious risks of damage for the structures themselves as well as for the barges.

➢ **Operational cycle-time of locks**

In this IW, locks are operated at 7 locations and operational cycle time of lock is indicated in below Table 11.3.1 by each lock.

Each cycle-time of lock include time for charge or discharge into/from lock chamber, for gate operation and for entering/leaving of barge.

Basically, cycle-time of lock depends on needed time for water-charge/discharge. Namely, time for charge/discharge takes longer, with increase in difference of WLs (differential head) in front and behind of locks

Among others, the lock with the longest cycle-time is Nahda lock because of its very large differential head of 5 to 6 m.

Its cycle-time is estimated about 1 hour and its time is about 2 times other locks. Therefore, it is possibility that this Nahda Lock will be bottleneck when barges traffic volume largely increases in future.

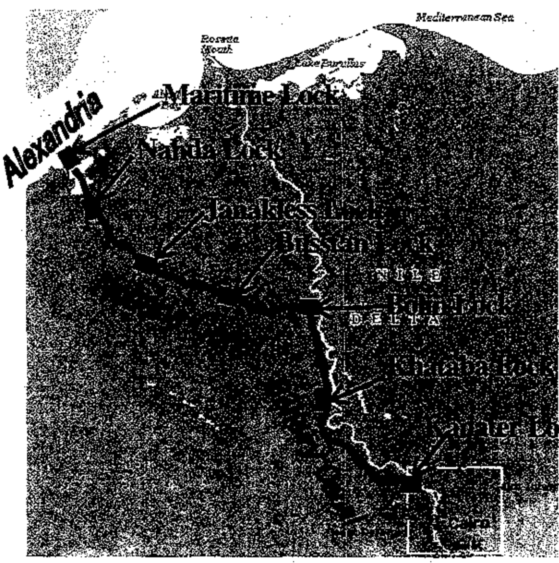


Table 11.3.1 Operational Cycle-Time by each Lock

Lock	Difference between WLs of Up-/Down-stream	Operational Cycle-Time				
		Total Cycle Time for Water-charge and-discharge		Total 10 min for Gate operation & Enter/Leave of Barge	Total Cycle-Time for Upward or Downward	
		Upstream ward	Downstream ward			
Entrance	1.7 to 0.4 (m)	10 min	10 min		20 min	20 min
Khataba	1.2 to 0.1 (m)	20 min	15 min		30 min	25 min
Bolin	0.8 to 0.2 (m)	15 min	12 min		25 min	22 min
Busstan	0.4 to 0.0 (m)	10 min	10 min		20 min	20 min
Janaklees	0.5 to 0.1 (m)	12 min	10 min		22 min	20 min
Nahda	5.6 to 5.3 (m)	45 min	35 min		55 min	45 min
End lock	2.5 (m)	15 min	15 min		25 min	25 min

(2)-3 Navigation Aids

At present, there are no navigation aids for assisting smooth and safe navigation in this IW. This circumstance hinders barges from safe navigation on bottlenecks such as shallow and narrow water areas, and obstructs night navigation in order to shorten transportation time by barges.

(2)-4 Bridges & Ferry Passing

Although there are two movable bridges, Steel Nekla lift bridge and Busstan, the most of bridges along the Beheiry and Nobaria Canal are an overhead type having sufficient air clearance of 5 to 6 m air clearance to allow an uninterrupted passage of barges with exception of Alexandria port railway and road bridge which has only about 3.5 m of air clearance. Movable bridge at Nekla remains closed during most of time since the air clearance is slightly less than 4 m to allow passing of normal type of barge while the air clearance of unopened Busstan bridge is too low to allow passing of barges and therefore frequent bridge operation is required at present.

In this IW, it is reported that the open spaces between bridge pier foundations are more than 16 m by RTA's navigation guide and other technical studies. To be accurate, the navigable open space is limited to approximately 14 or 14.5 m because concrete fender structures are constructed around piers.

In addition, un-motorized small boat ferry connections cross the canal by the use of rope or wire hanging over the canal water surface. But they represent no major obstacles for navigation.

(2)-5 Obstacles on Navigation

According to the past surveys in the mid-90s, the following obstacles on navigation were identified in this IW (see Appendix-11.4 for detail).

- Sunken units 11
- Unused structures/facilities 4
- Various other obstacles 13

These obstacles were classified according to the degree of jeopardy for barges traffic, and priorities of countermeasures were examined ranging from immediate removal to not urgent. However, some obstacles seem to remain and still hinder barges from safe and smooth navigation. Such obstacles are serious problems from the point of view of safety as well as force barges to navigate with lower speed. The later problem will result in ineffective cargo transport by barges.

(3) Infrastructure Improvements on Alexandria/Cairo IW

(3)-1 Waterway (Cross-Sections and alignment)

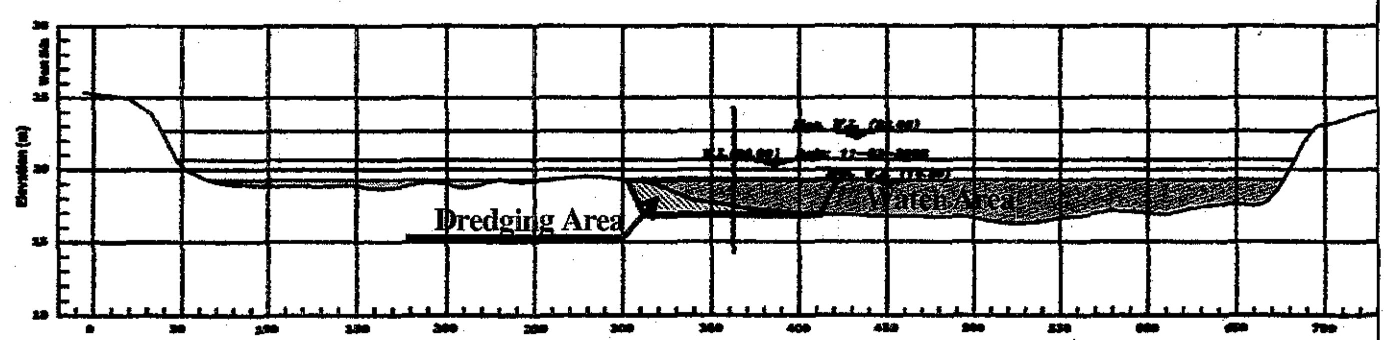
This sub-section outlines improvement measures, firstly, dredging works of c and Nobaria Canals are examined based on the following viewpoints.

- The first consideration for dredging works
- Requirements for waterway facility (width, depth)
- Improvements measures

- **The first consideration for dredging works**

In general, dredging works is effective measures for improvements of navigation way. However, in case of this Alexandria/Cairo IW, it is necessary to consider different factors from general navigation ways.

One of major differences is the ratio of dredging area and water area, this ratio of Nobaria Canal tends to be extremely larger than Nile River (see Figure 11.3.2 below). So there is a strong possibility that large amount of dredging will have some effects on water-level control, and dredging work is not necessarily effective without increase in water flow into this IW (see Figure 11.3.3 below).



↑ **Nile Mainstream** (between Cairo and Asyut)

↓ **Nobaria Canal** (the stretch from Janakless Lock to Nahda Lock)

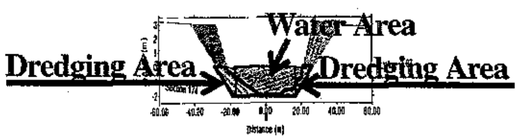


Figure 11.3.2 Comparison between Water-flow Area and Dredging Area

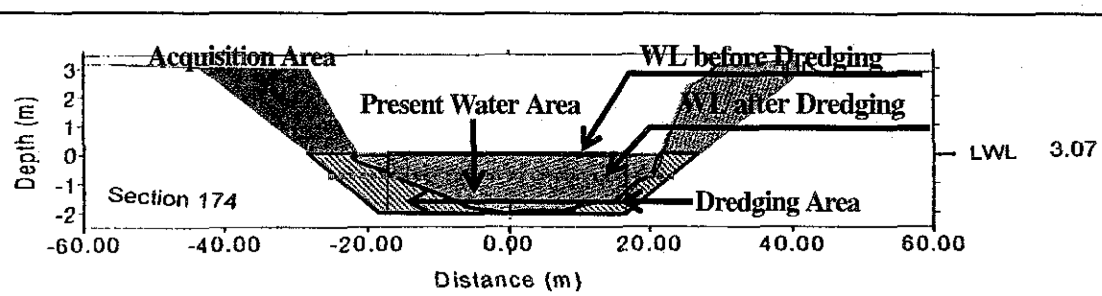


Figure 11.3.3 Sketch of Decrease in Water-Level after Dredging

(Nobaria Canal, magnification of above figure)

Except for the Maryt Lake, the stretch between Janaklees and Khataba has the smallest water area among this IW (see Figure 11.3.1). Therefore, dredging works in this stretch are carefully examined in terms of dredging volume and its areas.

As for dredging of Nobaria Canal, another issue is land acquisition which is required with large amount of excavation because along on this IW are variously used for cultivated land, road and railway.

Therefore, in this IW, widening and deepening works should be restricted to a minimum. The priorities of its works are only given as follows:

- To remove existing bottlenecks on navigation by maintenance/rehabilitation dredging
- To secure safe and smooth navigation of new-type barge by dredging

➢ Requirements for waterway facility (width, depth)

In the master plan, requirements for IWs were examined based on the following standards, and determined taking account of natural conditions of IWs, barges operation methods and size of new-type barge (see Appendix 11.5 for detail).

- ✓ Existing standard by RTA
- ✓ International standard by PIANC

Required width and depth of Alexandria/Cairo IW are applied as following standard:

- **Required Minimum Width of IW** : 3 or 4 times width of barge, namely 36 or 48meters in case of new-type barge

Here, this standard is applied with the following conditionality: one barge should slow-down and stop to enable barges to navigate smoothly and safely, when facing oncoming barges (see Figure 11.3.4 below). Barge operation methods as shown in below figure that are described in later section for detail.

