263-0053

PN-ABW-899

TECHNICAL/ECONOMIC FEASIBILITY STUDY FOR FLAT GLASS PRODUCTION FACILITIES IN EGYPT

Volume IV

Phase II (Feasibility Stage)-Environmental Impact Assessment

DRAFT REPORT

GE79TMP-1 (IV)

GENERAL ELECTRIC COMPANY - TEMPO
CENTER FOR ADVANCED STUDIES
SANTA BARBARA, CALIFORNIA
WASHINGTON, D.C.

GENERAL ELECTRIC

GENERAL ELECTRIC COMPANY, 816 STATE STREET, P. O. DRAWER QQ
SANTA BARBARA, CALIFORNIA 93102, Phone (805) 965-0551

T E M P O

ECA-181
CENTER FOR
ADVANCED STUDIES

14 December 1978

Mr. Abdel Hamid S. Abou Zekri, Chairman
El Nasr Glass and Crystal Company
11 Sheriffein Street
Cairo, A. R. E.

Dear Mr. Zekri:

Attached is the preliminary draft of the Environmental Assessment for the proposed program for increased flat-glass facilities in Egypt. The program that is assessed and the results of that assessment are summarized in the pages immediately following.

This volume of the Phase II report is being submitted for review in accordance with Paragraph F2, a(2) of the contract. Volumes I, II, and III are being prepared.

Review rs of this volume should be aware that some of the information is preliminary or is still not available, pending completion of preliminary engineering design. Some of the information and data values will not agree with information that will be presented in the other three volumes. For example, the amounts of raw materials used are slightly different from the amounts that will appear in the later volumes because these values have just recently been recalculated to reflect the chemistry of the most likely sand source. However, any such differences will be relatively small and will not affect the basic conclusions of the assessment. Differences will be reconciled in the final draft.

Sincerely,

Edward C. Arbuckle
Manager, Minerals and Industrial
Development

ECA:sm

Enclosures

Copy No.

TECHNICAL/ECONOMIC FEASIBILITY STUDY FOR FLAT GLASS PRODUCTION FACILITIES IN EGYPT

Volume IV

PHASE II (FEASIBILITY STAGE) –
ENVIRONMENTAL IMPACT ASSESSMENT

December 1978

DRAFT REPORT

PREPARED FOR EL NASR GLASS AND CRYSTAL COMPANY
CAIRO, EGYPT

GE79TMP-1(IV)

GENERAL ELECTRIC COMPANY–TEMPO
CENTER FOR ADVANCED STUDIES
SANTA BARBARA, CALIFORNIA, U.S.A.
WASHINGTON, D.C., U.S.A.

SUMMARY

This is an environmental assessment of a project to increase the production of flat glass in Egypt. The total project consists of construction and operation of a plant using the float process to produce approximately 100,000 MT of flat glass per year; mining, processing, and shipping of glassmaking raw materials; and shipping of finished glass. The preferred site of the glass plant is Tenth of Ramadan, a new desert city that is being developed approximately 50 km northeast of Cairo.

No significant impacts will occur from mining the raw materials. The raw materials will be obtained from existing quarries or areas that are designated as quarries. All of the sites are remote and barren.

Beneficiation of sand requires large amounts of fresh water unless a more expensive recirculating system is used, so any beneficiation plant will probably be located near the Nile or one of its canals. Waste water from sand scrubbing can be discharged into the Nile without exceeding Egyptian water quality standards. Waste water from froth flotation can be cleaned by discharge into a settling or tailings pond.

Shipping of raw materials and finished glass by truck will add about 125 trucks each day to the road traffic. This will be a small fraction of the total traffic and will increase traffic-related environmental impacts by an insignificantly small amount.

Since the glass plant will be located in a designated industrial area that is 2 km from the nearest residential area of Tenth of Ramadan, it is in accordance with land use at the site and will not adversely affect adjacent land uses. The glass plant conforms with all building requirements except that the building will exceed the recommended height.

The plant site is quite flat and very barren. No significant effects on land, water, vegetation, wildlife, or wildlife habitat from construction and operation of the plant can be foreseen. A closed recirculating system will minimize cooling water consumption. Waste water and sewage will be discharged into the sewage system

provided by the city. Solid waste will be disposed of at city dump sites. All socioeconomic effects seem to be beneficial.

The only adverse effect from the project that may be significant is the reduction of air quality by stack emissions. The fusion losses from the melting of the batch will produce relatively small amounts of air pollutants that will not exceed Egyptian or United States air quality standards, even under the most adverse meteorological conditions. However, the use of a high-sulfur fuel oil, such as that used at the Shoubra El Khema plant, could increase the oxides of sulfur emissions by an order of magnitude. Even with this increase the glass plant alone is unlikely to cause air quality standards to be exceeded; however, the plant will contribute to the reduction of air quality near the industrial site and also in the city when winds are from the south.

The project will not consume scarce resources or adversely affect long-term productivity. A number of alternatives to the currently planned project were considered, including different types of projects and different sites. The proposed project best meets Egyptian goals. In Phase 1, Tenth of Ramadan was judged as the best site overall and the one at which the environmental impact is likely to be the least.

ACKNOWLEDGMENTS

TABLE OF CONTENTS

		Page
SUMMARY		iii
ACKNOWLEDGMENTS		v
LIST OF ILLUSTRATIONS		xi
LIST OF TABLES		xi
SECTION		
1	PROJECT DESCRIPTION	1-1
	Introduction	1-1
	Description of the Proposed Action	1-1
	Typical Flat Glass Manufacturing Process	1-2
	Mining and Processing of Raw Materials	1-6
	Transportation of Raw Materials	1-9
	Construction and Operation of the Glass Plant	1-10
	Distribution of Glass	1-13
	Environmental Setting	1-14
	Planned Development	1-14
	Existing Environment	1-17
2	LAND-USE RELATIONSHIPS	2-1
3	PROBABLE IMPACT OF THE PROPOSED PROJECT ON THE ENVIRONMENT	3-1
	Furnishing of Glassmaking Raw Materials	3-1
	Mining Raw Materials	3-1
	Processing Raw Materials	3-1
	Transporting Raw Materials	3-2

SECTION		Page
3	Construction and Operation of the Glass Plant	3-3
	Effects on Land	3-3
	Effects on Air Quality	3-3
	Effects on Water	3-9
	Effects on Biota	3-9
	Effects on Socioeconomic Environment	3-8
	Worker Safety	3-10
	Summary	3-10
	Transportation of Finished Glass	3-10
4	ALTERNATIVES TO THE PROPOSED ACTION	4-1
5	ADVERSE ENVIRONMENTAL IMPACTS THAT CANNOT BE AVOIDED	5-1
6	THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY	6-1
7	IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES	7-1
8	CONSIDERATIONS THAT OFFSET ADVERSE ENVIRONMENTAL EFFECTS	8-1
APPENDIX		
A	SUGGESTED LAND-USE AND BUILDING REGULATIONS FOR THE INDUSTRIAL AREAS	A-1
	General Aspects	A-1
	Lots	A-1
	Land Occupancy	A-2
	Yards	A-2
	Heights	A-2
	Floor Area	A-2
	Landscaping, Recreation Areas, Social Accommodations	A-2
	Regulations of the Buildings	A-3
	Advertising Signs	A-3
	Enclosing	A-3

APPENDIX		Page
A	Traffic	A-3
	Electricity, Telephone, Water, Sewerage and Waste Disposals	A-4
	Sound Levels	A-4
	Air Pollution	A-4

LIST OF ILLUSTRATIONS

Figure		Page
1-1	Process flow diagram of a typical batch plant.	1-3
1-2	Regenerative side-port glass-melting furnace.	1-4
1-3	Illustration of float process.	1-6
1-4	Locations of raw material sources.	1-8
1-5	Facilities plan for glass plant site at Tenth of Ramadan.	1-11
1-6	Section view of glass plant.	1-12
1-7	Plan of Tenth of Ramadan and location of glass plant.	1-16
1-8	View looking south from proposed site.	1-18
1-9	View looking north from proposed site (Tenth of Ramadan construction activities in background).	1-18
1-10	Summary of weather at Tenth of Ramadan.	1-19
1-11	Estimated annual percentage frequency of surface wind.	1-20
3-1	Normalized ground-level average concentration for an effective source height of 100 meters as a function of distance from the source.	3-5

LIST OF TABLES

Table		
1-1	Major raw material requirements to produce 100,000 MT of glass per year.	1-7
1-2	Total truck-kilometers for transporting raw materials.	1-10
3-1	Air emissions from the glass-melting furnace.	3-5
3-2	Maximum ground-level concentrations of air emissions compared with Egyptian and United States standards.	3-7

SECTION 1
PROJECT DESCRIPTION

INTRODUCTION

The Government of the Arab Republic of Egypt (Egypt), acting through its General Organization for Industrialization (GOFI), is considering the feasibility of a new flat-glass production plant in Egypt. Under the sponsorship of the U.S. Agency for International Development (AID), General Electric–TEMPO is performing the two-phase feasibility study for the El Nasr Glass and Crystal Company (NGC), an Egyptian Government company. The purpose of the feasibility study is to assist GOFI and AID to evaluate the technical, financial, and economic advisability of undertaking the project. This Environmental Assessment is prepared in accordance with the requirement to assess the potential environmental consequences of AID-assisted projects.*

Phase I of the feasibility study, a prefeasibility phase, was conducted to review the commercial aspects of undertaking a flat glass plant and to give sufficient consideration to the technical, financial, and economic aspects to give guidance to NGC, AID, and GOFI at the prefeasibility level.† The future demand (domestic and export) for glass was estimated; raw materials requirements, availability, and costs were evaluated; the operation of the existing glass plant was analyzed; glassmaking processes were compared; site locations were evaluated; options to match glass production to the estimated demand were formulated; financial and economic aspects were analyzed; and recommendations were made.

DESCRIPTION OF THE PROPOSED ACTION

Egyptian authorities selected Tenth of Ramadan, a new desert city, as the site for the glass plant, as recommended in the Phase I report,

---

*"Chapter 11, Agency for International Development, Department of State, Part 216, Environmental Procedures," *Federal Register*, Vol 41, No. 127, pp 26913-26919, June 30 1976.

†General Electric–TEMPO, *Technical/Economic Feasibility Study for Flat Glass Production Facilities in Egypt; Phase I (Prefeasibility Stage) Final Report* (3 volumes). Prepared for El Nasr Glass and Crystal Company, 20 July 1978.

and chose the float process as the method to make the glass. Therefore, this Environmental Assessment volume addresses the construction and operation of a flat glass manufacturing plant using the float process and located at Tenth of Ramadan. The mining, processing, and transport of glassmaking raw materials is also included in this assessment. The glass plant is being designed to produce 100,000 metric tons (MT) of finished glass when the plant becomes operational in the mid-1980s. The assessment does not include possible future expansion by adding a second process line.

Since the plant design is at the feasibility level, numerous changes can be expected before the plant is finally constructed and operating. Therefore, the environmental analysis is as broad as possible so that design changes will remain within the scope of the Environmental Assessment. Toward this end, and also as an aid to understanding the total project and potential alternatives, a typical flat glass manufacturing process is described, followed by a description of the project as it is currently envisioned.

