Environmental Impact Assessment for Upgrading the Treatment and the Disposal Facilities of Alexandria

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Abstract

The initial focus of this project was to identify waste water alternatives that would build on the existing primary treatment facilities .As a result of the screening processes, 3 alternatives were identified for further study. The 3 alternatives were:

1) Expansion of the existing primary treatment to meet the projected increase in waste water flow through the year 2030 with continued disposal to the Main Basin of Lake Maryout, 2) Lake Discharge, which includes the alternative no. (1) plus secondary treatment (biotowers) and chlorination for disinfection , and 3) Lake Bypass, which includes the alternative (1) plus secondary treatment and chlorination with waste water conveyances to bypass the effluent around the Main Basin of Lake Maryout and into the agriculture drain.

Impacts to generic resources as land use and regional planning, human health and socio-economic resources, physical environment and aesthetic and cultural resources were assessed. An interaction matrix has been carried out during the construction and the operation phases. There may be some negative impacts for a short period during the construction phase especially noise, hardness and total suspended solid. All environmental parameters have indicated positive impacts during the normal operation phases.

The mitigation measures that may be potentially off set significant impacts identified during the evaluation of the impacts of the alternatives were assessed .By comparing of all alternatives, The Lake Bypass does have large benefits to the water quality and ecological community of the Main Basin and for water reuse, but, with several mitigations.

Objective of the Study:

* Improve waste water treatment facilities of Alex.
* Less pollution.
* Reuse the treated waste water.

Description of the Project

To improve the waste water treatment facilities in Alexandria, the existing primary treatment processes should be upgraded to secondary processes. The existing plants include screens, grit chamber, and clarifiers. So, this project will be upgraded by adding biological treatment process to raise the organic load removal to 80%. There are two treatment plants which are located in the east and the west of Alexandria where the waste water producing from the city is treated primarily. These plants include:

* Head work to remove the coarse substances.
* Grit chamber to remove the inorganic substances.
* Clarifiers to remove 30% of the organic substances.

The secondary treatment system which will be used is consists of:

* Biological treatment process (Biotower)
* Secondary clarifiers.
* Disinfecting by chlorination.

DESCRIPTION OF THE SITE OF THE DISPOSAL

Lake Maryout is composed of four basins which are separated by levees and waterways. The Main Basin, with an area of 6000 feddan, receives 1) primary treated effluents (Domestic and Industrial) from both treatment plants,2) direct disposal of untreated domestic and industrial effluents and 3) a flow from agriculture drains. So, this Basin is highly polluted by untreated waste water. In addition the surface water sources, ground water may influence the water quality of the Main Basin. It includes a large open unvegetated region in the eastern portion and a densely vegetated region in the western portion.

Base Line Measurements

(a) Water Quality Survey

Chemical Characterization :Main Basin and Kalaa Drain are affected by wastewater. These stations such as the Kalaa Drain and many portions of the Main Basin are characterized by lower dissolved solid concentrations (with associated lower chlorides , total solids ,et.) and higher wastewater characteristics (higher nutrient concentrations, higher organic deman, higher coliform concentrations). In addition,sediments of these stations have high metal concentration.

The Nubaria Canal, Omoum Drain, and all other lake basins (Fisheries, Northwest, and southwest) affected by agricultural drains. They are characterized by high dissolved solid concentrations and low wastewater characteristics such as nutrient and low sediment metal concentrations.

Intermediate lake and drain exhibited characteristics in between the two extremes noted above. There was evidence of impacts by both agricultural and wastewater inputs to the system.

Biological Characterization :In general, the four basins of Lake Maryout now range from meso-to hyper-eutrophic (i.e. very high nutrient content) with the Main Basin being significantly more eutrophic than any of the other three basins. Eutrophication is an important biological concept because it drives the types of biological communities that are able to exploit the existing enviroment. The extreme eutrophication of the Main Basin is adirect result of the high nutrient loads being discharged from the ETPand WTPT

The Main Basin has a statistically significant higher phytoplankton density than the Fisheries and Southwest basins and non-statistically significant, but , appreciably higher abundance than the Northwest Basin. The Fisheries Basin has the lowest abundance of phytoplankton, which could be related to its small size, dense cover of macrophytes, and lack of significant inflow from any drains or canals. Within the Main Basin the highest phytoplankton densities were in the areas that were affected by the discharge of the Kalaa Drain or WTP. The phytoplankton population of the Main Basin

dominated by flagellate and diatoms which are indicators of organic and inorganic enrichment . the phytoplankton population of the other basins is generally fish usable habitat volume and access by fishermen.