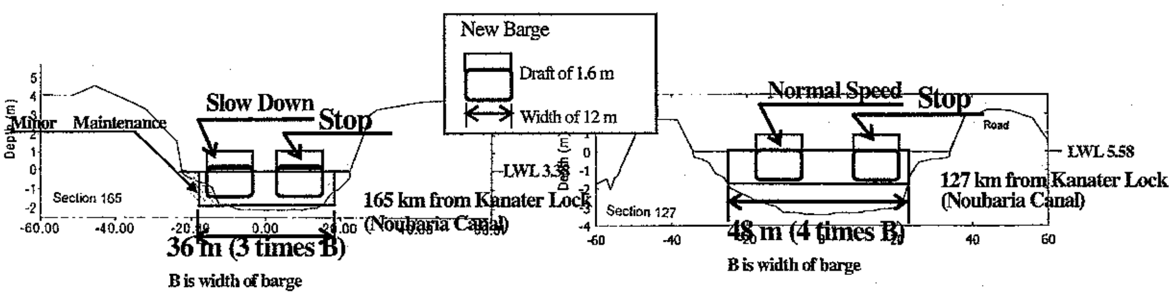


Figure 11.3.4 Required Minimum Width of Alex./Cairo IW and Barge Operation

As for width of IW, minimum width of 36 m is practically equivalent to the width of existing standard of RTA. Needless to say, it is necessary to largely widen existing IW when a barge with width of over 12 m can navigate IW, and such large widening works will result in effects on water level control, and it will not be feasible without some arrangement of water distribution program. Under these circumstances, maximum width of a barge is estimated at 12 m.

This requirement with 36 m is 3 times width of barge which is smaller than international requirements based on PIANC standard. However, it is considered that this requirement of 36 m is adequate in terms of safe and efficient navigation, because comprehensive measures such as navigation aids, barge operation are examined in the master plan (see Appendix-11.5).

As a result, the master plan proposes that required minimum width is 36 m in this IW (Alexandria/ Cairo IW).

- **Required Minimum Depth of IW** : 2.0 m, namely keel clearance is 40 cm in case of new type barge

Required minimum depth of IW is estimated in consideration of an appropriate keel clearance (KC), required dredging volume and other navigational factors. For instance, the design of "Damietta Project" has applied the Depth/Draft Ratio = 1.28, namely KC = 50 cm for draft of 1.8 m.

Generally, Depth/Draft Ratio should be estimated at the minimum, in order to minimize a dredging work and to maximize size of barge. Meanwhile, the enlargement of laden capacity has led to the increase in bottom resistance. Because a hull of barge is becoming almost rectangular in shape, in order to enlarge of laden capacity, thus bottom resistance is increasing compared with a rounded hull.

In consideration of above aspects, the master plan proposes that KC = 40 cm, target depth = 2.0 m and draft of new barge = 1.6 m, namely Depth/Draft Ratio = 1.25.

Although it is probable that keel clearance (KC) of 40 cm will be more severe condition than existing RTA standards (target depth of 2.3 m for full-draft of 1.8 m), it is considered that its KC of 40 cm is a permissible range in consideration of the following actual conditions in this IW.

1) When proposed improvements such as deepening are carried out, such stretch with water depth of 2.0 m is limited as follow:

   Upstream-ward of Nahda Lock : length of about 20 km
   Downstream-ward of Nahda Lock : length of about 10 km

Needless to say, remainder stretches can secure more than KC of 40 cm.

2) As for the upstream-ward of Nahda Lock, it is possible to secure KC of about 50 cm from March to November because WL is expected to increase in 20 to 30 cm for this period.
Even low water discharge period (from December to February), new-type barges can navigate with more appropriate KC when draft-control is conducted.

In the master plan, one of major strategies is to enlarge barges to the maximum extent that the physical conditions of improved IW facilities will permit. According to this strategy, beam of width will depend on the permissible widening dredging and draft of new type barge will be determined by the permissible keel clearance.

Therefore, maximum draft is 1.6 m corresponding to target depth of 2.0 m and afore-mentioned maximum beam of barges is 12 m comparing to canal width of 36 m.

➢ **Improvement measures**

The following countermeasure is required in order to secure safe and smooth navigation of new-type barges.
As mentioned previously, required minimum width of IW is estimated at 36 m and almost equivalent to existing standards (35 m) by RTA, and minimum depth of 2.0 m is shallower rather than existing standard of 2.3 m.

- Dredging works in order to secure width of 35 m, depth of 2.0 m.
  Here, designed depth of dredging is estimated at 2.0 m in order to secure KC of minimum 40 cm.

In the later stage of the Study, above-mentioned dredging work is examined and proposed (see Chapter 13 for detail).

In the master plan, its dredging work and new-larger barge will be combined to give two beneficial effects:
The first one is to secure more efficient and smooth navigation, because existing barges are forced to navigate under sever conditions such as less than KC = 20 cm, namely, existing minimum depth is only 1.8 m corresponding to average draft of 1.65 m. Dredging work will result in the improvement in such sever navigational conditions.
Secondary, bank erosion/scouring will decrease, due to reduced effect of navigation waves when sufficient width of IW is secured by these dredging.

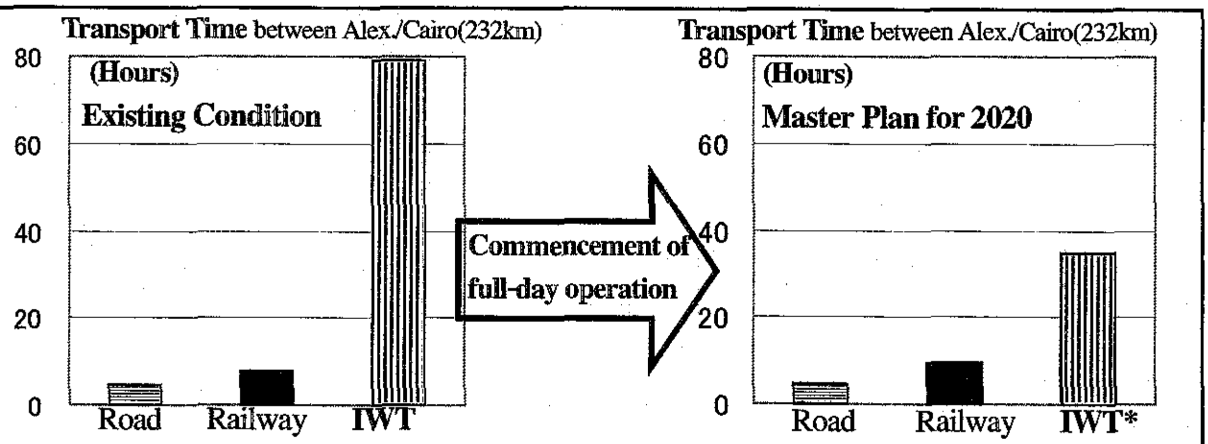
(3)-2 Lock

In this sub-section, improvement measures of Locks and further hydraulic studies are examined based on the following viewpoints.

- 24-hours operation of locks
- Extension of the End (Maritime) Lock at Alexandria Port
- Improvement in efficiency of Locks operation
- Consideration for locations of locks & barrages
- Other Measures

24-hour operation of locks

In the master plan, 24-hours operation of all locks in this IW is proposed.
This measure can drastically reduce the time needed for barge's round trip which will strengthen its competitiveness with road transport (see Figure below).



*Transport time by IW includes navigation time and passing time at each lock.

Figure 11.3.5 Saving in Transport Time by IWT due to 24-hour Operation

Extension of the End (Maritime) Lock at Alexandria Port

Big Maleh (Maritime) lock is dimensioned to be basically capable of accommodating 4 barges of 55m by 7.5 m or two sets of twin unit barges of maximum 100m by 7.5m simultaneously. But, since the port railway and road bridge crosses just above the Big Maleh lock, there are restrictions in the lock operation that the "open length" of the lock available is about 65m only and is not capable of accommodating twin barge or barges loaded with high tiered cargo of more than 3.5 m which is not allowed to pass the lock:

Vertical Air Clearance of Big Maleh	
Water Level at port side:	HHWL+0.48m
	HWL +0.29m
	MWL 0.00m
	LWL –0.14m
Water Level at Maryut Lake:	-2.5m constantly controlled
Upper Surface Level of Bridge:	Road Surface +5.2 to +5.3m
	Railway Trucks+5.1 to +5.2m

The end lock at Alexandria clears the requirements for neither air vertical clearance (about 3.5 m for 6 m criteria) nor lock chamber length (55 m for 116 m). Therefore, as explained as above, the present end lock at Alexandria represent the major bottlenecks due to the shortage of lock chamber length (the Small Maleh Lock) or open space of lock chamber (the Big Maleh Lock) for passing through by such barges as 2 twin unit or future container carrier having high air draft of more than 3.5 m. In view of this, possible offshore extension of small Maleh lock should be envisaged so as to have the same standard size of lock. Big Maleh lock with insufficient length for open space of lock chamber, after renovation of the small lock will be used temporary as the small lock is utilized at present.