Typical Flat Glass Manufacturing Process

Although flat glass manufacturing plants may differ in details, the production process is basically as described in this section.

The primary raw materials used in making flat glass are sand, limestone, dolomite limestone, and soda ash. Other ingredients are used in relatively small amounts for specific purposes. The sand and limestones are mined from natural deposits and the soda ash is either mined from natural deposits or produced by the Solvay process. If necessary, raw materials are "beneficiated" by mechanical and chemical techniques to obtain desired particulate sizes and enhance their purity. Beneficiation can be done at the quarry site, at the glass plant, or at some other site. The raw materials are shipped to a batch plant at the glass plant where they are conveyed to storage bins or silos.

A typical batch plant is illustrated schematically in Figure 1-1. As needed, raw materials are withdrawn from storage and conveyed to a weighing machine where the desired amount of each material is weighed out and then conveyed to a mixer. Cullet, waste glass that has been broken and crushed, is also mixed with the raw materials so that typically it forms from 30 to 50 percent of the total mixture. The cullet improves the melting of the mix and utilizes a material that would otherwise be wasted. The mixer thoroughly mixes the raw materials and cullet into the "batch" which is conveyed to a batch storage bin. The batch is withdrawn from the batch storage bin as needed and conveyed to the batch charger or furnace feeder which "feeds" the batch into the melting furnace at the specified rate.

SOURCE: Reznik, Richard B., *Source Assessment: Flat Glass Manufacturing Plants*, Monsanto Research Corporation, Dayton, Ohio, NTIS No. PB 252 356, March 1976.

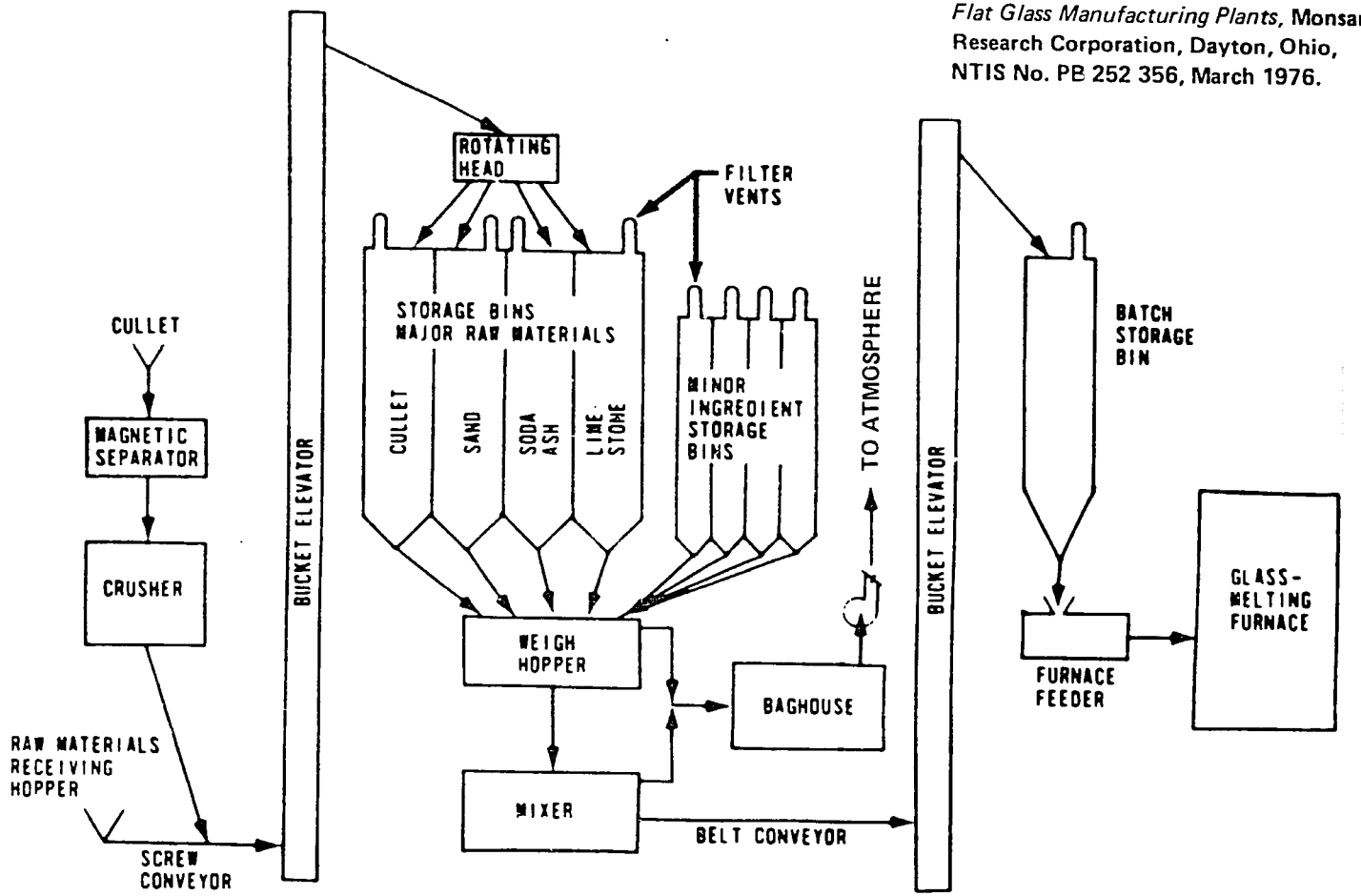


Figure 1-1. Process flow diagram of a typical batch plant.

The typical large glass-melting furnace is a side-port regenerative type. The size of the furnace depends on the desired capacity of the glass plant; the melting tank of a large furnace is typically 10 meters wide and 60 or 70 meters long.

The batch that is fed into one end of the furnace is heated to melting by open flame heaters that enter ports in the sides of the furnace (for a side-port type) and direct flame over the top of the batch and the molten glass. Traditionally the fuel has been coal gas or natural gas but oil can be used. To conserve fuel, regenerators are used at each side of a side-port furnace. The regenerators consist of two-story-tall chambers filled with brick checkerwork (checkers). In one cycle of operation, air is drawn in at the bottom of one regenerator, up through the checkerwork, and into the melting chamber where it is heated. The heated air passes into the opposite regenerator, through the checkerwork where it gives up waste heat in heating the checkerwork, and is exhausted through the stack. After 15 to 20 minutes the cycle is reversed and air is drawn through the heated checkerwork where it is preheated before passing into the melting tank and exhausted through the other regenerator, again giving up waste heat in heating the checkerwork.

As the batch melts, the molten glass flows slowly toward the other end of the furnace where it is eventually drawn off. The molten glass requires several days to thoroughly dissolve all materials, become homogeneous, and rid itself of air bubbles. Figure 1-2 illustrates a typical large furnace.

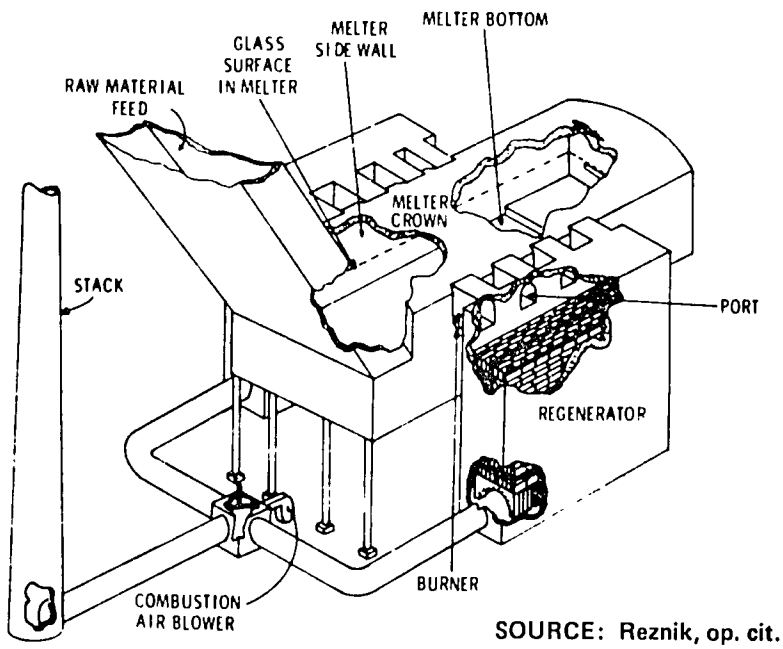


Figure 1-2. Regenerative side-port glass-melting furnace.

4

During the melting process, the raw materials react to form various oxides of the finished glass. These reactions also result in fusion losses where approximately 25 percent of the weight of the raw materials is given up as gases which are exhausted through the regenerators and the stack. A relatively small, but sometimes significant, portion of the fusion losses are air pollutants.

Flat glass can be formed by either an updraw-type of process into what is called sheet glass or by a float process into what is called float glass. The proposed glass plant is being designed for the float process, but because the updraw process is an alternative it will also be briefly described.

In an updraw process the molten glass flows from the melting tank into forehearths. From a forehearth a sheet of glass is started by various means and is drawn up by a drawing machine to form a continuous sheet of glass. As the sheet is drawn up it cools and hardens. The speed of drawing determines the thickness of the glass. In the Fourcault and the Pittsburgh updraw process the sheet is drawn up vertically through an annealing lehr to remove stresses and then through a cutting operation where the glass is cut into large panes. In the Colburn updraw process the sheet is bent over a roller just above the forehearth and then it is passed through a horizontal annealing lehr and a cutting operation. Two to six drawing machines, lehrs, and cutting operations will be used with a single furnace, depending on the specific type of updraw process and the plant capacity.

The float process is completely different from the updraw processes. Because it can produce superior flat glass in large quantities, the float process has replaced most of the updraw processes in the advanced countries.

Figure 1-3 illustrates the float process. The molten glass from the furnace flows into a "tin bath," a 50- to 60-meter-long tank containing molten tin. To prevent oxidation of the tin a nitrogen atmosphere is used in the bath tank. The molten glass floats on top of the molten tin and it cools and hardens to form a continuous "ribbon" of glass that passes through the controlled temperature range of the tin bath. The molten tin provides a very smooth finish to the bottom of the glass ribbon. The top of the ribbon is either finished by gravity or by floating a layer of molten tin on top of it. As the hot but hard ribbon is drawn from the float bath, its bottom surface may be sprayed with sulfur dioxide to form a protective coating of sodium sulfate.

The ribbon of glass is drawn from the float bath onto the rollers of an annealing lehr, usually heated by electricity or gas, where the glass is heated to relieve stresses. The lehr of a float process ranges from 100 to 150 meters long.