Within the small remaining fisheries usable habitat, there are still significant populations of four species of tilapia (two species of mullet, one species of catfish and one species of eel). The four species are a omnivorous , exceptionally robust species that are able to live where most other species of fish can not. The Fisheries Basin the largest T.Zillii and O. aureus and is the second best pond for O.niloticus. This is because this basin has comparatively better water quality than the other basins and an adequate amount of food for these species. The same three species also had the lowest rate of mortality in the Fishery Basin.

Significance of Findings : Both the chemical and biological results of this study (M.&E. 1996) indicate that the Main Basin is significantly degraded by the Kalaa Drain (primarily as a result of the ETP) and WTP discharges into the lake when compared to the other three basins of Lake Maryout.This is of particular importance because it was possible to reasonably develop a cause and affect relationship of wastewater parameters such as nutrients and ammonia on the existing biological community. This cause and affect relationship will then be used to predict how the biological community will react to predicted changes in water **quality as a result of implementing any of the** effluent disposal alternative being considered in the environmental assessment being conducted for wastewater disposal alternatives.

Base line Measurements

(b) Air quality survey

The levels of SO_2 are very high levels in ambient air. However, these levels sharply decrease with the distances from sources, The main source of SO_2 in this area is the municipal sewage waste water dumped in Lake Maryout. The rapid oxidation of H_2 S to SO_2 occurs within few hours after flux to the ambient air adding to the ambient

SO_2 level. One can notice easily that this area is highly subjected to pollution by H_2S. The highest level (0.63ppm) found in the site closed to the municipal sewage dump area in Lake Maryout, followed by the site close to the municipal land fill. Also, the level of NH_3 in the ambient air was (298.85) mg/m^3 and the levels of methane (CH_4) ranged between 5 and 8 ppm.

(C) Soil Quality Survey

The soil under investigation belongs to two main soil types in the area, lacustrine and alluvial. Two types of soil are, in general, have slightly alkaline reaction: Low organic matter content, Variable amounts of total carbonates and wide range of soil texture. The range of the amounts of total Zn in soils are from (117-120) ppm while the range of the amounts of total Cd in the lacustrine and alluvial soils are found to be between 1.25 and 1.75 ppm. The same trend has been found for Iron, Copper, and Chromium, as a result of the presence of several sources of pollution which are the landfill and waste water discharged in Lake Maryout.

(D) Noise Survey

The levels of noise (in dB) at the site are below recommended noise levels (85 dB).
An interaction matrix has been carried out during the expected construction and operation phases.
Table (1) represents the negative and positive impacts during the different phases of the project.

Table (1): Interaction Matrix for the Environmental Parameters in different phases of the project

Construction Phase						
Environmental Parameters	**Expansion**	**E1ectriciy Energy Supply**	**Water Supply Pipes**	**Water Disposal Drainage**	**Housing**	**Building**
Air						
NH_3	1/1	1/1	1/1	3/2	1/1	2/2
H_{2S}	1/1	1/1	1/1	3/2	1/1	2/2
CH_4	1/1	1/1	1/1	2/2	1/1	1/1
Dust	8/6	2/2	2/2	6/5	3/2	9/9
SO_2	1/1	1/1	1/1	6/5	1/1	1/1
NO_2	1/1	1/1	1/1	6/5	1/1	1/1
CO	1/1	1/1	1/1	6/5	1/1	1/1
HC	1/1	1/1	1/1	6/5	1/1	1/1
HM	1/1	1/1	1/1	6/5	1/1	1/1
Noise	8/7	7/4	7/4	4/2	3/2	9/9
Water						
BOD	1/1	1/1	1/1	1/1	1/1	1/1
COD	1/1	1/1	1/1	5/5	1/1	5/5
DO	1/1	1/1	1/1	3/6	1/1	4/6
Temp	1/1	1/1	1/1	1/1	1/1	1/1
T	1/1	1/1	1/1	1/1	1/1	1/1
O.M	1/1	1/1	1/1	1/1	1/1	1/1
H.M	1/1	1/1	1/1	6/6	1/1	6/6
PH	1/1	1/1	1/1	2/2	1/1	2/2
Hardness	1/1	1/1	1/1	8/8	1/1	8/8
TSS	1/1	1/1	1/1	9/9	1/1	9/9
SS	1/1	1/1	1/1	5/5	1/1	6/5
Soil						
pH/EC	1/1	1/1	1/1	1/1	1/1	1/1
HM	2/2	1/1	1/1	1/1	1/1	1/1
OM	1/1	1/1	1/1	1/1	1/1	1/1
Fertility	3/2	2/2	2/2	1/1	1/1	2/2
Deterioration	2/2	2/2	2/2	2/2	1/1	2/2
Socioeconomic						
Employment	+6/6	+6/6	+6/6	+6/6	+6/6	+6/6
Living of	+2/2	+2/2	+2/2	+2/2	+2/2	+2/2
Tourism	-2/2	-2/2	-2/2	-2/2	-2/2	-2/2
Land price	2/2	2/2	2/2	2/2	2/2	2/2
Displaced	1/1	1/1	1/1	1/1	1/1	1/1