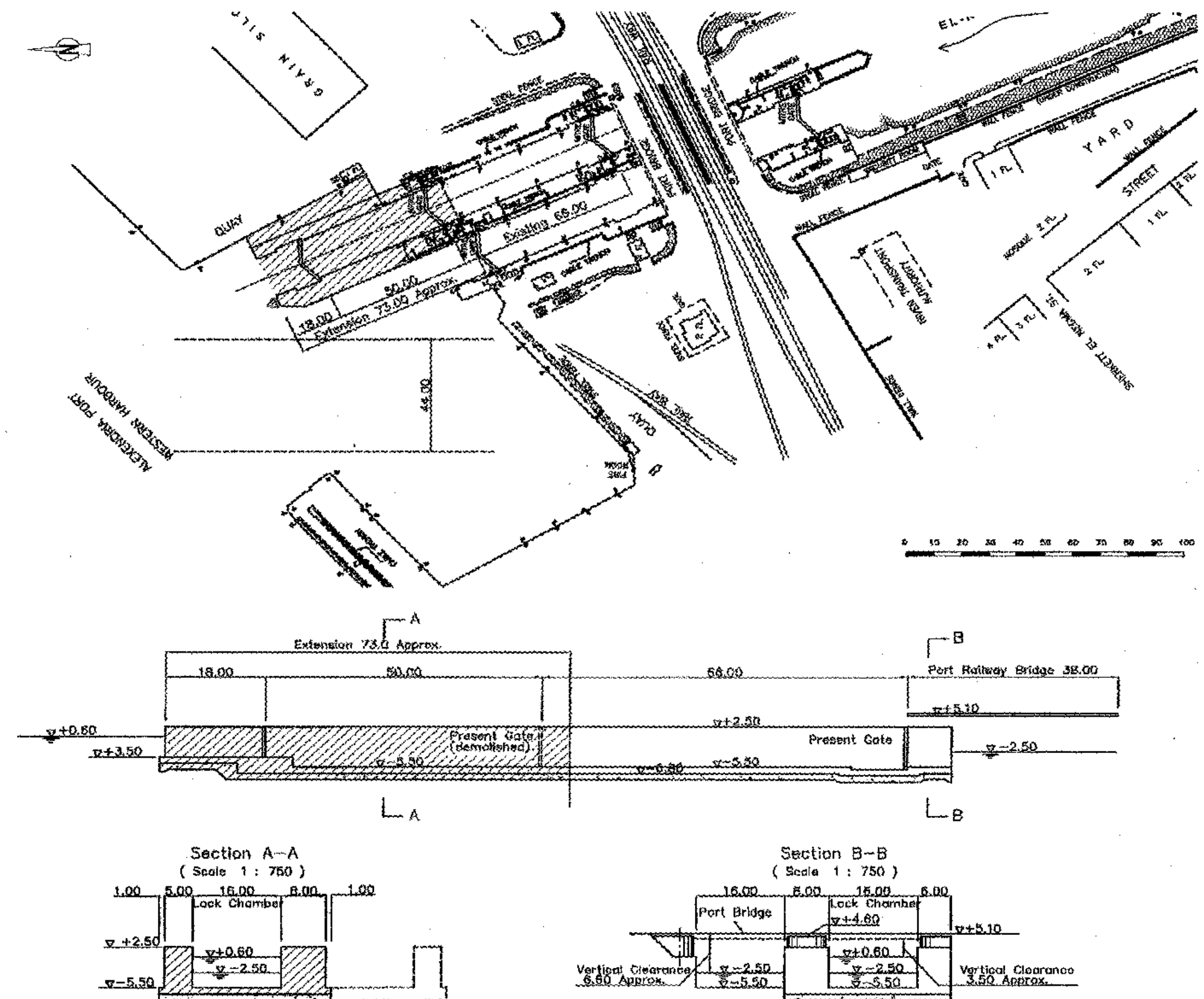


Figure 11.3.6 Extension of Maritime Small Lock at Alexandria

- **Improvement in Operational Cycle-time of Locks**

In Alexandria/Cairo IW, operational cycle-time of Nahda lock is prominent among others: the shortening of its longer time will contribute to increase in passable number of twin-units through this lock.

At present, operations of water-charge/discharge depend on making use of only differential head (different of WLs) without mechanical system. Therefore, it is necessary to consider introduction of pumping system for improvement in charge/discharge operations of Nahda Lock. Introduction of such system will increase capacity of this IW.

- **Review on Lock (& Irrigation) System – consideration for locations of locks & barrages -**

In addition, it is considered that two locks and barrages in Nobaria canal would be demolished or replacement in order to shorten the time needed for a barge's round trip and in order to solve shallow water problem upstream-ward of Nahda Lock (100 km Lock). However, this measure is important issue and is concerned in water distribution program in the West Delta. Therefore, it is necessary to carefully examine the aspects of irrigation and navigation beyond 2020.

- **Other Measures - Auxiliary Equipment in line with Night Navigation**

In order to materialize day-and night barge sailing, it must be implemented in line with additional provision of proper guiding, protecting structures and illumination at each lock.

(3)-3 Navigation Aids

Afore-mentioned improvement measures will facilitate modal-shift to IWT. Following measure should be adopted to cope with increase in barge traffic night and day from the point of view of navigational operation:

- providing and installment of navigation aids
- installing night visual equipment in the night sailing barges (see Section 11.3.1)

♣ Providing navigational aids

Components of needed navigation aids are as follows:

- To install lateral/cardinal lighted marks in Beheira / Noubaria Canal conforming to the buoyage system of the International Association of Lighthouse Authority (IALA) zone A;
- To install traffic signal lights in bridges/locks;
- Each lateral mark should be placed 500 meters apart in a zigzag pattern as a general rule with frequent occurrence of poor visibility in mind;
- Every mark should be the most reliable, stable, durable, antitheft and maintenance free make, thus the lateral marks are desired to be lighted **beacons** fitted with distance signs; while the cardinal marks indicating obstacles are desired to be lighted **buoys** for their changeability;
- The source of light should be solar battery system with light emitting diode.

Summary of proposed number of navigational aids is listed in table 11.3.2.

Table 11.3.2 Summary of proposed number of navigational aids

Leg	Dist. (km)	Lateral Mark	Cardinal Mark	Lock Traffic L't	Bridge Traffic L't
Cairo-Delta barrage	40	80		-	66 (11 B'ges)
Delta Barrge-Alexandria	200	400+ α		-	144 (24 B'ges)
Kaneter lock	-			2	
El Kantatba Lock	-			2	
Bolin Lock	-			2	
Bustan Lock	-			2	
Ganaklis lock	-			2	
Nahada Lock	-			2	
End Lock	-			2	
Total	240	480+ α	to be investigated	14	210

Here, '+α' means supplemental aids will be installed at sharp bends, stretches with applying semi-two way operation and other needed points for safe navigation. Details are estimated in Chapter 13. Cardinal marks will be placed at major obstacles.

- Equipments to be installed Providing navigational aids

In addition to above navigation aids, night-sailing barge (unit) needs the following equipments:

- A Projector to light up the waterway ahead is indispensable to support safe and sound transit by night

The projector should be set at the bow of a unit and it should be possible to adjust the direction of light axis both horizontally and vertically by hands at steering house; and it should also have sufficient capacity to light up the canal clearly (e.g. not less than 2.6 lux at center of axis 500 m apart at atmospheric transmission factor 100%).

- The night sailing units should thus be equipped with a power supply apparatus of enough capacity for increased electric equipment such as the projector, navigation lights, communication device, and crew accommodation.

(3)-4 Bridge

If the nature or demand of future cargo necessitates more frequent barge passing or introducing new types of barges such as those of higher air draft or wider beam may require possible replacement of movable type of bridge to fixed overhead type with sufficient air clearance (6 m min.) and navigable width of opening (not less than 12 m navigable width) so that, from the point of view to cope with this future possible demand, bridges will never present any major problems for navigation.

Where passage under the bridge is narrow horizontally and vertically, such navigation marking, adequate guiding or protecting structures for bridges is recommended to install in order to prevent from the likely occurrence of collision during barge passing which sometimes result in serious damage for the bridge structures themselves as well as for the barges.

(3)-5 Obstacles on Navigation

As shown in Appendix IV, navigational obstacles such sunken boats or debris of construction material still exist along this IW. Such obstacles on navigation should be removed after reinvestigation of bathymetric survey.

11.3.2 New Connection Canal at Bolin

(1) General

The initial concept to open a connection canal between Beheiry/Nobaria junction at Bolin junction and Nile Rosetta branch was presented in 1991. This idea is aimed at making a navigational water corridor between Kafr El Zayet and Alexandria port or Sibaiya in Upper Egypt for transportation of such raw materials as phosphate, sulfur and grease, etc. and was further progressed in the later stage of study by Netherlands Consultants in 1995. Because that the country's main production and consumption centers are mostly located in the vicinity of existing inland waterways, the inland waterway should be opened to connect important production centers with the origin of raw materials or destination of product cargoes if it is feasible.

As far as this new connection canal are concerned, a very short new connection canal may be feasible in view of suitable balance between benefits arising from future cargo demand and moderate construction investment because this canal is projected along the existing spillway. New connection is expected to generate moderate quantities of additional cargoes while the cost of providing new navigable waterway could be minimized.

In the Master Plan, the opening of waterway connections between Kafr El Zayet and the Beheiry-Nobaria canals near Bolin and rehabilitation of a part of the Nile Rosetta Branch should be taken into consideration in view of necessity in supply of material and delivery of product at Kafr El Zayet factory complex by means of possible inland waterway transportation. It should be kept in mind, however, that the future traffic capacity is to be based on possible share allocation to inland waterway transport among the projected demand (for the year 2020) and on realistic estimates of performance per barge and per year, starting from a permissible draft of less than 1.8 m.

(2) Cargo Demand Projection on New Connection Canal

In the master plan, the regional transport demand forecast for this new canal is estimated at 0.6 million tons for 2020 (see Chapter 10 for details).

(3) Proposed Measure to be undertaken

1) Existing Conditions of Spillway at Bolin

During the 1st Field survey in Egypt, a series of survey and investigation works was carried out at Bolin and along the existing spillway where new connection canal between Nile River Rosetta Branch and the junction between Beheiry/Nobaria canals is proposed. Such data on topography and subsoil conditions along the proposed site are used as a basis for designing and cost estimation in this study.

At present, there exists an irrigation spillway along the proposed opening canal, which consists of one barrage at the entrance of Beheiry/Nobaria junction. The existing both sides of spillway bank are connected by a small bridge passing on the top of existing barrage. The water head (the difference of water level between the canal and Rosetta branch) is reported to be about 6 m. This water difference is adjusted by the present of 5 cascades.

The following are the data on existing spillway collected by the field survey and data collection during the 1st Field Survey.