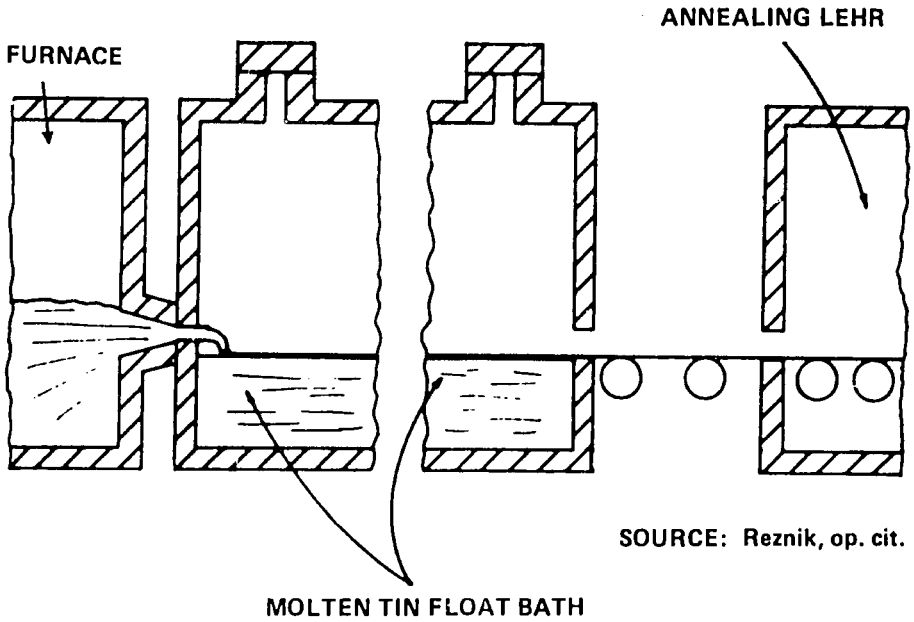


Figure 1-3. Illustration of float process.

After annealing, the ribbon of glass passes through an inspection station where it is visually inspected for defects. The ribbon continues to cutting machines which score the glass to the desired size. The ribbon is then broken into sheets by flexing it so that the glass snaps at the scored lines. The sheets of glass are then removed from the process line, either manually or automatically, and packaged. Defective glass and trimmings are reused as cullet. The packages of finished glass are transported to the warehouse or to shipping. Glass that is to be further processed (e.g., tinted, laminated) is usually washed with water before the additional processing.

Mining and Processing of Raw Materials

The glass plant is being designed to produce 100,000 MT of finished glass per year. The major raw material requirements to produce this amount of glass are shown in Table 1-1.

Figure 1-4 shows the locations of the raw material deposits and the potential glass plant sites that were appraised during Phase I. Others were considered in Phase II.

The limestone and dolomite will probably both be obtained from existing open-face mines located south of Suez. The minerals are loosened by blasting and the rubble is broken up to smaller sizes. Soda ash will be obtained via the Solvay process from an existing plant in Alexandria or, possibly, from an as-yet undeveloped natural source. All of these materials will be transported by truck to the glass plant.

Table 1-1. Major raw material requirements to produce 100,000 MT of glass per year.

Raw material	MT/yr	Percent of total
Sand (SiO_2)	74,575	60
Soda ash (Na_2CO_3)	25,425	20
Dolomite ($CaCO_3 \cdot MgCO_3$)	15,250	12
Limestone ($CaCO_3$)	6,950	6
Salt cake ($NaSO_4$)	1,700	1
Carbon (C)	120	-
	124,020[a]	100

Note:
[a]Includes 24 percent allowance for fusion losses during melting.

The sand quarry has not yet been selected. Existing quarries at El Maadi have almost unlimited reserves of sand, but because the sand contains excessive amounts of iron and other impurities it will require beneficiation. In contrast, the sands at Abu El Darag, south of Suez, appear to be of high quality and may not require beneficiation; but the extent of the deposit is not presently known. Geological surveys are needed to determine if the reserves are adequate to supply the glass plant. Regardless of which site is chosen for the sand source, the sand will be mined from open sandstone faces, screened to remove oversize particles, and transported by truck to the glass plant or, if one is required, to the beneficiation plant.

A variety of beneficiation techniques can be applied to improve the chemical and physical properties of the sand, depending on the specific improvements that are needed. The estimated beneficiation requirements for Maadi sand are described subsequently. Any beneficiation requirements for Abu El Darag sand will have to be less costly to compete with Maadi sand because of the greater distance, thus higher transportation costs, to ship Abu El Darag sand to Tenth of Ramadan. Therefore, the beneficiation requirements for Maadi sand can be considered as the "worst case" for analysis. The beneficiation process presently envisioned for Maadi sand is as follows.

Sand will be transported to the beneficiation plant located on a 5-feddan (2-hectare) plot of land, preferably near a plentiful supply of fresh water. The plant will be operated on a continuous duty basis.

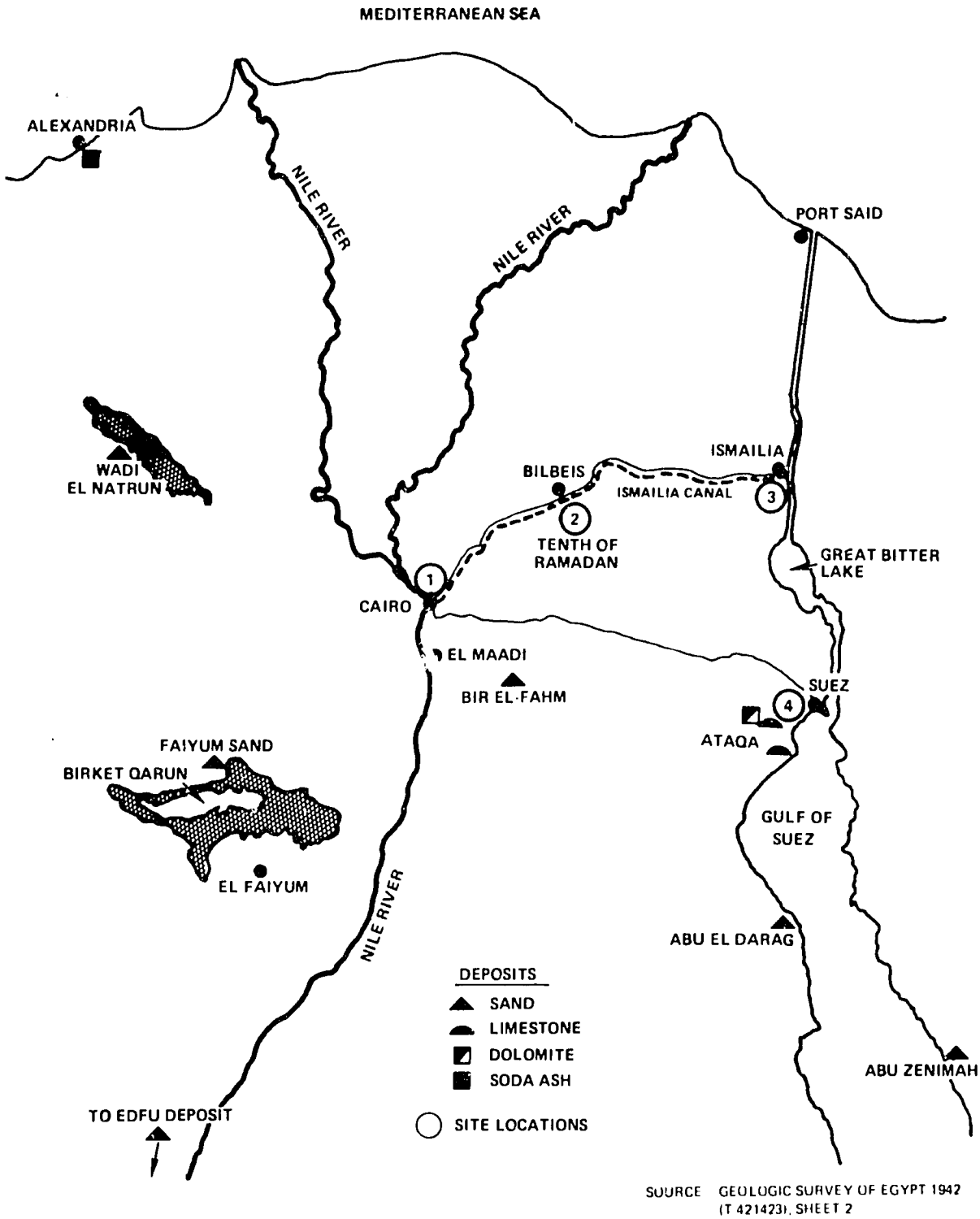


Figure 1-4. Locations of raw material sources.

At the beneficiation plant sand is withdrawn from the stockpile (at a rate of about 9.4 MT/hr to supply the glass plant with sufficient sand to pack 100,000 MT of glass annually) and fed to an attrition scrubber. Water is added at a weight ratio of 1 part water to 3 parts sand, and the sand is "scrubbed" by grinding the particles together to wear away iron stains that coat the particles. The scrubber discharge is fed to a cyclone and more water is added at a weight ratio of approximately 19 parts water to 1 part sand. The mixture is spun in the cyclone to separate the water and undersize particles from the sand of the desired size. About 5 percent of the sand remains with the waste water. The sand from the cyclone is then fed into a froth flotation system. (Originally, froth flotation was not believed to be needed because magnetic separation would be sufficient to complete the beneficiation. However, the presence of unacceptably high levels of refractory heavy materials (RHM) in most of the samples indicates that froth flotation is needed to beneficiate Maadi sand to the necessary degree of purity.)

In froth flotation the sand is mixed with detergent chemicals that have been diluted with water. The specific chemicals and their amounts depend on the impurities that are to be removed. Air is bubbled up through the mixture and the chemicals cause the impurities to be attracted to the bubbles, which carry them to the surface in froth that can be drawn off. In this manner the high-iron sand particles, particles of iron oxide, and refractory heavy minerals can be removed from the sand. The froth flotation mixture can be recycled through a settling pond or the froth can be drawn off and discharged to a tailings pond that is periodically dredged for disposal as solid waste.

The water in the sand from the cyclone and the water used to dilute the chemicals is adequate water input for the froth flotation. Therefore, the water use will be approximately 20 tons of water per ton of sand or about 4,000 m^3 of fresh water daily. If this amount is excessive, a recirculating system can be used, but this will increase the cost of the plant and will necessitate more land for a settling pond.

TRANSPORTATION OF RAW MATERIALS

All raw materials are expected to be transported by truck. The trucks that are presently used carry approximately 10 MT of sand per load. Assuming that the other raw materials loads are also 10 MT each, the glass plant will require approximately 20 loads of sand and 14 loads of the other raw materials each day on the average to provide the raw materials to produce 100,000 MT of glass annually. The number of kilometers traveled by trucks to furnish these amounts of raw materials to the plant site at Tenth of Ramadan are tabulated in Table 1-2.

Table 1-2. Total truck-kilometers for transporting raw materials.

Raw material	Source	Kilometers to Tenth of Ramadan	MT required per year	Average daily truck-kilometers[a]
Sand	Maadi (or Abu El Darag)	75 (or 276)	74,575	3,065 (or 11,280)
Limestone	South of Suez	220	6,950	840
Dolomite	South of Suez	200	15,250	1,670
Soda ash	Alexandria	275	25,425	5,830
Salt cake	Wadi El Natrun	∿150	1,700	140
Charcoal	Cairo	∿ 50	120	3
Total			124,020	9,548 (or 17,763)

Note:
[a]Assuming 10 tons per truck, 365 days per year operation, and round trips.

