NILU : OR 4/97
REFERENCE : O-96013
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DANIDA

Air Quality Monitoring Programme

Mission 4 Report

EIMP Environmental Information and Monitoring Programme

NILU Norwegian Institute for Air Research

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DANIDA; Air Quality Monitoring Programme

Mission 4 Report

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1 Introduction

A visit to Egypt was undertaken in November 1996 to finalize the annual report and to establish the plans for the second phase of the Environmental Information and Monitoring Programme (EIMP) for the Arab Republic of Egypt. NILU is responsible for the development of an air pollution monitoring system, which in the second phase will contain the establishment of the first monitoring sites and the start up of training.

The project is funded by DANIDA. The project leader is Jan Hassing from COWI in Copenhagen. VKI (the Danish Water Quality Institute) and COWI is responsible for coastal water monitoring, NILU is responsible for air pollution monitoring, VKI is responsible for the Reference Laboratory and COWI is responsible for pollution sources and emissions.

The visit in November also contained a continued selection of representative monitoring sites, and the first working group meeting. The objectives of this visit included the following tasks referring to the work programme activities:

- A.1.1. Prepare background for air quality monitoring working group, and conduct the first working group meeting.
- A.1.2. Finalize job descriptions for air quality Monitoring Laboratory personnel, and support the development of contracts.
- B.2.1. Select representative monitoring sites for A.Q. measurements with special emphasis on improving the sites selected in Cairo.
- B.2.5. Discuss and perform a final selection of sites for meteorological measurements, included a meeting with the Egypt Meteorological Service.
- B.2.9. Input to future activities.
- C.1.3. Discuss and assist in supporting equipment and tasks for the Reference Laboratory; air pollution part.

Some of the persons we met are presented in Appendix A.

2 Meetings 19 November 1996

2.1 Introductory meeting

In the meeting with Jan Hassing we briefly summerized the status of the project, he received our third visit report and a draft annual report.

Minutes from a meeting with Dr. ElZarka which stated that Salah Hafez had approved that Dr Mohamed Nasar will act as our counterpart on Air pollution monitoring. (see Appendix B).

The call for the Air Pollution monitoring working group meeting on 21 November 1996 had been sent out (see Appendix C), and a note from Mohamed Nasar had been presented to Jan Hassing on 11 November 1996 (Appendix D).

The main tasks to be undertaken during my short visit this time was discussed. The most important deliveries are:

- Revise the logical framework and harmonize it relative to other components,
- check revised goals,
- prepare activity time schedules with resolution one month,
- write activity descriptions (work programme) with max. 1/3 page per subtask,
- prepare budget for EIMP expenditures for equipment and operations,
- prepare staffing plan (beyond 1997 if possible),
- prepare outline plan for 1998-2000.

The programme for the week also included several tasks and duties in addition to the planning of future activities, such as

- site visits to select a new Cairo background station and a typical Cairo down-wind monitoring site,
- meetings with Dr ElZarka to discuss contracts and agreements,
- meeting with Omar Hussein Sayed to verify the development of digitalized maps,
- meeting with the Egypt Meteorological Service,
- the first working group meeting.

The outline for the seminar to be held at the beginning of phase 2 was outlined, and the seminar book was briefly presented. We agreed that this seminar and the second phase programme will NOT start until the Monitoring Laboratory personnel have been identified and hired. A detailed description of tasks and duties are to be found in the visit 3 report. The Monitoring Laboratory has to hire at least 4 new experts especially concerning the monitoring part of the programme, before any work can start.

2.2 Meeting with Dr. Mohamed Nasar

Mohamed Nasar has been considered as the EEAA responsible and our counterpart for the air quality monitoring network in Egypt. This assignment has already been approved by Chairman Salah Hafez.