Length:	Approx. 1,297m
Width of Spillway Bank:	Approx. 60 m between the top of banks
Width of Water Spillway:	Approx 25 m
Top Level of Bank:	Variable at approx.+11.8 ~ 10.6 at left bank (north)
	Variable at approx. +11.0 ~ 12.0 at right bank (south)
Water Levels:	Mean Water Level +9.20 m at Beheiry Canal Side
	Mean Water Level +2.70 m at Rosetta Branch Side
Maximum Discharge of Water:	50.4 m3/s
Dimension of Barrage:	Total Width of 16 m and 3 x 2.5 m regulator gates
Land Usage	Agricultural Field

2) Proposed New Connection Canal

The proposed project for this new connection between Beheiry/Nobaria canals junction at Bolin with Kafr El Zayat will compose of the following facilities:

- Opening navigable new canal between Beheiry/Nobaria canals junction and Rosetta Branch by deepening and widening existing spillway
- One (1) number of navigable lock together with aids for navigation
- One (1) number of barrage for water discharge
- Dredging for about 20 km stretch of Nile Rosetta branch till Kafr El Zayat

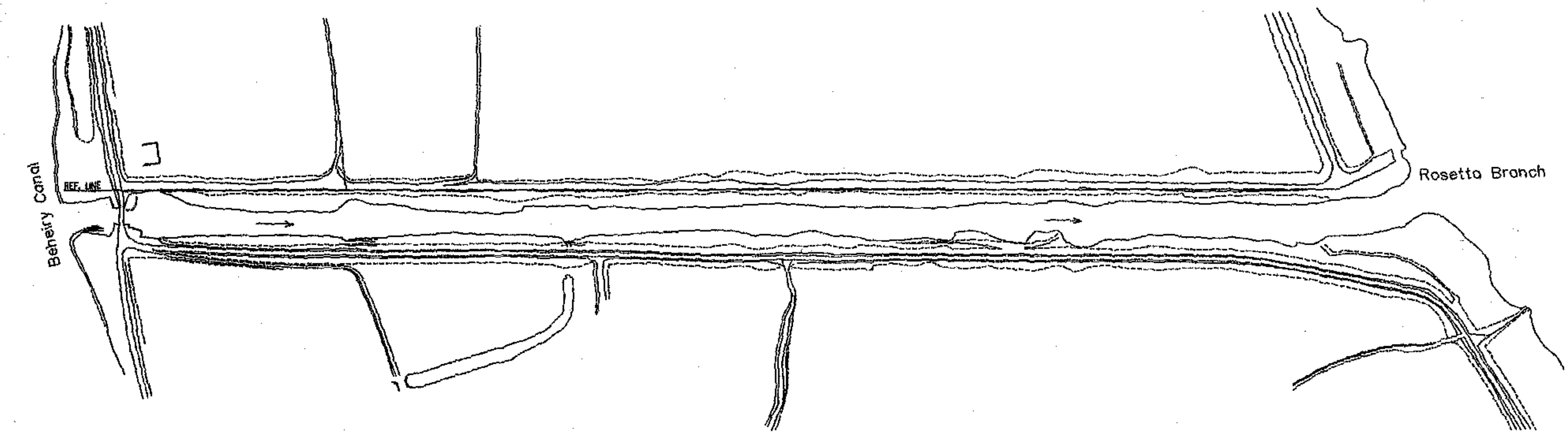
In considering the present mode of transportation for raw materials and products to/from Kafr El Zayat factory complex, the proposed connection canal for inland waterway transport will be constructed by deepening and widening the existing spillway for the structural requirements as follows:

Objective Barge:	Twin Barge Unit of 102m long, 7.5 m wide, 1.8m draft
Water Level at Beheiry Canal:	Max. WL+9.40m, Mean WL +9.2m, Min. WL+8.90m
Water Level at Rosetta Branch:	Max. WL+3.85m, Mean WL+2.70m, Min. WL+1.55m
Top Level of Canal Bank:	+11.25 based on the 1st Field survey
Navigation Lock:	One number of lock to adjust water level difference
Optional Facilities:	Mooring facilities at up- and downstream of lock

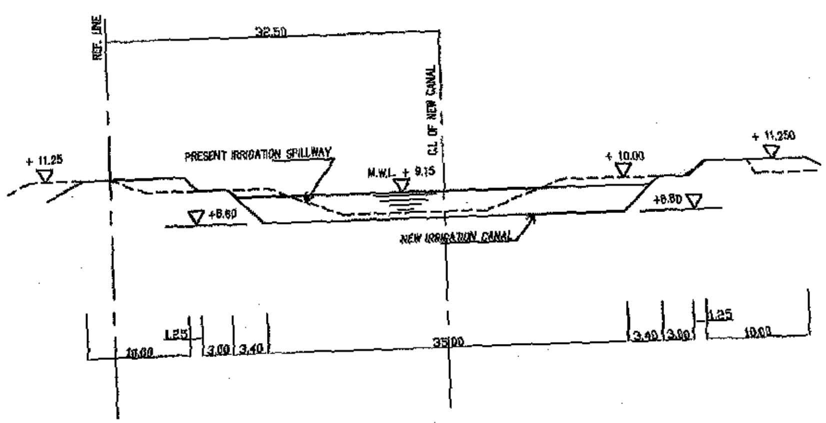
Simultaneously, it will be mandatory that, in line with opening new connection canal, a navigational channel dredging work is to be carried out along Rosetta Branch from the downstream end of new canal to Kafr El Zayat where industrial complex has developed. The proposed dredging should be executed to provide safe navigable fairway during the whole year, have a minimum dimension of:

Fairway Width: 35 m wide
Water Depth: 2.3 m water depth from LWL

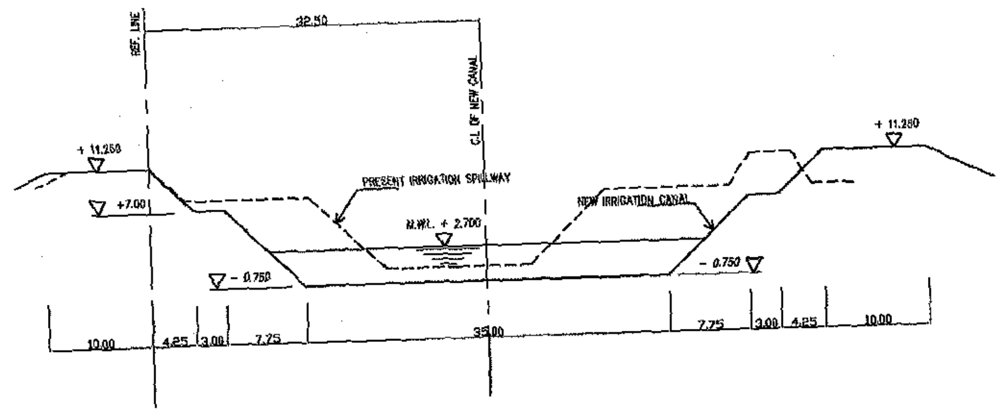
This project may require the extensive works to facilitate inland navigation throughout year and may only be justified when other interests in integrated management for the river water, irrigation and inland canal transport are taken into considerations as well.



Present Spillway



CROSS SECTION



CROSS SECTION

Figure 11.3.7 New Connection Canal at Bolin (1)

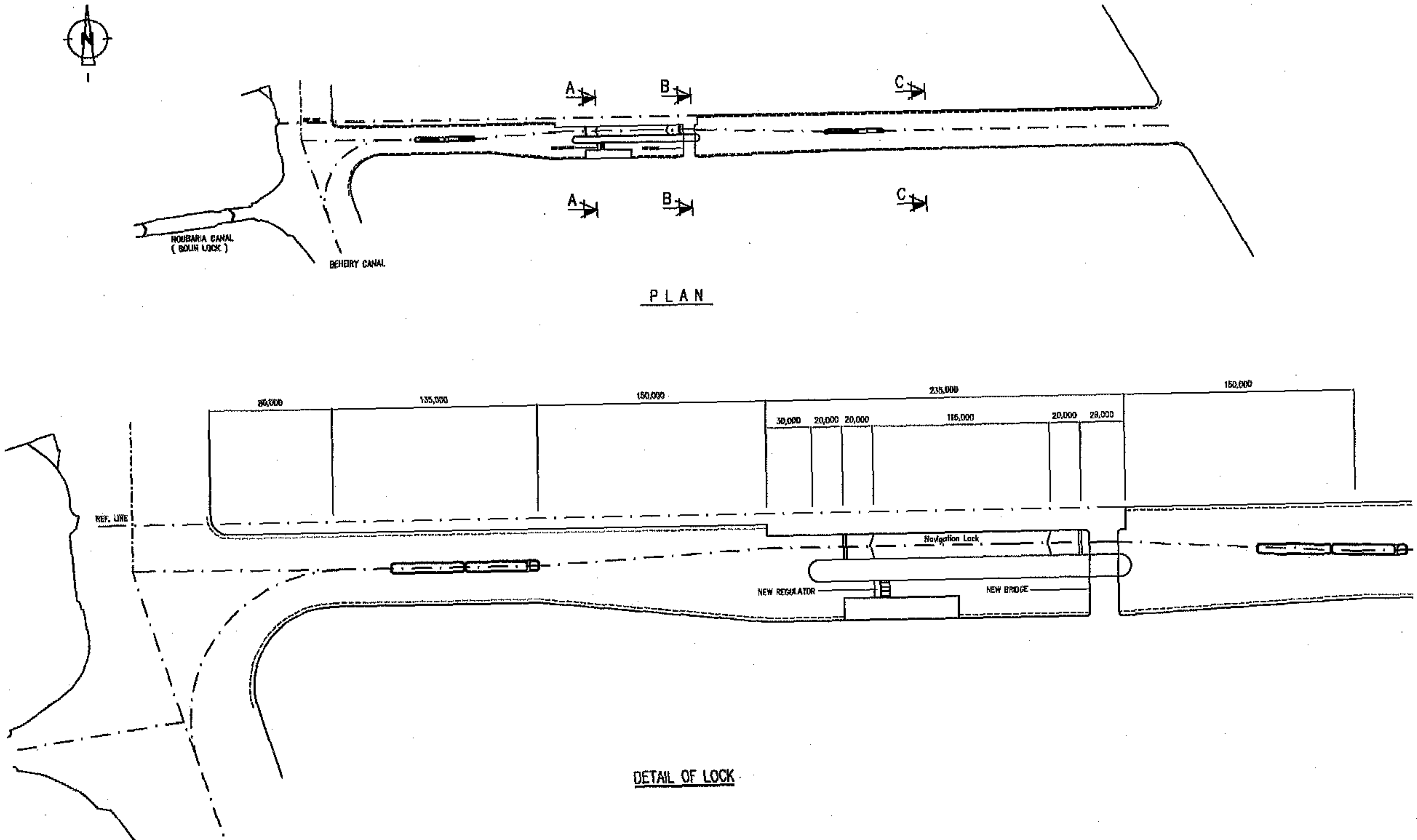


Figure 11.3.8 New Connection Canal at Bolin (2)