Based on the load and quantity assumptions used, the raw materials will require an average of approximately 9,550 truck-km daily if sand from Maadi is used or approximately 17,760 truck-km daily if sand from Abu El Darag is used.

Construction and Operation of the Glass Plant

The facilities plan for the glass plant (Figure 1-5) and a section view of the plant (Figure 1-6) show the major features of the plant. As indicated, space is reserved for the addition of a second float line in the future to double the capacity of the plant. Space is also reserved for the future addition of facilities to process flat glass for specialty use such as automotive and furniture manufacture. Glass plant parameters that are of interest for environmental analysis are the following:

- Dimensions and area of plant site: 540 by 620 meters; 33.5 hectares
- Design capacity of plant: 100,000 MT of finished glass per year
- Total raw batch materials needed: 124,000 MT per year

10

BEST AVAILABLE COPY

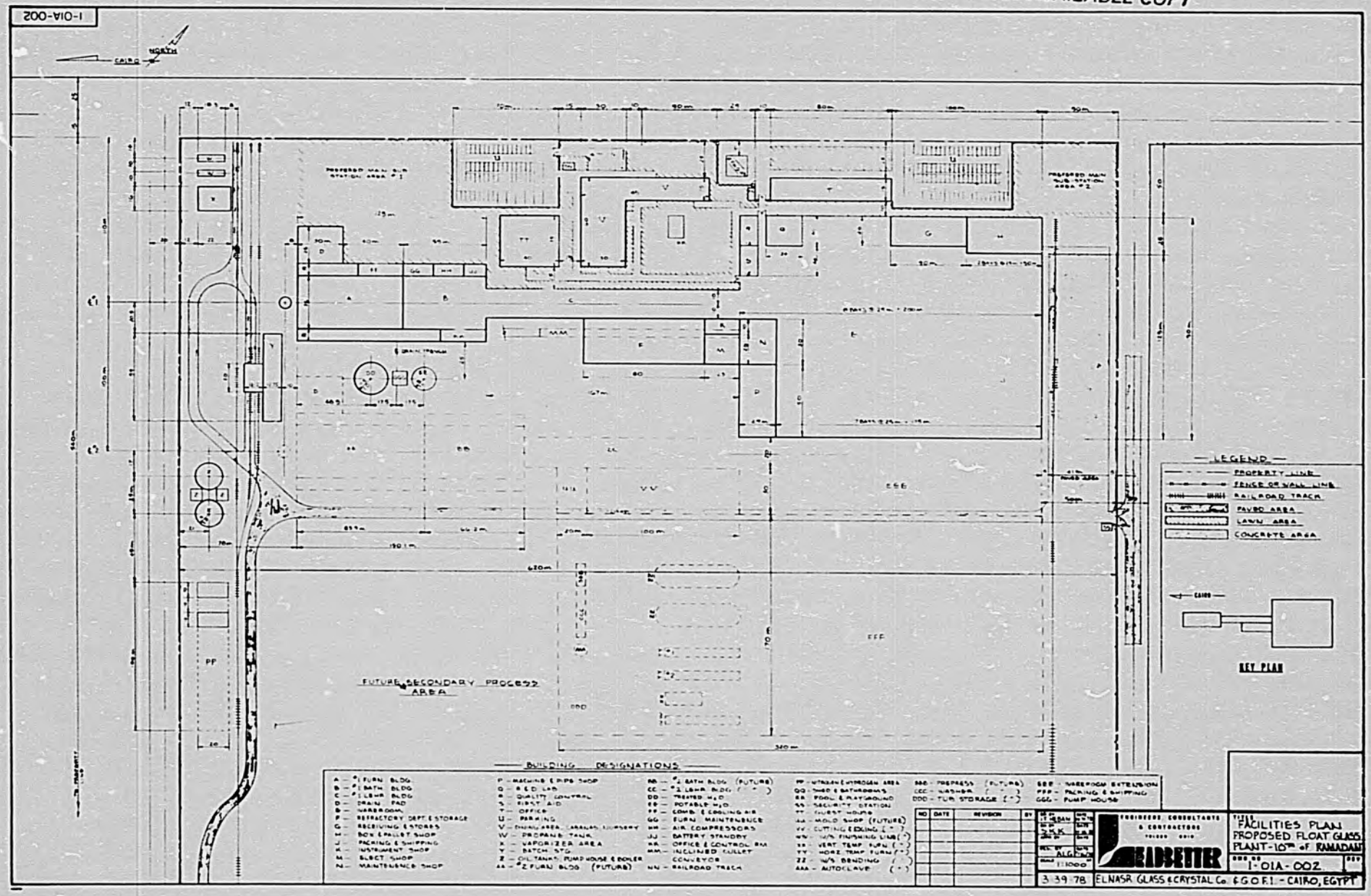


Figure 1-5. Facilities plan for glass plant site at Tenth of Ramadan.

BEST AVAILABLE COPY

(TO BE SUPPLIED LATER)

Figure 1-6. Section view of glass plant.

- Number of employees: 400 (more employees may be needed in the wareroom, depending on the degree of automation)
- Outage rate: percent planned and percent forced for a total of percent
- Total floor space of buildings: m^2
- Height of tallest building: meters
- Height and type of stack: 64.3-meter natural draft stack
- Type of fuel oil: heavy fuel oil with approximately 3 percent sulfur by weight
- Estimated use of fuel oil: approximately 38,000 m^3 per year
- Approximate water requirements: 135 m^3 per day
  - 15 m^3 of process water for batch (54 percent of batch by weight)
  - 40 m^3 of process water for washing cullet and finished glass
  - 80 m^3 of potable water for personnel and other inplant uses.

No construction activities are foreseen that are unusual in an environmental sense. The site will be graded level and excavated as needed. Foundations will be installed as necessary to support the structures and equipment. Construction, transport of materials, and installation of equipment will produce the dust, noise, air emissions, solid waste, water useage, and socioeconomic needs that are typical of any construction project. Because of the barrenness and remoteness of the site, no significant impact can be foreseen as a result of the construction phase.

The operation of the glass plant will be basically as previously described for a typical flat glassmaking process. No special waste disposal needs are foreseen. Waste water will be discharged into the sewage system provided by the city. The batch plant will be enclosed and equipped with baghouses and filters to contain fugitive dust. This will also reduce noise from this typically noisiest operation of a glass plant. Chemicals used will be typical of facilities with laboratories. Air emissions will not be treated.

Distribution of Glass

The glass will be transported by truck from the glass plant to regional warehouses for distribution. The demand for market areas in Egypt and for export has been estimated and the average distances

12'

from the plant site to these areas (to Suez for export) have been determined. From these data the demand-weighted shipping distance by road from Tenth of Ramadan is approximately 100 km (assuming barge transport from Cairo to Upper Egypt), i.e., glass shipments by truck within Egypt from Tenth of Ramadan to regional warehouses will average 100 km.

Assuming that the average load of glass being transported from the glass plant to a regional warehouse weighs 10 MT, an average of 5,500 truck-km will be required each day to ship glass to regional warehouses. Additional truck-kilometers will be required to transport glass from the regional warehouses to the locations at which the glass will be used. Smaller warehouses may also be used to more easily serve customers.

ENVIRONMENTAL SETTING

Potential locales for the glass plant were selected in Ismailia, Suez, Mostorod, and Tenth of Ramadan by Egyptian authorities. (See Figure 1-4 for the location of these cities.) Based on technical, social/political, and cost factors, these four sites were evaluated in detail in Phase I and the results were reported by the study team. This evaluation showed Tenth of Ramadan as the preferred site, followed by Mostorod and then Suez. Subsequently, the location at Tenth of Ramadan was chosen by Egyptian authorities as the site of the glass plant.

Planned Development

Tenth of Ramadan, a planned new satellite city located 50 km northeast of Cairo on a new highway linking Cairo with Ismailia, is being developed in accordance with a master plan.* Development is planned to be in two stages: Stage I will be completed in a 10-year time period to accommodate a population of 150,000 and Stage II will be completed in an additional 15 years to accommodate the total planned population of 500,000. Construction on Stage I has begun so Stage I should be completed by 1986.

The city is planned to be self-sustaining with heavy, medium, and light industries (designated in the master plan as Types A, B, and C, respectively). Industry will be vital to the success of Tenth of Ramadan. The Tenth of Ramadan master plan assumes that 3,000 employees at the end of Stage I and 6,000 employees at the end of Stage II will

---

*SWECO and Shawky-Zeitoun, *Tenth of Ramadan New Industrial City*, Working Papers, Vols 3 and 4, A.R.E., Ministry of Housing and Reconstruction, April 1976.

13

be employed in nonmetallic building material industries such as the proposed glass plant.

Figure 1-7 shows the general planned layout of Tenth of Ramadan. The indicated site of the glass plant is a 540- by 620-meter plot (33.5 hectares) approximately 2 km south of the edge of the city in one of the two areas designated for heavy industry.

A new four-lane highway connecting Cairo to Ismailia passes between the city and the industrial site. In 1970, before its widening to four lanes, the traffic on this road averaged 1,900 vehicles per day. The master plan estimates that this through traffic may increase to 30,000 vehicles daily by the year 2000. In addition, traffic to and from Tenth of Ramadan is then expected to average 19,000 vehicles daily (15,000 between Tenth of Ramadan and Cairo). Thus, when Tenth of Ramadan is fully developed 45,000 vehicles per day are estimated to travel along this main highway past the glass plant. The existing Cairo-to-Suez railroad line is about 10 km southwest of the proposed plant site. Construction of a new track to pass Tenth of Ramadan and terminate north of Suez at Fayid is proposed in the master plan. The Ismailia Canal is approximately 25 miles north of Tenth of Ramadan; no canal to Tenth of Ramadan is planned. Total industrial freight movements to and from Tenth of Ramadan are estimated to average 11,000 MT per day in the year 2000, mostly by truck.

As described in the master plan, water and sewer pipes, electric power lines, and telephone cables will be available in the street area of the industrial park. If needed, each industrial lot will be provided with a temporary storage area for solid waste. Areas for solid waste disposal will be available and space is also expected to be available for treatment of industrial wastes.

An adequate and reliable supply of fresh water is vital to the survival of a desert city such as Tenth of Ramadan. For Stage I, water will be obtained from wells. Eventually, it is planned to obtain water from the Ismailia Canal approximately 25 km north of the city. Domestic consumption for the future population of 500,000 at Tenth of Ramadan is estimated to be a maximum of 157,000 m^3/day. Total water consumption for all purposes at Tenth of Ramadan is estimated to be 125,000 m^3/day for the Stage I population of 150,000 and 400,000 m^3/day for the Stage II population of 500,000.

The land use and building regulations suggested by the master plan, which also include recommended limits for noise and air pollution, are given in Appendix A.