Construction Phase						
Environ-mental Parameters	**Expansion**	**E1ectriciy Energy Supply**	**Water Supply Pipes**	**Water Disposal Drainage**	**Housing**	**Building**
Health						
Rodents	**2/2**	**2/2**	**2/2**	**2/2**	**2/2**	**2/2**
Flees	**2/2**	**2/2**	**2/2**	**2/2**	**2/2**	**2/2**
Filies	**2/2**	**2/2**	**2/2**	**2/2**	**2/2**	**2/2**
Odours	**2/2**	**2/2**	**2/2**	**2/2**	**2/2**	**2/2**
Traffic	**4/4**	**4/4**	**4/4**	**4/4**	**4/4**	**4/4**
Ground water						
COD	**3/2**	**3/2**	**3/2**	**3/2**	**3/2**	**3/2**
DO	**3/2**	**3/2**	**3/2**	**3/2**	**3/2**	**3/2**
HM	**3/2**	**3/2**	**3/2**	**3/2**	**3/2**	**3/2**
EC	**4/3**	**4/3**	**4/3**	**4/3**	**4/3**	**4/3**
DS	**4/3**	**4/3**	**4/3**	**4/3**	**4/3**	**4/3**
SS	**3/2**	**3/2**	**3/2**	**3/2**	**3/2**	**3/2**
Turbidity	**5/3**	**5/3**	**5/3**	**5/3**	**5/3**	**5/3**

Normal Operation				
Environmental Parameters	**Biological treatment**	**Secondary clarifying**	**Disinfection chlorination**	**Sludge**
Air				
NH_3	**+3/2**	**+3/3**	**+1/1**	**+3/2**
H_2S	**+3/2**	**+2/2**	**+1/1**	**+3/2**
CH_4	**+2/2**	**+2/2**	**+1/1**	**+2/2**
SO_2	**+2/2**	**+3/3**	**+1/1**	**+2/2**
NO_2	**+2/2**	**+3/3**	**+1/1**	**+2/2**
CO	**+2/2**	**+3/3**	**+1/1**	**+2/2**
HC	**+2/2**	**+2/2**	**+1/1**	**+2/2**
DUST	**+1/1**	**+1/1**	**+1/1**	**+1/1**
HM	**+2/2**	**+1/1**	**+1/1**	**+2/2**
Noise	**+2/2**	**+2/2**	**+1/1**	**+2/2**
Water				
BOD	**+2/2**	**+2/2**	**+1/1**	**++2/2**
COD	**+2/2**	**+2/2**	**+1/1**	**+2/2**
DO	**+2/2**	**+2/2**	**+4/4**	**+2/2**
Temp	**+2/2**	**+2/2**	**+1/2**	**+2/2**
T. Coliform	**+2/2**	**+2/2**	**+1/2**	**+2/2**
OM	**+2/2**	**+2/2**	**+2/2**	**+2/2**
PH	**+2/2**	**+2/2**	**+2/2**	**+2/2**
Hardness	**+2/2**	**+2/2**	**+2/2**	**+5/2**