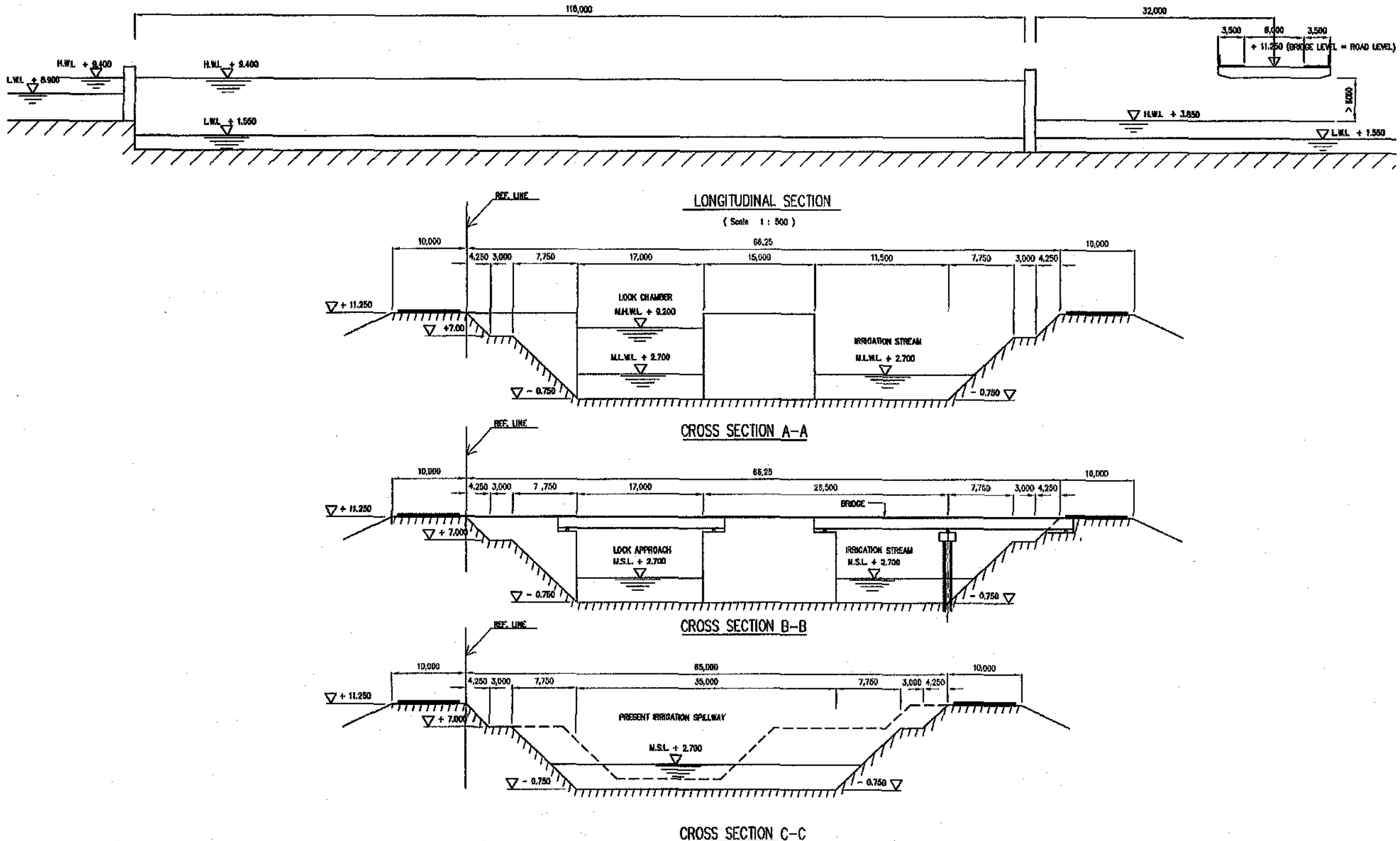


Figure 11.3.9 New Connection Canal at Bolin (3)

11.3.3 Infrastructure Improvements on Damietta/Cairo IW

(1) General

The master plan places Damietta/Cairo IW as second major water-borne transport axis in Egypt, Egyptian government also put great emphasis on this IW. "Damietta Branch Rehabilitation Project" is presently being executed by RTA, to enable barges to navigate the Branch between Damietta Port and GCR.

Therefore, this sub-section mainly outlines the following items concerning this on-going project, and summarizes issues to be further considered for establishment of proposed IWT system in the Master Plan.

- Waterway (cross-sections and alignment) and Obstacles on navigation
- Locks
- Navigation aids
- Bridges

(2) Issues to be considered

(2)-1 Waterway (Cross-Sections and alignment) and Obstacles on navigation

"Damietta Branch Rehabilitation Project" (hereinafter referred to as "Damietta Project") mainly consists of 3 components as follows:

- ✓ Development of navigation way (dredging work)
- ✓ Construction of locks
- ✓ Installment of navigation aids

This sub-section mainly summarizes its dimension of navigation way based on the plan of Damietta Project.

In Damietta Project, dredging of IW is designed at width of minimum 40 m, depth of 2.3 m.

As for width of IW, though a lot of meanders still lie when Damietta Project is completed, the width of IW is varied on basis of other conditions such as bend radii. Thus, navigable widths with over 40 m are designed with such sharp bends.

Water depth is planned taking account of some clearances which can permits passing barge's draft of maximum 1.80 m.

Consequently, it is estimated that width and water-depth are adequate for navigation of existing twin-units.

Needless to say, obstacles will be removed along its navigation way route when Damietta Project is carried out.

(2)-2 Locks

➢ **Operation time of locks and the time needed for a barge's round trip**

When RTA applies only the daytime-based operational system to new locks, it is almost certain that transport by barges can not match road transport due to its much longer transport-time

➢ **Size (dimension) of locks**

Damietta project for the construction of 2 new locks at Delta and Zifta on the Damietta branch is currently underway by the Ministry of Transport, River Transport Authority. After the completion of these locks, new locks provide 120 m usable lock chamber by 17 m wide except for Faraskour dam lock (rehabilitated in 1986), which has a different dimensions of 132 m length and 16 m width. These new locks are constructed together with lock entrance structures and waiting berths as floating fender structures, guided by steel fender piles, operational buildings and infrastructures, etc.

All locks can accommodate a new-type twin-unit or a new-type twin-unit, which represent neither obstacles nor constraints for inland waterway barge transportation.

➢ **Operational cycle-time of locks**

Lock gates, filling system and gate protection system will be provided with all new locks. The gate for the navigation lock is miter gate type, operated under balanced water conditions by double acting hydraulic servomotors. The lock filling system is of the gate bypassing system type. Each culvert is controlled by a flat fixed gate, and operated under unbalanced water conditions by a single acting hydraulic servomotor. The miter type gate will be protected against any impact from ships maneuvering inside the lock.

Introducing new system such as water filling system, operational cycle-time is assumed at ranging 0.5 to 0.75 hours.

(2)-3 Navigation Aids

Damietta Project includes installation of navigation aids and a part of installation has been made a contract. Based on its contract, navigation aids will be installed in the downward stretch from new Delta Lock in the first stage and its length of about 15 km. Next, night navigation equipments such as lanterns will be equipped along its navigation way. Therefore, appreciate facilities will be provided to cope with night navigation in future.

(2)-4 Bridges

It is reported that there are 13 bridges to cross the Branch with exclusion of two old bridges at Shirbin road and old Damietta road, both of which have a minimum span width of 9 m and are reported to be removed once short notice is given. Among others, 9 bridges are movable type including 4 bridges for railway lines. The minimum vertical clearance of fixed overhead type bridges is 8 m at new Damietta road bridge.

(3) Infrastructure Improvement on Damietta/Cairo Waterway (Damietta Branch)

(3)-1 Waterway (Cross-Sections and alignment)

Based on the following estimation, minimum width of 40 m is appropriate to navigation of new wider barge.

According to the design of Damietta Project, design minimum width of 40 m can allow two twin-units with beam of 7.5 m to pass each other at normal speed when the two units move in opposite directions (see Appendix-11.7 for detail). This fact means that more wide navigation way canal will be required in case of introduction of wider barge, based on present navigation methods such as passing each other at normal speed.

However, the master plan proposes that new operation methods will be applied in case of new wider barge. According to this new operation, when wider barges moving in opposite directions encounter each other, one barge should stop and safe navigation will be secured even though increase in traffic of wider barges. Therefore, design width of Damietta Project is adequate for navigation of new wider barges.

Similarly, depth of 2.3 m is also sufficient for navigation of existing twin-units.

(3)-2 Locks

- **24-hours operation of locks**

In the master plan, 24-hours operation of all locks in this IW is proposed.

This measure can drastically reduce the time needed for barge's round trip which will strengthen its competitiveness with road transport.

- **Other Measures - Auxiliary Equipment in line with Night Navigation**

In order to materialize day-and night barge sailing, it must be implemented in line with additional provision of proper guiding, protecting structures and illumination at each lock.

(3)-3 Bridges

Unlike the Behiery-Nobaria Canals, the Damietta Branch waterway have many obsolete swing bridges and sometime lifting bridges in railway lines. In particular, the railway bridges can be opened only during short periods, which prevent any efficient use of such canals as a transport connection.

If the nature or demand of future cargo necessitates more frequent barge passing or introducing new types of barges such as those of wider beam or higher air draft may require possible replacement of these movable type of bridge to fixed overhead type with sufficient air clearance (6 m min.) and navigable width of opening (2 openings of not less than 12 m wide) so that, from the point of view to cope with this future possible demand, bridges could never present any major problems for navigation.

Where passage under the bridge is narrow horizontally and vertically, such navigation marking, adequate guiding or protecting structures for bridges is recommended to install in order to prevent the likely collision during barge passing which sometimes result in serious damage for the bridge structures themselves as well as for the barges.

11.3.4 River Port and Sea Port Facilities

(1) River Port

1) Scope of River Port in Master Plan

The river port owners are separated into two sectors, public sector and private sector. The private river ports, mostly private factory's facilities, are dedicated to their own requirements. Additional or new river port facilities and equipment are prepared based on their individual development plans. On the other hand, public river ports to cater for the various shipping companies should be developed by the public sector based on a comprehensive port development plan taking into account the future prospect of IWT. Accordingly, a public river port development plan is formulated in this study.

2) Constraints and Countermeasures

IWT of cargoes has been developed to transport raw materials and products of the factories along the Nile River and canals. The required river port facilities have been developed by the private factories themselves. Generally, existing private river port facilities and equipment are sufficient to handle the required cargo volumes, since IWT cargo volume has been decreasing recently. Moreover some river ports are not used due to the modal shift from IWT to land transport.

The capacity of the existing private river port facilities and equipment depend on their dimensions, productivity, and condition. Some factories might need to increase their port capacity to cater for future cargo volumes, if a large increase is expected. When private companies intend to shift some cargoes from land transport to IWT, they will develop river port facilities and suitable cargo handling equipment by themselves.