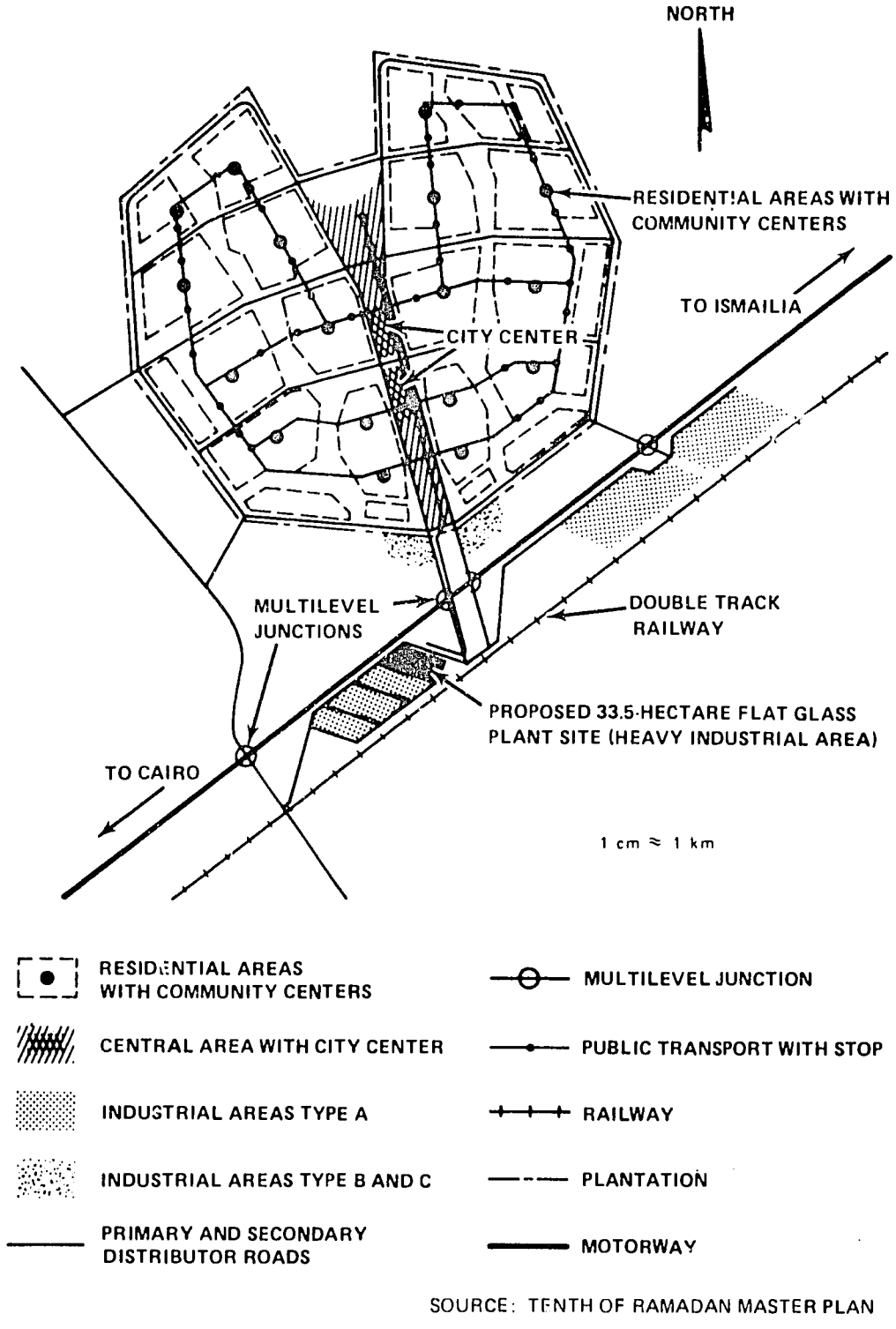


Figure 1-7. Plan of Tenth of Ramadan and location of glass plant.

Existing Environment

The land in the proposed industrial park is fairly level for a width of 1.5 to 2 km from the Cairo-Ismailia road and for a length of about 3 km along this road. In general, the land slopes from south to north. The elevation of the plant site is 140 to 145 meters above sea level. The industrial area is bounded on the southwest by rather steep slopes up to the Bilbeis-Suez desert road and in the northeast the land drops down to Wadi Gaffra. Photographs of the area are shown in Figures 1-8 and 1-9.

The natural environment at Tenth of Ramadan is characterized by arid desertic to semi-desertic conditions. A visit to the site showed the industrial park area to be very barren; vegetation is nonexistent except in the wadis at lower elevations. Tenth of Ramadan and the adjacent lands are not of primary interest for reclamation to agricultural use because of variation in topography and the relatively long distance to water for irrigation.

Tenth of Ramadan has no meteorological station. Climatological data in the master plan have been estimated based on data from the nearest meteorological stations. The weather is summarized in Figure 1-10. The wind rose data in Figure 1-11 indicate that winds will blow from the glass plant site toward the city approximately 10 to 15 percent of the time, mostly from the southwest during the winter months when only the extreme souteast portion of the city will be in the direction of air emissions from the glass plant.

The mean annual daily temperature is estimated to be 12.3°C, varying from a mean daily minimum of 8.2°C in January to a mean daily maximum of 34.5°C in June and July. Rainfall is expected to average 2.2 cm annually, varying from a trace in August and September to 0.58 cm in January. The mean daily relative humidity is expected to average about 55 percent, varying from 44 percent in May to 63 percent in November. Annual estimates for Tenth of Ramadan are 2 days of thunderstorms, 70 days of mist, 17 days of fog, 27 days of rising sand, 4 days of sandstorms, and 2 days of gale winds of 34 knots or more.

Soils at Tenth of Ramadan are comprised of alluvial soils of the old Nile delta that dominate the terraces and alluvial fan soils that occur less frequently. Soil maps are not available to enable determination of soil type at the site of the glass plant, but at the higher elevation of 140 meters it is probably the Nile delta soils. These higher terrace elevations are covered with typical "desert pavement," i.e., a layer of gravel and stones remaining after wind erosion of lighter materials. Beneath this layer is a slightly developed soil profile. Groundwater is reportedly at a depth of about 150 meters.

From the data given in the master plan, the old Nile delta soils are extremely salty. The first 20 cm of this soil type contains a large fraction of clay and silt that would be very sticky when wet

Figure 1-8. View looking south from proposed site.

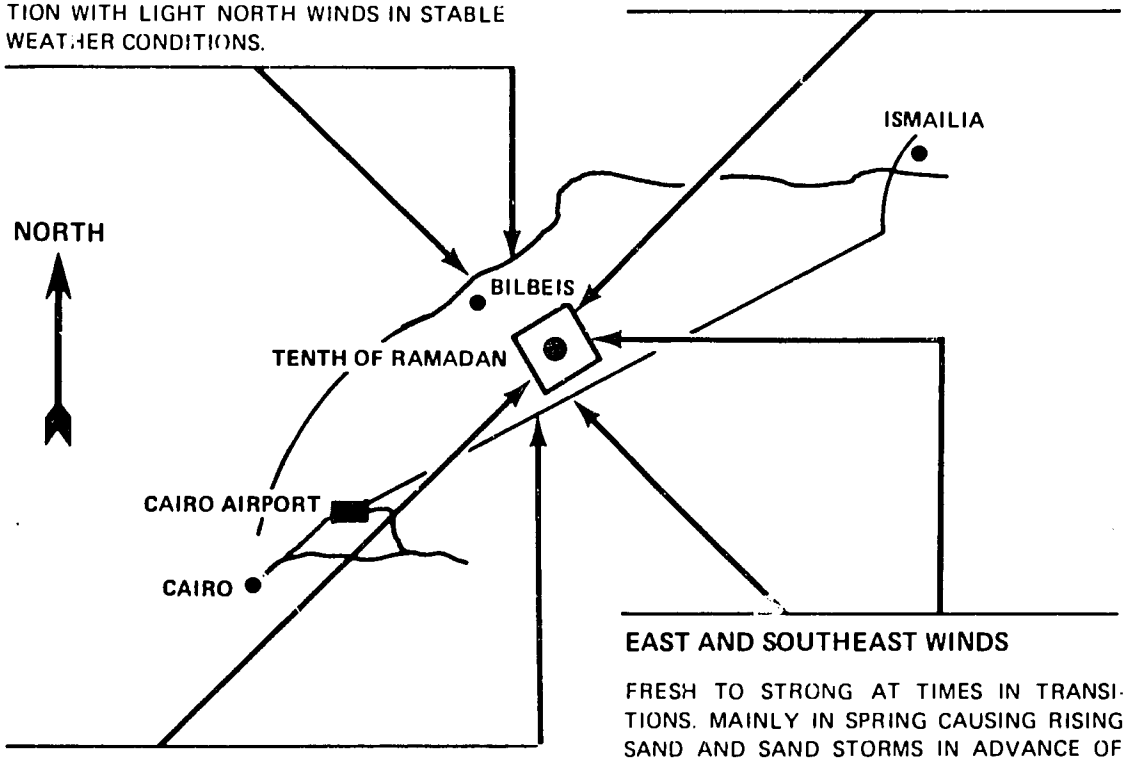
Figure 1-9. View looking north from proposed site (Tenth of Ramadan construction activities in background).

NORTH AND NORTHWEST WINDS

MOST PREVALENT IN SUMMER AND AUTUMN. GENERALLY LIGHT TO MODERATE. OCCASIONALLY DURING WINTER AND TRANSITIONS, FRESH TO STRONG, ACCOMPANIED AT TIMES BY RAINY SHOWERS IN THE REAR OF ACTIVE COLD FRONTS. EARLY MORNING FOG OR MIST OCCURS AT TIMES IN ASSOCIATION WITH LIGHT NORTH WINDS IN STABLE WEATHER CONDITIONS.

NORTHEAST WINDS

LIGHT TO MODERATE IN GENERAL. MOST PREVALENT IN TRANSITIONS. WHEN LIGHT, ASSOCIATED AT TIMES WITH EARLY MORNING FOG OR MIST.



EAST AND SOUTHEAST WINDS

FRESH TO STRONG AT TIMES IN TRANSITIONS. MAINLY IN SPRING CAUSING RISING SAND AND SAND STORMS IN ADVANCE OF DESERT DEPRESSIONS IN KHAMSIN HOT DRY CONDITIONS.

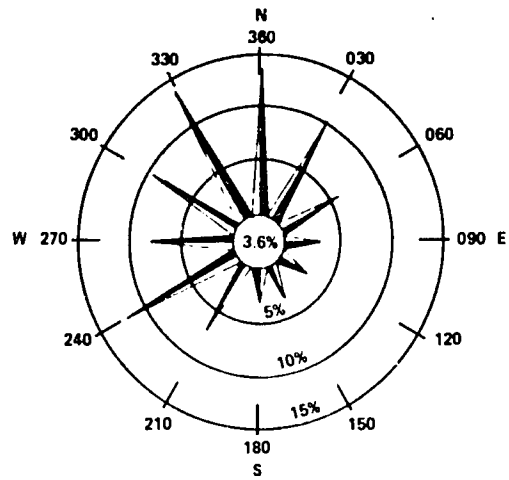
SOUTH AND SOUTHWEST WINDS

OCCUR DURING ALL SEASONS BUT MOST PREVALENT IN WINTER. MODERATE IN GENERAL. OCCASIONALLY STRONG AND MAY REACH GALE FORCE CAUSING RISING SAND AND SAND STORMS IN ADVANCE OF DEEP WINTER DEPRESSIONS AND ACTIVE DESERT DEPRESSIONS IN SPRING.