Dr. Nasar has a B.Sc. degree in chemistry and physics from the Cairo University in 1969. He was the director of the national network for air pollution monitoring and analyses at EOHC in Embaba and was employed here from 1978 till 1995. He has been running impact assessment studies, operations and calibrations of instruments and he is at present responsible for environmental studies on air pollution at the Tabbin Institute for metallurgical studies. He also participated in the US Aid study on particulate pollution in Cairo.

After the third visit to Egypt in October Dr. Nasar received a long list of tasks and duties that he could undertake until we returned to Egypt again. He had fulfilled a large part of these tasks, as far as possible within the agreements and infrastructure available at the time being.

Appendix D gives a brief overview of the tasks undertaken by Dr. Nasar. He suggested in the meeting that he would very much like to be the EEAA counterpart on air quality monitoring, but that no contract has been signed yet. He had been undertaking several tasks already without receiving ant financial compensation. Jan Hassing, however, guaranteed that some compensation would be made available, at least from the EIMP project if the EEAA could not finalize a contract soon.

Dr. Nasar stated that he would quit all obligations and assignments that he had to fully concentrate on the EEAA counterpart tasks. He also indicated that he would be willing to take the counterpart position for the source emission component. At least during the discussion, it was clear that he could act as an advisor to this component and hire an assistant (whom he already knew) to actually start the inventory of emission sources. For air pollution this task could be closely related to the monitoring programme.

Concerning the building and construction work that have to be undertaken before any installation of monitors or samplers, Jan Hassing mentioned that there will be a memo of understanding with the Embaba laboratory so that EIMP can pay for any expenditures for these preparations.

At the meeting that Dr. Nasar have had with Dr. Hamza at the Atomic Energy Authority (AEA) it had been indicated that an annual fee has to be paid from EEAA to the AEA for operating, servicing, calibrating and retrieving the data. A total annual fee of about 30 000 EL had been mentioned. This has to be considered and re-evaluated relative to the actual work and the number of sites operated by AEA.

A new list of tasks was presented to Dr. Nasar and discussed (Appendix E).

3 Meeting with Dr. El Zarka

A meeting with Dr. El Zarka was requested from EIMP to discuss the employment, the tasks and the contract with Dr. Nasar and with the Monitoring Laboratory. Jan Hassing, B. Sivertsen and Dr. El-Zarka participated in the meeting.

It became clear in a meeting we had with Dr. El-Zarka in October that a contract will be prepared with Embaba Laboratory as the Monitoring Laboratory. This contract will have to contain building/construction work, rentals of space, lines (telephone and power) and salary for the staff. Several new staff members are identified and have to be found.

In the previous meeting with Dr. Nasar it was obvious that he wanted to be the EEAA counterpart on Air Quality Monitoring, but no contract has been finalized and signed as of yet. He also pointed out that he was able to be a supervisor for the emission inventory component. Especially when it concerns air pollution, these components are closely related.

Dr. El Zarka underlined that he wanted to have one specially assigned person for the source emission component. This was especially important for the future work to be undertaken by EEAA. This was understandable, and we agreed on assigning Dr. Nasar preliminary as an advisor to the emission source sub project.

Dr El Zarka wanted to talk with Dr. Nasar to finalize an economic agreement. He also would see to that a contract would be made available and signed as soon as possible.

Concerning the Monitoring Laboratory it was made clear that the second phase of the monitoring programme cannot be started before at least 4 new key persons are assigned to the laboratory. These persons have been described in the institutional support document and in the TOR for the personnel to be available at the Monitoring Laboratory.

Before installation and initial training starts in phase 2, the minimum four new experts that have to be found and hired should be able to fill the following positions:

- Head of monitoring system,
- computer expert for sampling and analyses,
- computer expert for monitoring and
- electronic engineer for monitoring.

These persons are not available at Embaba laboratory today .

4 Site visits to new sites in the greater Cairo area

Bjarne Sivertsen together with Dr Nasar visited two new possible sites for air quality measurements in the greater Cairo area. These proposals have emerged from the discussions with Dr. Nasralla and are improvements concerning one background station and one station downwind from the city of Cairo.