Normal Operation				
Environmental Parameters	**Expansion**	**Electricity Energy Supply**	**Water Supply Pipes**	**Water Disposal Drainage**
SOIL				
PH	**+2/2**	**+2/2**	**+1/1**	**+2/2**
EC	**+2/2**	**+2/2**	**+1/1**	**+2/2**
HM	**+2/2**	**+2/2**	**+1/1**	**+2/2**
OM	**+2/2**	**+2/2**	**+1/1**	**+2/2**
Fertility	**+3/3**	**+3/3**	**+3/3**	**+3/3**
Deterioration	**+1/1**	**+1/1**	**+1/1**	**+1/1**
Socioeconomic				
Employment	**+6/6**	**+6/6**	**+6/6**	**+6/6**
Living of	**+2/2**	**+2/2**	**+6/6**	**+2/2**
Tourism	**+2/2**	**+2/2**	**+2/2**	**+2/2**
Land price	**+2/2**	**+2/2**	**+2/2**	**+2/2**
Displaced	**+1/1**	**+1/1**	**+1/1**	**+1/1**
Health				
Rodents	**+2/2**	**+2/2**	**+2/2**	**+2/2**
Flees	**+2/2**	**+2/2**	**+2/2**	**+2/2**
Filies	**+2/2**	**+2/2**	**+2/2**	**+2/2**
Odours	**+2/2**	**+2/2**	**+2/2**	**+2/2**
Traffic	**+4/4**	**+4/4**	**+4/4**	**+4/4**
Ground Water				
COD	**+3/2**	**+3/2**	**+3/2**	**+3/2**
DO	**+3/2**	**+3/2**	**+3/2**	**+3/2**
HM	**+3/2**	**+3/2**	**+3/2**	**+3/2**
EC	**+4/3**	**+4/3**	**+4/3**	**+4/3**
DS	**+4/3**	**+4/3**	**+4/3**	**+4/3**
SS	**+3/2**	**+3/2**	**+3/2**	**+3/2**
Turbidity	**+5/3**	**+5/3**	**+5/3**	**+5/3**

Small negative impacts have been appeared during the construction phase for a short time especially for noise, hardness and TSS.

All the environmental parameters in air, water, and soil have indicated a positive impact during the operation phase

Waste Water Management Alternatives

The waste water management alternatives for the city of Alexandria include:

1- Expanded existing primary treatment capacity to 2030 with continued discharge to the lake.
2- Upgrade the treatment of the waste water to secondary processes with continued discharge to the Main Basin.
3- Upgrade the treatment facilities to secondary one with Lake Bypass by discharging effluent to the agriculture drain to reuse.

Environmental Alternatives Evaluated For the Waste

Water Treatment:

1- Impacts Associated With Expanded the Primary Treatment

Under this condition, biological oxygen demand, suspended solids will be increased in the Main Basin. While no change in dissolved oxygen, nitrate, ammonia phosphate, and fecal coliform. Minor changes in plankton density and community composition would occur in this basin along with a small increase in emergent vegetation.

2- Impacts Associated With Lake Discharge:

Under this condition, the water quality in Main Basin would show some improvements except Nitrate Plankton and macrophyte communities in the Main Basin are not predicted to show major changes and the area supporting a viable fishery may increase by 10 to 15%.

3- Impacts Associated With Lake Bypass:

Under this alternative, the water quality in Main Basin would improve due to a decrease in loading of most waste water-related parameters. Long term recovery (up to 10 years) is predicted for most of the Main Basin. Plankton densities are predicted to decrease and replacement with macrophytes over the long term and fishing area would increase almost 100%.

Socio-Economic Impacts

If there is no action takes place, severe and unacceptable impacts to both human health and socioeconomic, as it would lead to further degradation of existing environments and could eventually lead to waste water flooding in streets or the reopening of the near-shore discharges to the Mediterranean Sea. The expansion of the primary treatment alternative only would also have significant impacts to human health and socioeconomic, although it would represent some improvements over "No action". Sea Discharge removes all pathogens from the Alexandria environment, which is a significant benefit to human health. Lake Discharge and Lake Bypass all provide disinfection, which would reduce, but not eliminate the presence of pathogens in the Main Basin and downstream waters. Continued progress on industrial pre-treatment and other means of reducing the input of priority pollutants to the wastewater collection system is important for all alternatives. Aesthetic resources as waste water impacts are removed from the environment, thus, in general, Sea Discharge and Lake Bypass Alternatives provide the most improvement to aesthetic resources. The expansion of the primary treatment would have long-term impacts on land use outside existing sanitary drainage facilities. Expansion of the primary treatment and sea discharge have the lowest quality and thus have less before water reuse, relative to secondary treatment alternatives. Impacts to air quality are minimized by removing the waste water (Sea Discharge) or by providing secondary treatment and disinfection (Lake Discharge and Lake Bypass). To further minimize the potential for nuisance odors, aeration has been recommended in Kale Drain for Lake Discharge and Lake Bypass.