MAY BE ACCOMPANIED BY THUNDERY SHOWERS IN ADVANCE OF COLD FRONTS, MAINLY DURING WINTER AND AUTUMN.

SOURCE: TENTH OF RAMADAN MASTER PLAN WORKING PAPERS, VOL 3

Figure 1-10. Summary of weather at Tenth of Ramadan.



A. LENGTH OF ARROW REPRESENTS THE PERCENTAGE FREQUENCY OF SURFACE WIND BLOWING FROM RANGE OF DIRECTIONS AT 30 DEGREES.

B. PERCENTAGE FREQUENCY OF CALM OR VARIABLE SURFACE WIND IS INDICATED INSIDE THE CENTRAL SMALL CIRCLE.

SOURCE: TENTH OF RAMADAN MASTER PLAN WORKING PAPERS, VOL 3

Figure 1-11. Estimated annual percentage frequency of surface winds.

and would inhibit plant growth by blocking aeration when wet. From 20 to 120 cm deep the soil is more sandy. In both soil layers sodium and chloride levels are extremely high. The alluvial fan soils are quite sandy and have moderate amounts of salt.

The entire region is poor in natural vegetation because of its low rainfall and coarse surface soil texture. The only areas of natural vegetation are the wadi areas and only these and the alluvial fan areas are suitable for planting. The old Nile delta soils would require large amounts of fresh water to initially leach out the salts (a minimum total depth of 75 cm of water) and abundant water after planting to avoid salt accumulation around the root systems.

Because of lack of vegetation at the glass plant site, wild life habitat is nonexistent at the site.

Egyptian environmental standards for water, ambient air quality, and noise exist or have been proposed. These standards are presented in Section 3 for comparison with emissions from the project facilities.

19

SECTION 2
LAND-USE RELATIONSHIPS

The proposed project will not significantly affect land-use relationships, except that the furnace building will exceed the suggested building height limitation (see Appendix A).

The raw materials will be mined at existing or designated quarry sites that are very remote and barren and unsuitable for other uses. Transportation of raw materials and finished glass will add an insignificantly small amount of traffic to the road system.

The site for the glass plant is an area designated for heavy industry in a planned new desert city, Tenth of Ramadan. The site is on a barren terrace that is unsuited for agriculture. The nearest planned residences of the city will be approximately 2 km north of the glass plant. At this distance there will not be any significant effect by the glass plant on land use by the city. The glass plant will not foreclose any known future options on land use.

SECTION 3

PROBABLE IMPACT OF THE PROPOSED PROJECT ON THE ENVIRONMENT

The total proposed glass plant project consists of (1) furnishing glassmaking raw materials, (2) construction and operation of the glass plant, and (3) distribution of finished glass. The environmental impact of each of these is assessed in this section.

FURNISHING OF GLASSMAKING RAW MATERIALS

Furnishing raw materials consists of mining the materials, processing the materials, and transporting the materials to the site of the glass plant.

Mining Raw Materials

No significant adverse environmental impacts are foreseen from mining the sand, limestone, and dolomite. (Limestone is also the basic raw material used in manufacturing soda ash by the Solvay process.) The mining sites are either at existing quarries or at sites that are designed for quarry development. All of the sites are very barren and remote. Loss of vegetation and animal habitat will be negligible. There are no nearby residences to be disturbed by mining activities. There will be no conflicts with land uses. There are no water supplies in the vicinities of the quarry sites so water pollution or significant use of water cannot occur. There will be no significant depletion of resources. The amounts of materials mined are not great; the yearly supply of sand (75,000 MT to produce 100,000 MT of glass) would occupy a volume approximately equal to that of a cube 30 to 35 meters on each side.

It should be pointed out that Egyptian mining safety practices differ from U.S. practices; some hazardous conditions exist at the present mines. For example, the dolomite mine that was visited is a sheer face of dolomite limestone and overburden. Working at the base of this cliff is dangerous. The face should be worked in terraces to reduce the possibility of injuries from falling debris.

Processing Raw Materials

As discussed in Section 1, sand beneficiation requirements and the site for a beneficiation plant, if one is required, have not been

determined in detail. However, it can be assumed as a worst case that the sand will require attrition scrubbing and froth flotation. Such a beneficiation plant would require a land area of approximately 2 hectares.

The only potentially significant adverse effects concern use and pollution of water. Large amounts of fresh water are required for attrition scrubbing and cyclone separation—about 21 cubic meters per metric ton of sand (input). Unless the plant is located near a plentiful and free supply of fresh water—either the Nile or one of its canals—the process water will have to be recycled, which will increase the cost of the beneficiation plant by an estimated 10 to 15 percent.

The output from the cyclone is a slurry of about 375 parts water to one part of fine particles of sand and iron oxide. Since this slurry is less concentrated than the Egyptian standard of 0.5 percent by volume for sediment in water dumped into the Nile, treatment is not necessary before dumping it into the Nile or its canals.

If froth flotation is used the waste water must be discharged into a settling pond or tailings pond or a sewer line.

Transporting Raw Materials

As discussed in Section I, virtually all transportation of raw materials will be by truck. A yearly output of 100,000 MT of finished glass requires an average daily transport of 340 MT of raw materials. Assuming 10 MT per truckload, 34 trucks will enter and leave the plant each day. This total of 68 truck trips daily will be insignificant in comparison with the 50,000 motor vehicles that are expected to travel on the Suez-Ismailia highway at Tenth of Ramadan in the year 2000. Present traffic on this road should be well over 2,000 vehicles daily since the average traffic volume in 1970, before the road was expanded to four lanes, was 1,900 vehicles. Additional noise, dust, and air pollution will be insignificant in comparison with existing traffic.

The raw material truck traffic will average either 3.5 or 6.4 million truck-km annually, depending on whether the sand is taken from the Maadi area or from Abu El Darag. Traffic accident statistics for Egypt were not available, but based on data from United States sources, nonfreeway truck traffic in the United States results in approximately 0.03 fatalities per million kilometers of truck travel. If this fatality rate is assumed for Egypt, the delivery of raw materials by truck would result in an average of one fatality every 9 years (for sand from Maadi) or every 5 years (for sand from Abu El Darag). Even assuming a significantly higher death rate from Egyptian truck traffic, less than one traffic death annually due to transportation of raw materials would be expected.

CONSTRUCTION AND OPERATION OF THE GLASS PLANT

The construction and operation of the glass plant has effects on the natural environment of land, water, air, and biota and also the socioeconomic environment. The significance of these effects is assessed in this subsection, based upon the description in Section 1 of the project and the environment at Tenth of Ramadan. Recommendations regarding worker safety are also given.

Effects on Land

The site for the glass plant comprises 33.5 hectares of land, all of which presumably will be graded level. Less than 25 percent of this land area will be covered by buildings, other structures, and paving. Much of the remaining area will be left as open space to accommodate possible future expansion of the plant.

No significant impacts on land can be foreseen. The earthmoving operations will produce the dust and temporary wind erosion conditions that are inherent with such operations, but because of the remoteness of the site these effects are not significant. The scarcity of rainfall and relatively flat existing site ensure that hydrology will not be significantly affected. The lack of vegetation and relative flatness of the site indicate that effects on vegetation or animal life habitat will not be significant. Tenth of Ramadan will provide a solid waste disposal site.

The project is in an area designated for heavy industry and meets all recommended building regulations, except that the furnace building will exceed the recommended limit for building heights.

Effects on Air Quality

Operation of the quarries, transport of goods and personnel, and operation of the glass plant itself will result in increased air emissions. The significance of these emissions is evaluated in this subsection.

Operation of the quarries will result in exhaust emissions from vehicles and machinery and in dust from handling and processing the raw materials. None of these is significant. The amount of the exhaust emissions is negligible and any dust is only a local effect that will not affect the public because of the remoteness of the quarries.

Transportation of raw materials, finished glass, and personnel will result in vehicle exhaust emissions, dust from unpaved roads, and dust from blow off of raw materials. Again, none of these air emissions seems significant. The total mileage of the transport vehicles is small in comparison with other traffic vehicles and dust blowing off transported raw materials can be alleviated by covering the load.

24

A considerable amount of information is available regarding air emissions from glass plants in the United States.*†‡ Reznik is specifically for flat glass plants and is most pertinent. According to this source, over 99 percent of all air emissions from glass plants is from the melting of the raw batch materials—air emissions from raw material preparation and the annealing lehr are insignificant by comparison. Visits to United States plants confirm that no visible emissions of particulates occur from raw materials preparation; the batch plants are enclosed and air outlets are exhausted through filters and baghouses. Therefore, only the air emissions from the melting furnace are evaluated in this assessment.

A metric ton of raw batch forms only about 800 kg of molten glass; the remaining 200 kg (the fusion loss) is given off as gases and particulates into the furnace exhaust system. Over 99.9 percent of the flue gas is carbon dioxide, water vapor, and other nonpolluting gases —less than 0.1 percent of the raw batch is discharged from the stack as air pollutants.* Of these pollutants, only oxides of nitrogen (NO_x), oxides of sulfur (SO_x), and particulates are significant; carbon monoxide and hydrocarbons are produced in relatively small amounts. Based upon measurements from a large number of United States glass plants, the air pollution emission factors are as shown in Table 3-1.

The stack for the glass plant is designed as a natural draft stack that is about 64 meters high. Air pollution calculations use an effective stack height to take into account the fact that hot gases exit from a stack with a certain velocity. According to Reznik, approximately 30 meters should be added to the stack height to get the effective stack height for the glass plant.

Figure 3-1 shows the normalized ground-level average concentrations of stack emissions as a function of distance from the stack and Pasquill's stability categories, which are related to atmospheric conditions.§ Stability Category A produces the highest concentrations of

---

*Reznik, Richard B., *Source Assessment: Flat Glass Manufacturing Plants*, Monsanto Research Corporation, Dayton, Ohio, NTIS No. PB 252 356, March 1976.

†Schorr, J.R., Diane T. Hooie, Philip R. Sticksel, and Clifford Brockway, *Source Assessment: Glass Container Manufacturing Plants*, Battelle-Columbus Laboratories, Columbus, Ohio, NTIS No. PB 262 002, October 1976.