The siting reports are presented in Appendix F.

A monitoring station at Om ElMasrien in the very southern part of Giza (Cairo Southwest) will be adequate for catching the mean average downwind impact from the greater Cairo area. The monitors will be taken from the earlier indicated site at Attaba, which we believe could be reproduced by the measurements at Tahrir square, which is considered more important for the central Cairo urban area.

4.1 General Meteorological Authority

During our visit to the General Meteorological Authority of Egypt we met with Mr. D.M. Ahmed. We were presented to meteorological stations in Egypt, we visited the roof top measurement station and we had a brief introduction to the ozone measurement programme. A three week intensive measurement campaign was carried out together with experts from KFZ in Karlsruhe, Germany, during the summer of 1991 (see Appendix L).

5 Future upgraded air quality measurement programme for the greater Cairo area

5.1 Strategy

The first priority air pollutants as presented by UNEP/GEMS, WHO, OECD and others are:

- Sulphur dioxide (SO_2).
- Total suspended particulate matter (TSP), or better PM_{10} (suspended particles with diameter less than 10 micrometer).
- Nitrogen dioxide (NO_2) and/or NO_x (nitrogen oxides).
- Ozone (O_3).
- Carbon monoxide (CO).

Not all parameters will be measured at all sites. This will be dependent upon site specifications and typical dominating sources. In some sites also dust fall will be measured on a monthly basis with simple dust fall gages.

Meteorological data on an hourly bases will be needed to explain the air quality data collected. Wind speeds, wind directions and atmospheric turbulence (stability) are the most important parameters. Sites for automatic weather stations (AWS), one in Alexandria and 3 in Cairo, had already been selected.

5.2 The greater Cairo area monitoring programme

Based upon the site visits undertaken in the second visit in May-June the third visit in September and the fourth visit in October, the following Table summerizes the total programme for Cairo.

Air quality measurement sites in greater Cairo

Name	Area type	UTM co-ordinates X	Y	Parameters	Instruments	Com
Azbakaya	Street canyon	330,5	3326,62	NO_x, CO, PM_{10}, NMHC	Gas monitors, Hivol	
Embaba	Residential	328,73	3329,25	NO_x, SO_2, O_3, PM_{10}, dustfall, meteorology	Gas monitors, hivol, bucket, AWS	
Embaba road	Road side	328,74	3329,25	NO_x, CO, NMHC, PM_{10}	Gas monitors, Hivol	
Tahrir square	Urban centre	329,3	3325,3	NO_x, SO_2, O_3, NMHC, TSP, PM_{10}	Gas monitors, hivol	AEC
Fac. Medicine	Urban/ residential	334,0	3329,25	NO_x, SO_2, TSP, PM_{10}?, meteorology	Gas monitors, hivol, AWS	
Nasr City	Residential	337,8	3327,45	NO_x, SO_2, PM_{10}/TSP	Gas monitors, hivol	
Shoubra el Kheima.	Industrial	331,?	3333,?	SO_2, NO_x, PM_{10}/TSP, dust fall, (VOC?)	Gas monitors, hivol, dustfall bucket	
Maadi	Residential	332,4	3315,15	SO_2, NO_x, PM_{10}	Gas monitors, hivol	
Tebbin	Industrial	337,2	3395,26	SO_2, PM_{10}, TSP, dustfall, meteorology	Gas monitors, hivol, bucket, AWS	
Giza, Cairo University.	Residential	326,6	3323,2	SO_2, NO_x, O_3	Gas monitors	Cair Univ
Om ElMasrien	Residential	327,23	3320,74	SO_2, PM_{10}/TSP, O_3	Gas monitors, hivol	
Theebes lang. school	Back-ground	354,79	3338,67	SO_2, O_3, PM_{10}	Gas monitors, hivol	
Giza pyramid	regional impact ?	319,9	3317,5	SO_2, NO_2, BS/TSP	Sequential samplers	weekly
Abo elSaaoud	Residential	329,20	3321,85	SO_2, BS	Sequential sampler	weekly
Hawamdia	Residential	332,37	3308,56	SO_2, BS, TSP	Sequential samplers	weekly
Shoubra west	Industrial	330,5	3333,40	SO_2, BS	Sequential sampler	weekly

A total of 12 sites have been selected for monitors and suspended particulate sampling and 4 more sites have been identified for integrated sampling with following analyses.