Meanwhile, there are no public river port facilities in operation to accommodate IWT of general cargoes including containers. It is essential for the improvement of IWT to introduce other cargoes than private industrial cargoes. For IWT of containers and general conventional cargoes, the development of public river ports is strongly required. In particular, a new public river port in Greater Cairo should be developed urgently, since most cargoes to be transported in Egypt have their origin/destination in Greater Cairo.

3) Required Public River Port Facilities for 2020

a) Functional Allotment between the Private River Ports and the Public River Ports

At present most IWT cargoes are dry and liquid bulk cargoes which are materials and products of the factories located along the Nile river and canals. These cargoes are unloaded and loaded at private river ports developed adjacent to the factories. Even in future, all IWT bulk cargoes are assumed to be handled basically at private river ports the same as the present. Present IWT cargoes, such as coal, coke, sugar, mollases, and fertilizer, are assumed to continue to be handled mostly at the existing private river ports in future. It might be necessary to improve port facilities and cargo handling equipment at some private ports to accommodate future increasing cargoes. While newly introduced IWT bulk cargoes, such as maize and wheat, which are to be shifted from land transport, are also assumed to be handled at private river port facilities which will be developed by the private companies. Since these private river ports are exclusively used for each private company, the required river port facilities and equipment should be also developed by each company.

Meanwhile, general cargoes, such as timber, cement, iron/steel products and container cargoes, are handled at public river ports, because these cargoes have many consignors and consignees. Therefore public river ports to accommodate the demand of the general cargoes should be developed by the public sector. RTA is the sole responsible organization for the development of the public river ports. To realize IWT of containers and other general cargoes, a public river port in Greater Cairo should be developed by RTA.

Table 11.3.2 Functional Allotment between the Private River Ports and Public River Ports

	Present	2020	
	Private Port	Private Port	Public Port
Bulk Cargo (Dry Bulk, Liquid Bulk)	○	○	—
General Cargo (Timber, Cement, Iron/Steel Product)	—	—	○
Container Cargo	—	—	○

b) Cargo Throughput and Calling Barges of Public River Port in Greater Cairo

A new public river port should handle all containers and general cargoes. Cargo volumes and number of calling barges to be handled at a new public river port are shown in Table 11.3.3 – 11.3.4.

Table 11.3.3 Cargo Throughput at New Public River Port in Greater Cairo in 2020

Unit: 000MT

Cargo Item \ Sea Port		Greater Alexandria		Damietta	Total
		Alexandria	Dekheila		
Inbound	Timber	350	—	86	436
	Cement	64	—	—	64
	Iron/Steel Products	70	—	—	70
	Containers (000 TEUs)	40	80	92	212
Outbound	Containers (000 TEUs)	40	80	92	212
Total	General Cargo	484	—	86	570
	Containers (000 TEUs)	80	160	183	423

Table 11.3.4 Number of Calling Barges at New Public River Port in Greater Cairo in 2020

Cargo Item \ Sea Port		Cargo Volume per Barge	Greater Alexandria		Damietta	Total
			Alexandria	Dekheila		
Inbound	Timber	1,378 (MT/barge)	254	—	63	317
	Cement	1,378 (MT/barge)	47	—	—	47
	Iron/Steel Products	1,378 (MT/barge)	51	—	—	51
	Containers	96 (TEU/barge) (88 for Dekheila)	417	910	959	2,286
Outbound	Containers	ditto	417	910	959	2,286
Total	General Cargo	1,378 (MT/barge)	352	—	63	415
	Containers	96 (TEU/barge) (88 for Dekheila)	417	910	959	2,286

c) Port Facilities for Container Cargo

- **Required Dimensions of Berths**

Required dimensions of berths are basically obtained by the following formula:

Berth Length = Barge Length + Barge Breadth
Berth Depth = Barge Draft x 1.1

According to the barge design, one unit of container barges consists of a pusher and a dumb barge. Each LOA is 50m and LOA of the unit is 100m. Breadth of the unit is 12m. Draft is 1.6m. Therefore the required dimensions of the container berth are 115m in length and 1.8m in depth.

- **Handling Productivity**

In order to compete with other transport modes, truck and railway, IWT system should aim at offering not only low service price but also reasonable service time. Ensuring high productivity and efficient management of cargo handling is vital for the improvement of IWT.

To reduce the cargo handling time at quay side, it is assumed that two quay side cranes should be applied for one unit of barges. The productivity of the quay side crane should compete with that of sea ports, such as Alexandria Port and Dekheila Port. The container handling productivities in 1997 at Alexandria Port and Dekheila Port were 17-19 boxes / hour / vessel. The future target productivity of these ports (in the study on master plan and rehabilitation scheme of the Great Alexandria Port) is 16-24 boxes / hr / crane. Therefore the productivity target of the quay side crane at the new river port should be 15 boxes / hr / crane in 2020.

Productivity	15 boxes / crane / hour
Number of Cranes per Berth	2 cranes

- **Required Number of Berths**

Based on the above mentioned assumptions and other cargo handling conditions, the required number of container berths in 2020 is calculated to be two (2) (See Appendix.11-8).

In addition to the loading/unloading berths, a berth for a waiting barge is required for navigation safety and efficient cargo handling. Therefore three (3) berths, whose total quay length is 345m, are required in 2020.

- Required Number of Container Stacking Ground Slots

Total required number of ground slots is shown in Table 11.3.5 (See Appendix -11.8).

Table 11.3.5 Total Required Number of Ground Slots

Container Status	Required Number of Ground Slots (TEU)
Inbound Container Stacking Slots	982
Outbound Container Stacking Slots	618
Empty Container Stacking Slots	485
Total Required Number of Ground Slots	2,085

- **Required Container Terminal Area**

Container terminal areas of the existing Alexandria Container Terminal and El Dekheila Container

Terminal are 16.3 ha and 38 ha respectively. Available ground slots of each terminal are estimated at about 3,000 TEUs and 4,000 TEUs respectivly. Therefore the average required terminal area for one TEU ground slot is assumed to be 70 m2. Based on this assumption, required container terminal area for 2,085 TEUs ground slots is estimated to be around 14.5 ha.

d) Port Facilities for General Cargo

- **Required Dimensions of Berths**

Required dimensions of berths are basically obtained by the following formula:

Berth Length = Barge Length + Barge Breadth
Berth Depth = Barge Draft x 1.1

According to the barge design, one unit of cargo barges consists of a pusher and a dumb barge. Each LOA is 50m and LOA of the unit is 100m. Breadth of the unit is 12m. Draft is 1.6m. Therefore the required dimensions of the general cargo berth are 115m in length and 1.8m in depth.

- **Handling Productivity**

Loading and unloading to/from barges is carried out by truck cranes. Considering available working range of truck crane and efficient cargo handling, two truck cranes should be applied for one unit of barges. Target handling productivities for each commodity are shown in Table 11.3.6.

Table 11.3.6 Commodity-wise Productivity of General Cargo Operation

Commodity	Package Style	Future Productivity (MT/hr/vessel)	Present Productivity at Alexandria Port (1997) (MT/hr/vessel)
Timber	Bundle	110	47
Cement	Bag	30	20
Iron/Steel Products	Bundle	70	39

Source: JICA Study Team, The Study on Master Plan and Rehabilitation Scheme of the Great Alexandria Port (November 1999)

- **Required Number of Berths**

Total required number of general cargo berths is calculated to be two (2) (See Appendix-11.8).

In addition to the loading/unloading berths, a berth for a waiting barge is required for navigation safety and efficient cargo handling. Therefore three (3) berths, whose total quay length is 345m, are required in 2020.

- **Required Areas of Sheds and Open Yard**

Required areas of sheds and open yard are calculated at 2,000 m2 and 16,000 m2 respectively (See Appendix-11.8).

e) Cargo Handling Equipment for Container Cargoes

- **Quay Side Crane**

There are two alternatives for the quay side crane, a gantry crane and a movable crane. The main advantage of a gantry crane is the high productivity. The advantage of a movable crane is lower investment cost. However, the difference of the productivity between a movable crane and a gantry crane is not so large and moreover a movable crane can handle some rows of containers in the barge without changing its position. Considering the above mentioned conditions and barge design, a movable crane is recommended.

The available number of quay side cranes for handling containers at a port is a governing factor in determining the turnaround time of container barges. Hence, it is necessary to provide the optimum number of cranes to ensure the completion of the container handling within the short port stay time of container barges.

The required number of quay side movable cranes for handling containers is calculated at four (4) (See Appendix.11-8).

- **Rubber Tire Mounted Gantry Crane (RTGs)**

There are some alternatives in terms of container handling systems in the container yard. The characteristics of each system are compared in Table 11.3.7. Considering handling container volume and efficient use of land area, RTG system is proposed as the container handling system at the port.

For quayside operation, one unit of RTGs will be adequate to work in combination with one quay side crane.

In general the operation efficiency of RTGs in receiving/delivery containers is approximately 23 boxes per hour due to re-handling of containers stacked in three or four tiers stow and hoisting or lowering operations across stacks which blocks the movement, and so on.

The total required number of RTGs is calculated at 11 units on the assumption that containers loading/unloading will be stacked once in the marshalling yard (See Appendix-11.8).

Table 11.3.7 Comparison of Container Handling Systems

Kind of Equipment	Straddle Carrier	RTG	Forklift/ Reach Stacker	On Trailer (Chassis)
Required CY Area	Medium	Small	Rather Large	Huge
Investment Cost	Medium	Medium	Low	High
Balance to Capacity of G/C	Excellent	Good	Good	Good
Efficiency of Work	Medium	Medium	Low	High
Flexibility of Work	High	Low	Mediu m	High
Damage Ratio of Container	Medium	Low	High	Very Low
Maintenance Cost & Repair Time	High	Medium	High	Low
Application of Automation	Medium	Easy	Mediu m	Mediu m
Construction Cost of Pavement	Heavy	Medium	Heavy	Low

- **Prime Mover (Tractor / Trailer)**

The required number of yard tractor-trailers is calculated at 12 units (See Appendix-11.8).

f) Cargo Handling Equipment for General Cargo

- **Quay Side Crane**

Loading and unloading to/from barges is carried out by truck cranes. Considering available working range of truck crane and efficient cargo handling, two truck cranes should be applied for one unit of barges. The required number of truck cranes in total is 4 units (2 cranes x 2 berths).

- **Forklifts**

The required number of forklifts is calculated at 8 units (See Appendix-11.8).

g) Summary of required facilities and equipment in 2020

The required facilities and equipment for a public river port are summarized in the following Table

11.3.8.