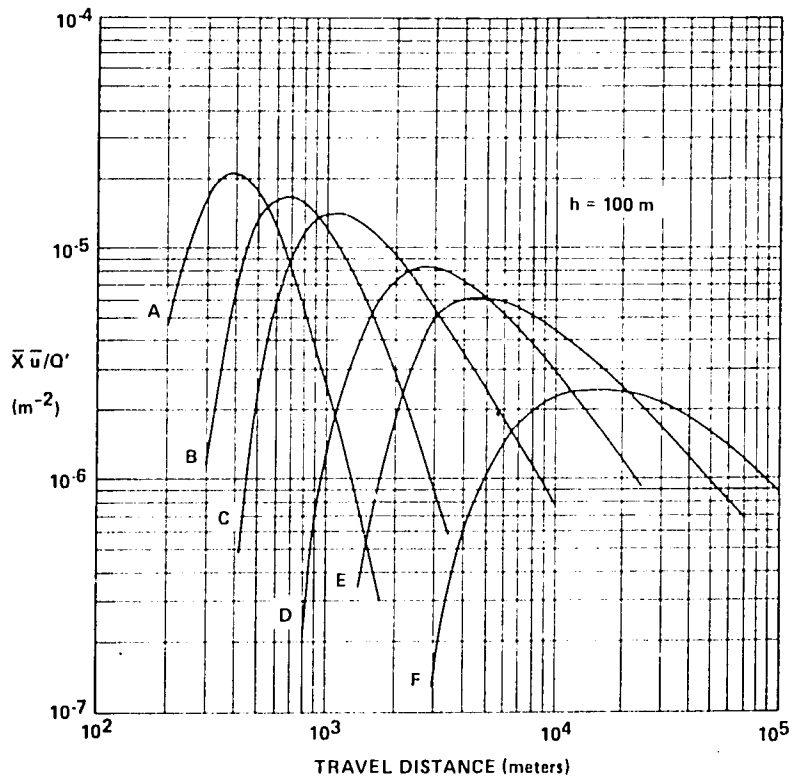
‡Industrial Gas Cleaning Institute, *Air Pollution Control Technology and Costs: Seven Selected Emission Sources*, Stamford, Connecticut, NTIS No. PB 245 065, December 1964.

§Slade, David H. (ed.), "Appendix A-3, Graphic and Tabular Aids," *Meteorology and Atomic Energy 1968*, p. 413, U.S. Atomic Energy Commission, NTIS No. TID-24190, July 1968.

Table 3-1. Air emissions from the glass-melting furnace.[a]

Species	Emission factor (kg per MT of finished glass)		Annual Emissions (kg per 100,000 MT of finished glass)	Emission rate[b] (g/sec)
	Average	Standard deviation		
NO_x	4	±3	400,000	13.8
SO_x	1.5	±1	150,000	5.2
Particulates	1	±2.3	100,000	3.4
Hydrocarbons	0.04	–	4,000	0.14
CO	0.02	–	2,000	0.07
Totals	~6.5		~650,000	~22.4

Notes:
[a]Adapted from Reznik, op. cit.
[b]Assuming 8 percent downtime for plant.



SOURCE: Slade

$\bar{X}$ = TIME AVERAGED GROUND-LEVEL CONCENTRATION (mass/second)
$\bar{u}$ = AVERAGE WIND SPEED (meters/second)
Q' = RATE OF MATERIAL EMISSION FROM CONTINUOUS SOURCE (mass/second)
A-F PASQUILL'S DIFFUSION CATEGORIES

Figure 3-1. Normalized ground-level average concentration for an effective source height of 100 meters as a function of distance from the source.

emissions at ground level; this maximum concentration occurs approximately 400 meters downwind from the stack. However, stability category A occurs less than 1 percent of the time. Stability categories C or D with a wind from the south will produce the highest concentrations of pollutants in the nearest residential areas of Tenth of Ramadan, which will be located approximately 2 km north of the plant site. Based upon Figure 3-1 and the emission rates shown in Table 3-1, the maximum ground-level concentrations of pollutants have been calculated and are shown in Table 3-2, where air quality standards are included for comparison. United States standards are included because the Egyptian standards shown are only suggested local standards. The study team was informed that Egyptian national standards, when made, would probably be based upon United States standards.

From Table 3-2 it can be seen that the air emissions from the plant stack will not exceed recommended Egyptian air quality standards or United States primary air quality standards, even assuming the most adverse circumstances. (The United States standard for NO_2 would be exceeded near the plant under stability category A, but the standard is for an annual average rather than the short time period that stability category A might occur. The annual average from the plant at any particular location will be considerably less than the United States standard for NO_2).

In summary, based upon the preceding analysis, the glass plant alone will not cause Egyptian or United States air quality standards to be exceeded, even if the plant is expanded in the future to double its planned capacity. However, this conclusion must be tempered by the fact that the emissions data shown in Table 3-1 are based primarily upon furnaces burning natural gas as fuel. Burning the high-sulfur fuel oil used at the existing Shoubra plant will add significantly to the air emissions.

Assuming all of the sulfur in the fuel is exhausted through the stack is a conservative assumption because some of the sulfur will react with ingredients of the batch and with particulate that will be trapped in the checkers. The United States Environmental Protection Agency was contacted for information on oil-burning glass plant furnaces. Only two soda-lime furnaces were identified as having emission measurements taken while burning fuel oil. One furnace operated by the Corning Company was measured as emitting 98 pounds/hour (44 kg/hour) of SO_2 while burning 12,600 gallons/day (47,000 liters/day) of 1-percent-sulfur fuel oil.* A new float plant in Kingsburg, California was measured as emitting 76 pounds (34.5 kg) of SO_x per hour while burning a fuel oil with 0.65 percent sulfur.†

---

*Personal communication with Wayne Rupert, Corning Company, Corning, New York.

†Personal communication with Russel J. Ebeid, Plant Manager, Kingsburg Float Glass Plant, Guardian Industries, Kingsburg, California 93631.

Table 3-2. Maximum ground-level concentrations of air emissions compared with Egyptian and United States standards.[a]

Species	Maximum ground-level concentrations[b] ($\mu g/m^3$)	Maximum ground-level concentrations at nearest residential areas at Tenth of Ramadan[c] ($\mu g/m^3$)	Recommended Egyptian air quality standards for urban areas ($\mu g/m^3$)[d]	United States primary air quality standards ($\mu g/m^3$)
NO_2	138	23	–	100 (annual average)
SO_2	52	8.7	650 (25 pphm) (2-hour average) 130 (5 pphm) (30-day average)	80 (annual average) 365 (24-hour average)
Particulates	34	5.6	–	75 (annual average) 260 (24-hour average)
Hydrocarbons	1.4	0.02	–	160 (3-hour average)
CO	0.07	0.01	–	10,000 (8-hour average)

Notes:

[a]Based on Figure 3-1 and the emission rates shown in Table 3-1.

[b]Assumes stability categories A to B (unstable to extremely stable conditions) and a wind speed of 2 m/sec which is about typical for these atmospheric conditions. The maximum concentration occurs 400 to 700 meters downwind from the stack.

[c]Assumes stability categories C to D (slightly unstable to neutral conditions), and a wind from the south with a speed of 6 m/sec which should be about the minimum wind speed for these atmospheric conditions at Tenth of Ramadan (strong daytime insolation and little cloud cover at night).

[d]From Tenth of Ramadan Master Plan.

Fuel oil consumption is about the same as that planned for the plant in Egypt. The data from the Corning plant indicate that virtually all of the sulfur in the fuel is emitted from the stack as SO_X while the data on the plant in California indicate that only about one-third of the sulfur in the fuel is emitted from the stack. Therefore, a conservative assumption is that all of the sulfur in the fuel will be emitted from the stack as SO_X.

The Mazut fuel oil used in the furnace of the Shoubra glass plant is a heavy type of oil that reportedly contains 2.5 to 3 percent sulfur. Emission factors for combustion of this type of oil are 58 grams of SO_X and 1 gram of particulates per liter of oil.* NO_X is a product of the heat of combustion rather than type of fuel (although some NO_X is created when nitrogen fixed in the fuel is released). Therefore, NO_X is not greatly increased if fuel oil rather than natural gas is burned. Other emissions from combustion of fuel oil are small and can be ignored in this analysis.

An estimated 40,000 m^3 of fuel oil will be burned each year in the melting furnace. Based on the above emission factors, this combustion will produce approximately 2,320 MT of SO_X and 40 MT of particulates in the furnace. If it is assumed that all these emissions are exhausted from the stack, the emission rates will be about 75 g/sec of SO_X and about 1.3 g/sec of particulates, in addition to the emissions from fusion loss of the batch. This will increase the emission rate of particulates only about 40 percent from the values shown in Table 3-1, but the emission of SO_X of about 780 $\mu g/m^3$ (slightly greater than the recommended 2-hour average for Tenth of Ramadan and about double the United States 24-hour standard) near the plant and about 130 $\mu g/m^3$ in the nearest residential areas of Tenth of Ramadan (about one-third the United States 24-hour standard). Therefore, although there is little likelihood of exceeding air pollution standards in the city of Tenth of Ramadan, the standards might be exceeded in the vicinity of the industrial area. However, the maximum ground-level concentrations in the industrial area will be considerably less than the concentration of 5 pphm, or 13 mg/m^3, permitted for industrial workers in Egypt and the United States.

In summary, the glass plant alone will not cause Egyptian or United States air quality standards to be exceeded in the city of Tenth of Ramadan. Using conservative assumptions, the short-term ambient air standards might be exceeded in the near vicinity of the glass plant but will be significantly less than concentrations that are permitted for industrial workers. However, other industries burning large amounts of high-sulfur fuel oil will add to the total air emissions

---

*U.S. Environmental Protection Agency, *Compilation of Air Pollutant Emission Factors*, Second Edition, Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina, AP-42, Part A, 1976.

from the industrial area and may cause the air quality standards to be exceeded. This can be forestalled if fuel oil with lower sulfur content is used or if sulfur emission controls are required for industry.

Effects on Water

During the construction phase water will be used as process water and perhaps to keep down dust from earthmoving operations. The water used during construction will be obtained from the wells in the area. The amount will not be significant in comparison with the water that will be used when the plant becomes operational.

Waste water from the operation of the plant will be discharged into the industrial site sewage system and thence to the sewage treatment plant. Covering the ground surface with impermeable surfaces such as buildings and pavements will change the characteristics of rainfall runoff and soil penetration. However, the scarcity of rain and the deep water table ensure that these effects will not be significant and that any contaminated runoff water will not get into the groundwater.

The approximately 135 m^3 of water that the glass plant will use each day for process water, for the batch cooling and water makeup, and other in-plant uses represents a relatively modest amount because a closed recirculating system will be used for cooling water; an open system would have substantial evaporative losses. Government authorities have repeatedly stated that adequate water will be available to support the glass plant and other users.

Effects on Biota

Significant effects on vegetation and animal life from construction and operation of the glass plant are not envisioned. The plant site has little, if any, vegetation and animal habitat. No endangered species will be affected.

Effects on Socioeconomic Environment

All the effects on the socioeconomic environment appear desirable, rather than adverse. Industry such as the glass plant is essential to the development of Tenth of Ramadan. The glass plant and the nearly 400 workers and their families will create a demand for goods and services in Tenth of Ramadan that will aid in the development of the city.

Except possibly for air emissions, the plant is too far from the city to directly affect the populace. It will be barely visible, if at all, and will not create noise in the city.

Worker Safety

Existing Egyptian worker safety practices in the glassmaking industry result in conditions which are unsafe by United States standards. A relatively modest and inexpensive program is recommended at the new plant to increase worker safety and reduce possible unhealthful conditions.

The following will require action by the glass plant management to assure safe working conditions:

- Eye protection. All personnel working or passing through the batch, furnace, lehr, cutting, or ware areas should be provided with protective eye covering.
- Body protection. All personnel handling glass should be provided leather gloves and aprons. Additional leather upper torso and neck protection should be provided to handlers of large glass sheets. Shoes should be required, especially in the cullet storage areas.
- Heat. Plant design should minimize worker exposure to heat. Workers required to be near the furnace (e.g., batch feeders) should be provided cooling fans. Protective clothing must be supplied to all hot crews.