5.3 Air quality measurement sites in Alexandria

A total of 6 sites is being proposed for continuous monitors and samplers. A summary of these measurements is presented below.

Air quality measurement sites in Alexandria

Name	Area type	UTM co-ordinated X	UTM co-ordinated Y	Parameters	Instrument
ElSaaf	Urban, open	777 120	3 454 947	SO_2, NO_x, PM_{10}, TSP	Monitors
Samoha	Resid., industries	779 779	3 456 249	SO_2, NO_x, PM_{10}, TSP	Monitors
IGSR, Alex. Univ.	Urban, road side	778 149	3 455 800	NO_x, PM_{10}, SO_2, TSP, CO, NMHC, meteorol.	AWS
ElMax	Industries	770 889	3 448 665	SO_2, NO_x, PM_{10}, TSP	Samplers
Abu elDarda	Resid. industries	775 622	3 454 547	SO_2, NO_x, PM_{10}, TSP	Samplers
Ramler	Street canyon			NO_x, PM_{10}, SO_2, TSP	Monitors

When possible automatic monitoring data will be transferred daily via modems and telephone connections to the monitoring laboratory at Embaba. In other cases the data will be collected on floppy diskettes and brought to the monitoring laboratory weekly for retrieval and quality control.

6 Planning of second phase programme

The task managers met for a briefing and harmonizing of the planning of the second phase of the EIMP project.

It was clear that all components have a need for training that should be co-ordinated. Especially concerning training in prerequisited skills such as computer applications, English etc. The DANIDA training officer Mr Blackburn at EETP should be contacted to co-ordinate these efforts for the persons to be involved in the EIMP programme.

Some basic training in prerequisite skills should be undertaken for personnel employed by the institutions participating in the EIMP programme. The first service contracts have been presented to some of these institutions and input to establishing training objectives have been presented by Mr. Blackburn at EETP (see Appendix G).

The start up of the second phase relative to the availability of instruments and skilled persons was also discussed. There will be no point of getting to Egypt before everything is available and ready to run. In the discussion it was indicated that this could take from 3 to 6 months.??

Time that the Reference Laboratory is using to train personnel at the air pollution Monitoring Laboratory will be assigned to the economy (budget plan) of the Reference Laboratory. On the other hand will training that the air pollution monitoring experts (Leif Marsteen) will have to conduct at the Reference Laboratory be part of the air pollution monitoring programme budget.

Detailed plans for the second phase of the project was established and are presented in Appendix H. These plan contain

- a revised logical framework matrix,
- activity descriptions,
- work plan,
- budget.

7 Meeting at EMOHC concerning personnel

A meeting was organized at EMOHC, Embaba, to discuss the organizational structure, personnel available and the need for new experts (see Appendix I). A survey was undertaken to obtain brief reports (simplified CVs) for selected key persons. It was clear from the discussions that at least 4 new experts were needed. The sampling and chemical analytical side was fairly well covered, while the air quality monitoring, computer and data handling side needed new skilled personnel.

8 Monitoring equipment

The procurement of instruments is under way. A comprehensive specification package has been delivered to COWI/DANIDA, and the first bids are being evaluated.

A list of ambient air quality equipment to be provided by DANIDA is presented in Appendix J. A list of priorities concerning purchase will be established. It will be important to have some of the gas monitors installed for operation as soon as possible. The first set of equipment will be established at the Reference Laboratory. Training will be undertaken here, before installations at the Monitoring Laboratory and at the first sites in Cairo.