Table 11.3.8 Summary of required facilities and equipment in 2020

Container Terminal (Terminal Area : 14.5ha)	
Berth	3 Berths (Length 345m ; Depth 1.8m)
Container Yard (TEUs)	Ground Slots 2,085 TEUs (Inbound / Outbound 1,600 ; Empty 485)
Quay Side Equipment	Movable Crane [4]
Cargo Handling Equipment	RTG [11], Tractor and Trailer [12], etc
Other Facilities	CFS, Administration Building, Maintenance Shop, Gate, etc.
General Cargo Terminal (Terminal Area : 2.5ha)	
Berth	3 Berths (Length 345m ; Depth 1.8m)
Storage Facilities	Shed (2,000m2), Open Yard (16,000m2)
Quay Side Equipment	Truck Crane [4]
Cargo Handling Equipment	Forklift [8] etc.

Note: [number]

4) Proposed Public River Port in Greater Cairo

a) Site of New Public River Port

Regarding a development site of a container terminal in Cairo, eight candidate sites on the Nile River ranging from El Tebbin (923 km) to Tanash (970 km) were evaluated in 1995 by RTA. Among these eight sites, three sites, which are Ather El Nabi, El Massara and El Tebbin, were studied in detail. After the evaluation on the three sites, the site at Ather El Nabi was selected as most favorable for the IWT container terminal. The following advantages of Ather El Nabi were pointed out by the consultant.

- site is well located in Cairo with direct access to Ring Road;
- quay of adequate length allows for at least two twin vessel units to berth simultaneously and future extensions of the crane and container stacking area;
- suitable to establish a customs area and separate the current activities from the proposed container handling and storage activities;
- site is owned by RTA.

As disadvantages 'no available crane' and 'necessity of strengthening present quay' were mentioned.

Based on the above site selection and further studies on container terminal in Cairo, RTA and an Egyptian private transport company, Egytrans, are promoting the development of a new container terminal at Ather El Nabi. This site is located along the Branch Canal and the land owner of that site is RTA. This means that land acquisition is not necessary for the container terminal development. This site also has an advantage in terms of an access route since it is easy to access the main roads in

Cairo, such as Cornish El Nile Street and Ring Road.

Our demand forecast of IWT shows that a new port should have two major facilities, a container terminal and a general cargo terminal. The new port requires 3 container berths (total quay length : 345m) with a terminal area of around 14.5 ha and 3 general cargo berths (total quay length : 345m) with a terminal area of around 2.5 ha. As a result, the new port requires a terminal area of around 17 ha.

The site of the container terminal planned by RTA is the northern area from Monib Bridge of Ring Road. This land area is around 8 ha with an approximately 500 m canal front. However, in the southern area from the bridge RTA also owns a land area in excess of 10 ha with an approximately 1 km canal front, which is now used for open cargo storage yard, ship yard and garage for public buses (See Fig. 11.3.6-1). It is assumed that this area can be redeveloped for port facilities. Therefore, this site could be expanded southward within RTA owned land. The total area and canal front length together with both land areas owned by RTA satisfy the required scale for the development of a new public river port. Therefore, it is proposed that the public river port be developed in this area.

(Reviews for Future Development)

In the master plan, it is estimated that Ather El Nabi port could cope with the growth in cargoes until 2020. Assessing that the proper equipment is introduced and cargo handling efficiency is improved. However, this will be the first time for containers to be handled at a river port, and it is necessary to monitor actual performance of container handling when the first phase of the project commences. It is recommended that a review of river port development be conducted based on the operational performance of Ather El Nabi Port, road network planning in the Greater Cairo Region and new investment in IWT by private sector.

As mentioned previously, three sites which are "Ather El Nabi", "El Massara" and "El Tebbin" were examined as candidates of a container river port.
Moreover, several studies suggest new sites of river container terminals on the northern area of GCR (see the following Figure 11.3.7).

After the first phase of the project, it is considered that above review of river port development will be conducted ranging from Tebbin to northern sites in the whole GCR as shown in Figure 11.3.7.

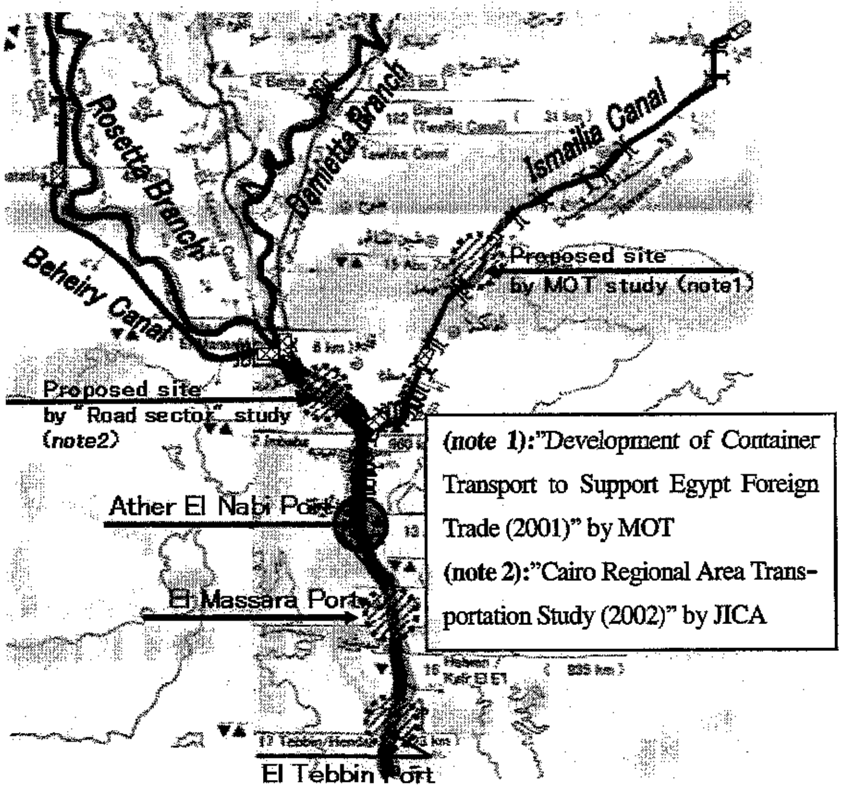


Figure 11.3.7 Candidates for Public River Port Development by Recent Studies

b) Natural Conditions and Existing Facilities at Ather El Nabi

- **Branch Canal**

The Branch Canal has a length of about 1,800 m and width at mean water level of about 45 m. The canal is connected to the Nile River at almost a right angle in its northern end and at an approx. 60 degree angle in its southern end. The canal is generally relatively straight, but there is an approx. 70 degree bend in the northern part of the canal and an approx. 30 degree bend in the southern part.

The result of a bathymetric survey conducted in September 1999 indicated that the canal has insufficient water depth for the navigation of the proposed barges.

The current speed does not exceed 1 m / s (2 knots).

- **Bridges Crossing**

There are three bridges crossing over the canal. Two bridges of the Cornice El-Nile Street cross over both ends of the Branch Canal. The bridge columns are founded in the canal on the banks. The bridge columns only in the southern end of the canal are furnished with fender beam structures as protection against the impact from possible barge collision. The horizontal clearance between the bridge columns is about 27 m for the southern bridge and about 20 m for the northern bridge. The vertical clearance under the bridges is about 10.5 m for the southern bridge and about 7.5 m for the northern bridge.

The Monib Bridge of Ring Road has no columns in the Branch Canal and its vertical clearance is more than 10 m.

Therefore the clearance of the bridges is sufficient for the navigation of the proposed barges (As for proposed barges, see 11.3.5 for detail).

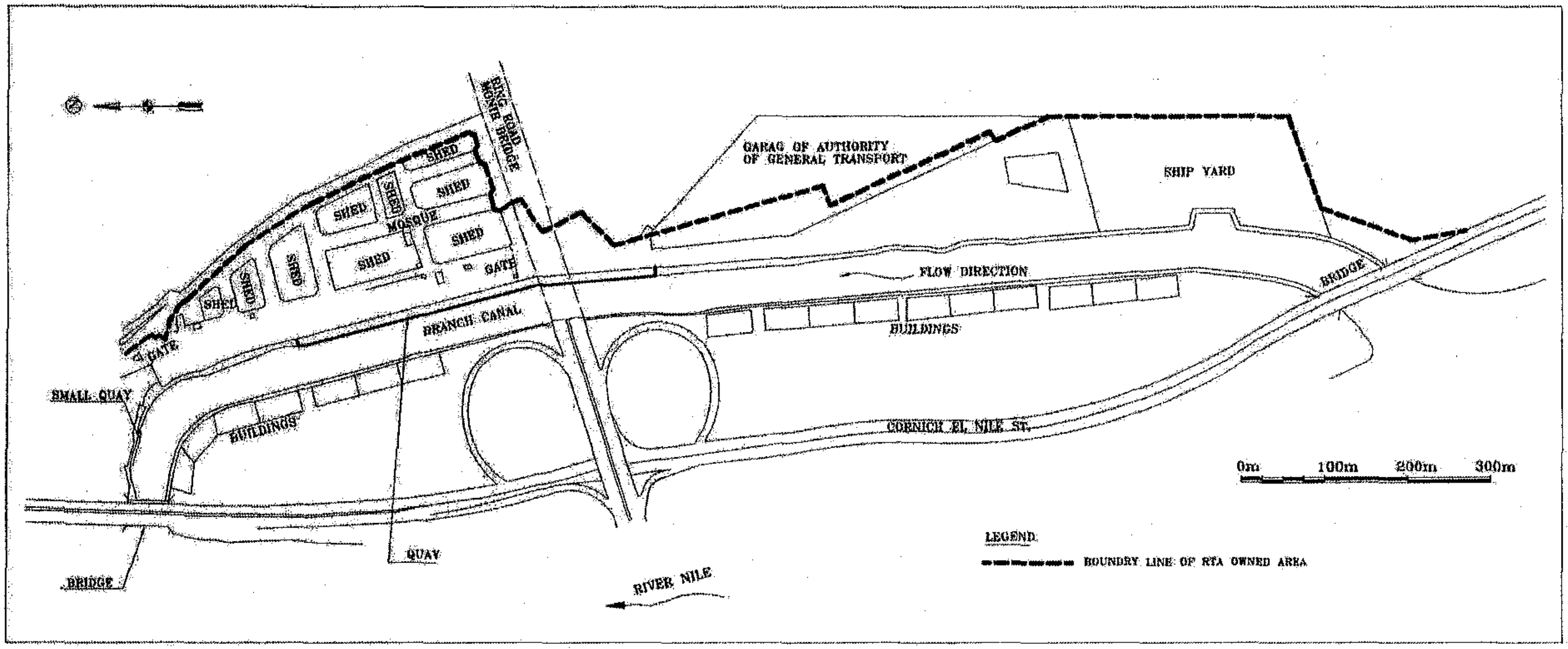


Figure 11.3.8 Present Condition of Ather El Nabi Area

- **Existing Quay**

The quay, located at the northern part of the canal, was constructed as a deck founded on reinforced concrete piles in 1962. Its total length is about 450 m. It had been used for unloading of stones from barges and feluccas. At present the quay is hardly used because its backyard area is occupied by the green grocery market. The quay structure needs to be reinforced when it is transformed into container terminal facilities.

c) Basic Layout Plan

A container terminal berth should be developed at the northern side of Monib Bridge. Container terminal including a large portion of container yard for inbound and outbound containers can be developed in this area. Empty container stacking area should be developed at the southern side of Monib Bridge.