A modern well-constructed glass plant will result in noise levels and vibration levels that do not require special protection. No toxic chemicals or fumes are produced.

Summary

The only significant adverse effects that are foreseen from construction and operation of the glass plant is possibly exceeding air pollution standards for oxides of sulfur in the vicinity of the plant and the contribution of these emissions to lowering the air quality in Tenth of Ramadan on occasions when winds are in a northerly direction.

TRANSPORTATION OF FINISHED GLASS

The addition of about 54 trucks per day to the existing and projected future road traffic will produce insignificant incremental environmental impact. The total truck-kilometers to transport finished glass to regional warehaouses is estimated to be approximately 1 million km per year. At the accident rate of 0.03 per million truck-km in the United States the transportation of finished glass would result in one additional traffic death every 33 years.

SECTION 4
ALTERNATIVES TO THE PROPOSED ACTION

The primary goal of the proposed project is to supply flat glass to Egypt in a manner that is technically, financially, and economically sound. The following project options were considered in Phase I:*

1. Immediately scrap the existing flat glass plant at Shoubra El Khema (SEK) and import all flat glass.
2. Immediately scrap SEK and construct a new updraw or float plant.
3. Do nothing at SEK.
4. Do nothing at SEK and construct a new updraw or float plant.
5. Do nothing at SEK. Immediately construct a new updraw plant, later convert it to a float plant.
6. Upgrade SEK. Immediately construct a new updraw plant, later convert it to a float plant.
7. Make minor alterations to SEK.
8. Redesign the SEK furnaces.
9. Redesign the SEK furnaces and construct a new updraw plant.
10. Redesign the SEK furnaces and construct a new float plant, then abandon SEK for clear flat glass production.

The first six options were abandoned because they either did not result in a flat glass supply that would meet demand or they seemed clearly inferior to the other options because of higher costs or greater foreign exchange penalties.

Subsequent to the Phase I report, Egyptian authorities chose to construct a new float plant. Any modifications to SEK are to be part of a separate project.

---

*General Electric Company—TEMPO, *Technical/Economic Feasibility Study for Flat Glass Production Facilities in Egypt, Volume III—Phase I (Prefeasibility Stage)—Technical and Financial Aspects of Plant Location*, GE78TMP-2(III), 20 July 1978.

Site options for the glass plant were also available. Four potential locales selected by Egyptian authorities (in Mostorod, Suez, Ismailia, and Tenth of Ramadan) were evaluated in detail in Phase I. Tenth of Ramadan was (1) the preferred site overall; (2) the preferred site from the standpoint of technical, political, environmental, and social noncost considerations; and (3) the site judged to result in the least adverse environmental impact. Following this analysis the Egyptian authorities chose Tenth of Ramadan as the site of the glass plant.

Raw materials can be obtained from alternative sites; no significant environmental impact is envisioned from use of any of these potential sites.

SECTION 5

ADVERSE ENVIRONMENTAL IMPACTS THAT CANNOT BE AVOIDED

The only significant adverse effect from the project is the emission of oxides of sulfur into the air from the glass-melting furnace, primarily because of the relatively high sulfur content of the fuel oil. The glass plant alone probably will not result in the air quality standards being exceeded, but the plant will contribute to the degradation of air quality.

Ways of reducing the impact from SO_x emissions include direct emission controls, such as scrubbers; process modifications, such as using a fuel oil with lower sulfur content or using natural gas; and operational modifications, such as reducing the use of high-sulfur fuel oil when air pollution meteorological conditions occur. However, any air pollution control strategy should include all local industry, rather than just the glass plant.

SECTION 6

THE RELATIONSHIP BETWEEN LOCAL SHORT-TERM USE OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

No adverse effects on long-term productivity are foreseen as a result of the project. Water use will not be excessive. The raw materials used in glassmaking are not scarce. The site of the glass plant is barren and remote and not suitable for agriculture or grazing.

SECTION 7

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Large amounts of glassmaking raw materials will be consumed when the glass plant is in operation. However, these materials—sand, limestone, dolomite limestone, and soda ash which is manufactured from limestone by the Solvay process—are plentiful and relatively inexpensive. The sand and limestone occur in almost unlimited quantities.

The land to be committed to the plant site is designated as an industrial area of Tenth of Ramadan. Because of the scarcity of vegetation at the site, biota losses, if any, will be negligible. No endangered species will be affected.

The plant will consume fuel, in the form of oil and electricity, and cooling, process, and drinking water, as does virtually any industrial plant. The use of a closed recirculating system for cooling water will minimize total water consumption.

In summary, there are no commitments of resources that are sufficiently adverse to threaten the feasibility of the project.

SECTION 8

CONSIDERATIONS THAT OFFSET ADVERSE ENVIRONMENTAL EFFECTS

Except for the reduction in ambient air quality from the use of high-sulfur fuel oil, there do not appear to be any significant adverse environmental effects from the proposed project. Considerations that offset adverse environmental effects include the following:

- Industrial development is essential to the success of the planned desert city, Tenth of Ramadan.
- The project will provide employment and will aid in building a technological and skilled labor base for Egypt.
- The project is in accordance with land-use designations and the land involved is very barren and unsuited for agriculture.
- The project is important to the economy of Egypt. Without the project, foreign exchange losses due to the importing of flat glass will not only continue, but will increase. The financial analysis indicates that when the glass plant becomes operational, an excess of glass will enable Egypt to develop export markets resulting in a gain in foreign exchange.

APPENDIX A

SUGGESTED LAND-USE AND BUILDING REGULATIONS FOR THE INDUSTRIAL AREAS*

GENERAL ASPECTS

The areas A and B and C, respectively, shall be used mainly for industrial purposes, including manufacturing, assembling, processing and storaging of raw materials, intermediate and final products. Even use for wholesale, storaging and terminals shall be included in all areas. In the C-part of the B and C area, crafts and retail in connection with craft or industry shall be included.

Adjacent to the industrial areas, some areas will be available for local service, administration and education.

The types of industry allowed for each industrial area are restricted to those designated industries for A-, B-, or C-types. Change of the type of industry shall be permitted only within the same type of industry.

The industrialists are asked to deliver to the development authority documents showing the industrial use, general layout and drawings of his plant. No execution will be permitted before the approval of the authorities. No significant change or modification of a building or sub-areas shall be carried out without previous permission.

LOTS

As a principle all lots are interior lots served from a street along one side only. Exceptions apply to corner lots.

No lot shall have a width, along the street less than half its length, perpendicular to the street. Through lots shall be regarded as two interior lots. In railway-served blocks, through lots may be established only at the rear end of the siding, in order not to prevent the railway traffic.

---

*Taken from Volume 4, Appendix I, Tenth of Ramadan Master Plan Working Papers.

LAND OCCUPANCY

Land occupancy for closed buildings and other industrial uses, including storage, that prevent the area occupied to be considered as open space, shall not exceed 60 percent of the lot area.

YARDS

The following yards are to be left around the buildings within the lots in order to provide space for ventilation and circulation.

No ordinary front yards are required. If the building is withdrawn from the street, the remaining yard shall have a depth of at least 12 meters, in lots no longer than 100 meters, and at least 18 meters in longer lots. If not built upon, this yard shall be planted. It may contain parking areas.

Side and rear yards shall have a depth of at least 12 meters. In a sequence of lots the side yards on one side may be excluded if the width is doubled on all the yards on the other side.

When a building shall be attached to a railway siding, a rear yard for the purpose may be reduced to 6 meters.

The minimum space between buildings in the same lot shall be equal to the height of the tallest building.

HEIGHTS

The height of buildings shall not exceed 15 meters.

The height of a chimney stack shall as a minimum be twice the height of the tallest surrounding building.

FLOOR AREA

The total floor area of the buildings must not exceed 1.5 of the area of the lot.

LANDSCAPING, RECREATION AREAS, SOCIAL ACCOMMODATIONS

A front yard shall be treated as a landscape element whose maintenance is the responsibility of the owner/leaseholder.

Three percent of the lot area, as a minimum, shall be provided for recreation purposes and be planted.

When the number of workers in a lot reaches 500, they must be provided with a welfare center, including suitable W.C., showers, lockers for guard robes and facilities for quick lunch and drink.

On the level of the industrial area, the employees must be provided with the following:

- A social unit, including facilities for a limited social club, a social office and an office for activities.
- A health centre with a limited polyclinic and first-aid unit with about 5 beds for emergencies.
- An administrative unit including a representative of the Syndicates, working office and registration.

Green areas outside the industrial lots are of public use. No one will be permitted to change the use. The areas are under the responsibility of the development authority.

REGULATIONS OF THE BUILDINGS

Window spaces shall not be less than 10 percent of the floor area.

Multistory buildings must be provided with at least two staircases. Every building must have two accesses as minimum.

One sanitary unit (lavatory + W.C.) shall be provided for each 200 m^2 factory space or 25 employees.

ADVERTISING SIGNS

Advertising signs may not be put up without the authority's permission. As a principle a sign should be put on the facade of a building.

ENCLOSING

The lots shall be enclosed by walls, railings or wire fencing at least 2 meters high, which shall follow either the lot's boundaries or be withdrawn the depth of a front yard.

TRAFFIC

Parking is not allowed in the street. Required parking area for employees and visitors shall be arranged within the lots. The arrangement must not lead to reverse car movements, interfering with the street traffic.

Loading and unloading shall appear within the lots and without interference on the street traffic.

In order to keep suggested security standards of the street network, certain distances shall be kept between crossings and lot exits.

For that purpose certain parts of the front boundaries are prohibited exits, see map. Lots smaller than 3 ha may have at most two exits. Lots greater than that shall have at least 50 meters distance between exits.

ELECTRICITY, TELEPHONE, WATER, SEWERAGE AND WASTE DISPOSALS

Each lot can be provided with electricity by either 11-kV or 0.4-kV high-tension underground cables. Connection shall be done by the development authority. All lots are to be provided with circuit breakers.

The industrial areas will contain high tension overhead lines, which call for protection zones. By a 220-kV line no building may be erected nearer than 17.5 meters from the nearest cable, by 66-kV not nearer than 16.5 meters.

The water and sewerage pipes, power lines and telephone cables are laid in the street area. No modification by industrialists is permitted.

Water will be supplied to all lots for different purposes

Fire hydrants will be provided at a maximum of every 100 meters along the street.

Every lot will be provided with a drainage system for industrial and fecal sewage water.

Each lot can be provided with telephone cables with the required number of lines. Telephone exchange switch will be permitted.

Every lot, if needed, is to be provided with a dump for solid wastes disposal which can be carried away to public dump areas. No disposals are allowed to occupy any outer areas other than for the purpose designed internal areas.

SOUND LEVELS

The lot holder shall limit noise emittance due to the type of industrial area in which the activity is established. An objective might be not to exceed 60 dbA in adjacent residential areas.

AIR POLLUTION

The lot holder shall limit air pollution due to the type of industrial area in which the activity is established.

The following is recommended for SO_2:

2-hours' value < 25 pphm

30-days' value < 5 pphm.