The hydrology of the Main Basin of Lake Maryout would change appreciably for the expansion of the primary treatment and Lake Discharge Alternatives. Lake Bypass Alternatives would remove the Kalaa Drain and WTP flow from the Main Basin. These changes combined with changes in water flow between the Omoum Drain and the Main Basin would result in reduced movement of water in the Main Basin. Sea Discharge Alternative would remove project flow from Lake Maryout, which also would result in reduced movement of water in the Main Basin.

Non of the other alternatives, except Sea Discharge, are predicted to impact the physical characteristics of the Mediterranean Sea. Sea Discharge would alter the sea floor in the area of construction.

Environmental Regulations

A law concerning the environment does exist in Egypt (Law no. 4-1994). The executive regulations of this law were promulgated in 1995. The law requires an Environmental Impact Assessment (EIA) study to be carried out for certain establishments, projects and extensions or renovations of existing establishments, in order to ensure the safety of the environment and the achievement of sustainable growth. The articles number 19,20,21,22 and 23 of law no.4 for 1994 concerning the EIA system. Executive regulations articles are number 10,11,12,13,14,15. Finally guidance on EIA is published by the E.E. A.A.booklet titled Guidelines for Egyptian EIA system as Law no.4.

The EIA system screens projects into three categories using pre-stated list as reference, depending on the severity of possible environmental impacts. The three categories are, white, gray and black. This project is a black category, which need full environmental impact assessment.

Public Hearing

A public Hearing meeting was held by the meeting attended by representatives of the following authorities, and other interested persons:

- Governorate of Alexandria.
- Alexandria General Organization for Sanitary Drainage.
- University of Alexandria.
- Alexandria Hygienic Safety Department.
- Environmental Committee of Local Governorate.
- General Organization for fisheries.
- N G O S.
- Inhabitants from the nearest residential area and owners of surrounding projects.

Most of the people of Alexandria preferred the Lake Bypass Alternative, and reusing the secondary treated waste water in irrigation.

Positive effects as a result of implementing this project are summarized as follow:

- Aesthetic resources as waste water impacts are removed from the environment, thus in general, Sea Discharge and Lake Bypass Alternatives provide the most improvement to Aeshetic resources.
- Impacts to air quality are minimized by providing secondary treatment and disinfection. To further minimize the potential for nuisance odors, aeration has been recommended in Kalaa Drain for Lake Discharge and Lake Bypass.
- Increasing in fish production.
- Increasing the income for the farmers and fishermen and highing the level of standard for them.
- Impact of the project on employment is positive.
- Reusing the waste water of treatment as a strategic aim in irrigation and cultivating the desert with wood plants, green belt and flowers trees.
- Opening new fish market for the fishermen.
- Irrigation for the green area of touristic coastal villages to save the potable water.
- Health conditions in the area are expected to be improved at the operation of the project. Thus the impact on the health of the fishermen and the people of Alexandria in general is positive.

Mitigation

1- Expanded the Existing Primary Treatment

Mitigation measures recommended for this alternative, are chlorination to protect human health, and fine mesh screens to prevent floatable, solid waste from impacting the lake and downstream water bodies.

2-Secondary Treatment Alternatives

All secondary treatment alternatives would approximately double the amount of the sludge generated. So, if the sludge disposal site does not have adequate space to accept the sludge, additional site area would be required. Resolution of this impact is critical to making the secondary treatment alternatives viable, as sludge disposal is a critical component of the process.

3- Lake Discharge and Lake Bypass

Mitigation measures evaluated included mechanical aerators located at the down-stream end of agriculture drain to increase dissolved oxygen in it as in the lake; measures to minimize ammonia; and an aqua culture facility to mitigate socioeconomic losses associated with impacts to fishery resources.

Conclusions

By comparing the three alternatives, the Lake Bypass alternatives does have large benefits to water quality and ecological community of the Main Basin and for water reuse, but, with some mitigations.

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