General cargo berths and terminal should be developed southward from the above mentioned container terminal.

Layout of a new public river port is shown in Fig.11.3.9.

d) Navigation Plan in the Branch Canal

Due to the limited width of the Branch Canal one-way traffic is inevitable. One-way traffic towards upstream (entering from the northern end and leaving from the southern end) is recommended due to the easiness of maneuvering of the barges, in particular in the north bend, and stability of mooring barges.

Water depth of the Branch Canal is not sufficient for the new barges to be introduced. Dredging work is required to secure an appropriate waterway width and depth of 1.8 m. The required width is assumed to be 24 m (barge width x 2) in a straight area and 35 m (almost 3 times of barge width) in front of the berths. However, although the proposed barge has good maneuverability, some additional dredging work for expanding the width of waterway in the north bend is required in order to facilitate maneuvering of the barges.

The proper navigation aid facilities at both ends of the canal and columns of the bridges should be installed for navigation safety. Fenders for the columns at the bridge of the northern end may be required.

e) Access Road

In order to make the best use of the site's close proximity to the main road network in Cairo, effective access route from/to the main roads should be established. In access road planning, not only port related traffic but also general traffic in this area should be taken into consideration, since this area has a heavy traffic volume even at present. In other words, an efficient road network in this area including the port should be developed. Main point is assumed to be realizing an effective connection between the port area and Ring Road. Direct connection by flyover might be preferable from the view point of the separation of port related traffic and general traffic.

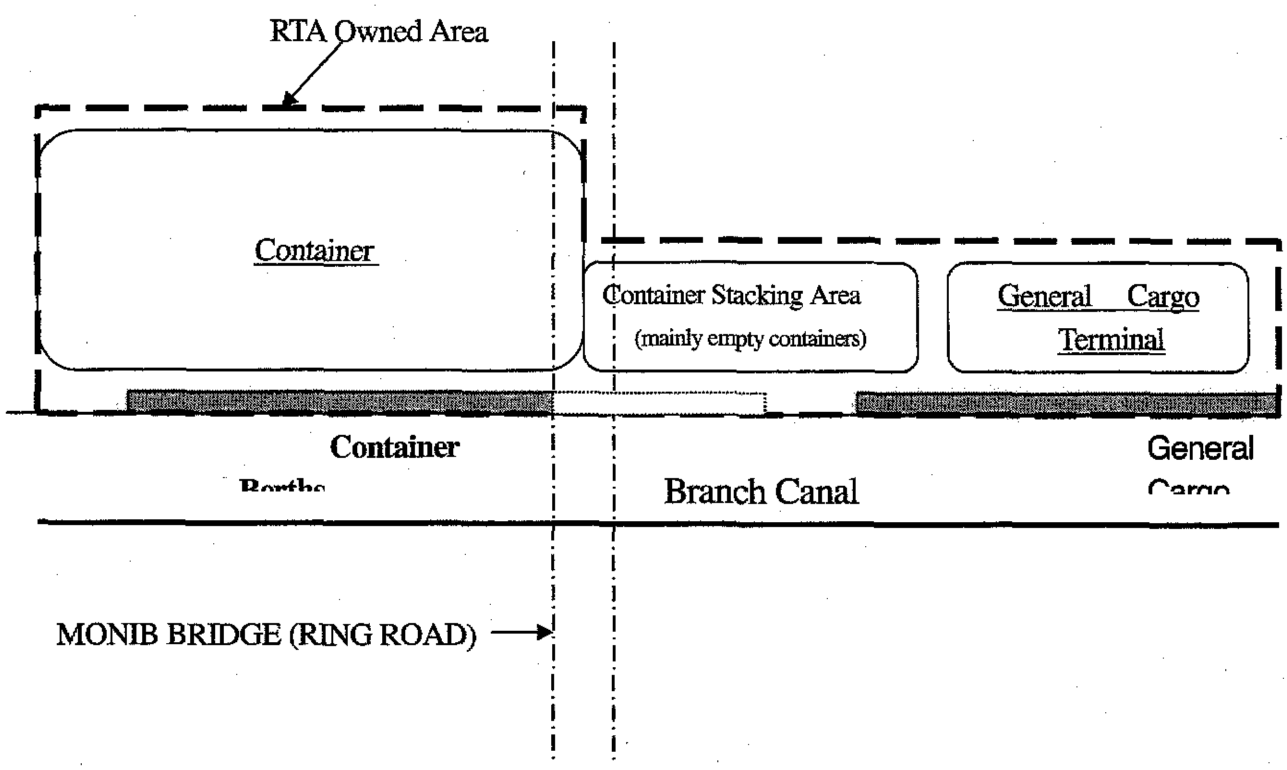


Fig.11.3.9 Layout of New Public Port at Ather El Nabi

(2) Sea Port Facilities

1) General Views on the Requirements for Sea Ports

The most important point for the development of the IWT is to attract as much cargo as possible. To achieve this target the transport cost and time of IW must be competitive with railways and trucks. In this regard, it is important to establish an efficient and economical transshipment system between sea-going vessels and IWT barges at seaports.

There are two methods for the transshipment between sea going vessels and IWT barges, direct transshipment and indirect transshipment (transshipment via land area). The most suitable method should be selected for each commodity based on a careful evaluation. Generally, direct transshipment does not require land stock facilities but it causes long berthing times of sea going vessels due to lower cargo transshipment productivity than that of quay side loading/unloading. Hence the transshipment via land stock facilities is generally preferable for efficient cargo transshipment if it is possible to provide required berths and stock facilities for IWT barges.

To accommodate IWT cargoes to be transshipped at sea ports (Alexandria Port, El Dekheila Port and Damietta Port), the proper port facilities, such as barge berths and basin, and cargo handling equipment should be prepared. In particular, the tranship method and area for newly introduced IWT cargoes including containers, general cargoes, and maize/wheat, should be evaluated carefully. However, compared with the total cargo handling volumes at sea ports, IWT cargo handling volumes there will still be small even though they are assumed to increase significantly in the future. Therefore, the seaports basically can cater for the future IWT demand with existing equipment and facilities for the moment except for some bulk cargo loading equipment. However, from a long-term perspective, the further development of cargo handling equipment and port facilities such as barge basin will be required to accommodate future IWT cargo demand and to achieve efficient transshipment between sea and IW.

2) Alexandria Port

Alexandria Port is the sole seaport connected with IWT at present. Main IWT cargoes are coal, coke, molasses and sulpher. Moreover containers, grain and general cargoes such as timber and cement are expected as additional IWT cargoes in the future. The requirement for each cargo is as follows.

a) Coal / Coke

Two transshipment methods between sea-going vessels and IWT barges are adopted at the coal/coke terminal. One is direct transshipment in side-by-side mooring style with the rail mounted cranes and the other is transshipment via stock yard. IWT of coal/coke is forecasted not to increase in the future. Therefore the existing facilities and equipment can accommodate future demand. However the introduction of wider barges (12m width) may cause difficulty for direct transshipment due to the limitation of the outreach of the cranes.

b) Grain

IWT of grain used to be conducted between Alexandria Port and Imbaba. The loading equipment for river barges still remains at the grain terminal but is not workable due to long disuse. New loading equipment for river barges should be installed in order to resume IWT.

c) Container

There are two options for container handling of IWT barges, gantry crane and movable crane. If the existing gantry cranes can be used for container handling of IWT barges, additional investment for cargo handling equipment is not required. However, priority to use berths with gantry cranes is given to sea going vessels. Considering berth occupancy condition, it is difficult for IWT barges to use these berths constantly. If possible, cargo handling of IWT barges should be carried out at another berth in the container terminal, such as RORO berth, to shorten the land transport distance at the port. If this would cause excessive congestion at the container terminal, the appropriate berth should be prepared near the terminal. Berth No. 44 is one of the suitable sites. A movable crane for cargo handling of IWT barges also needs to be prepared.

d) General Cargoes

There is no IWT of timber at present. However many port barges are used for unloading timber with ship gears in the port basin. The transshipment to river barges also can be conducted in the same way. Some iron/steel products are transported by river barges. Cement can be transshipped by truck crane. It is considered that a large investment is not required for IWT of general cargoes.

3) El Dekheila Port

There is no IWT at El Dekheila Port. The requirements for potential cargoes for IWT with coastal-going barge system are as follows.

a) Container

The container terminal has sufficient quay length and a mobile crane which can be used for cargo handling of river barges. The berth and cargo handling area adjacent to the terminal also can be provided for river barges.

b) Coal

All imported coals at the material quay are transported to Tebbin by rail. Since the wave condition at this quay is not calm for IWT barge mooring, another appropriate berth should be prepared for cargo handling of IWT barges. Loading equipment of the belt conveyer system from the remote stock yard is also required. A huge investment is assumed to be required for the introduction of IWT.

c) Grain

All imported grains are transported by trucks. Loading equipment from the silos is required for IWT.

4) Damietta Port

Containers, grain and timber are forecasted to be IWT cargoes. The requirements for IWT of grain and containers are as follows.

a) Grain

The river barge basin with loading equipment from the silos has been already constructed. This basin is connected with Damietta Branch through the connecting canal. Therefore IWT can be started immediately after the completion of the Damietta Branch development project.

b) Container

The container terminal has a mobile crane which can be used for cargo handling of IWT barges. The general cargo berths adjacent to the container terminal can be used for IWT barges.