The Reference laboratory for air pollution monitoring will need one room. The layout for this room has been sketched in Appendix J.

At the Cairo University, who has offered data to EIMP/EEAA air quality monitoring system, the instruments that has been obtained is presented in Appendix K.

9 Digitalized maps

Mr. Omar Hussein at the GIS office in EEAA had been given the task of preparing some selected theme maps of Cairo. This work had been started, and Mr. Hussein presented the first maps with UTM reference grids.

The maps are shown in Appendix L. They can be used in the further EIMP work for presenting monitoring sites, emission sources and air quality measurement data. They may also be valuable input to the data base working tool. The NILU developed AirQUIS-system can use these maps directly as part of the map base.

Appendix A

Persons we met

EIMP

Names and adresses in Egypt (EIMP)
Nov. 1996

Office:EIMP,3 Abdel Aziz Selim street
Fax. Tel. 202 361 5085
Dalia (finance), Dina (secr),Hassan,
Samir(sjåfør), Mahmod
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eimp@intouch.com
Hassing private: tel: 202 340 5741
D Clarke, 23 road 84, Apt 62, Maadi.
Ulla Lund, Arne Jensen, Jacob Andersen

EEAA, 17 Teeba Street, elMohandessin.
Dr. Salah Hafez (Chairman)
Dr. Mohamed el Zarka (Jans counterpart)
Dr. Abdil Latif Hafez (Air Quality respons.)
Ms Heba Mohammed Adly, (Env. researcher).
Mrs Hoda Hanaffi (head of GIS)
Mr Mohammed Saki , and Omar Hussein (GIS)

Env.Mon. Centre Tayar Fecri Street,
OmalCity, EMBABA (at E:Fever inst.)
Dr. Seham M.H. Hendy (head) tel: 311 8978
Mr. Mohammed (J Refaye) El Amawi (AQ) tel: 311 9691

TIMS, Tabbin- Helwan (tel:5010170)
Prof. Saaid, and dr. Hassan Hamad
Prof. Saied El Khalil

NRC; Shari el Tahrir, Dokki Square,
prof. Mahmoud Nasrallah, tel 3537299, Fax 3370931

JICA Minilabs.EEAA offices in Maadi
Dr Mawaheb Abov el Azm

Institute of Graduate Studies and Research
Univ of Alexandria
Prof M El-Raey, tel:422 7688
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Appendix B

Minutes of Progress meeting # 11

EIMP

Minutes of Meeting

Minutes of Meeting	Progress Meeting #11
Subject:	EIMP
Date:	17 November 1996
Place:	EEAA
Participants:	Dr Mohamed ElZarka MZ EEAA
	Mr Jan Hassing JMH EIMP
Prepared by:	Jan Hassing/ 18 November 1996/Doc88
Distribution:	EEAA(2), Danida (1), EIMP (1)

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Action

1 Communication

The present office has still only one telephone line. The new EEAA Maadi offices are expected to be equipped with 30 lines. However, these are not installed as yet. Mobile phones are becoming available for local calls within Cairo and later within Alexandria. Dr Zarka would like to see EIMP equipped with two mobile phones. JMH mentioned the need to have good contact between EIMP and the monitoring institutions which would also require mobile phones at the institutions.

2 Counterparts and other programme personnel

The counterpart for Data Management, Mohamed Mohamed Zaki is still in the process of changing his employment status. Sherine Khalil's employment (Coastal Water Counterpart candidate) is approved by Salah Hafez but employment contract is still outstanding. The same situation applies for Mohamed Nasar (Air Pollution candidate). A possible counterpart for RefLab has been identified but negotiations not yet finalised. Considerations regarding the counterpart for the point source component are ongoing.

An assistant (Mr Mohamed Fathy) to the expatriate team leader will be employed as of 1 December, 1996.

Staff employed by EIMP (Office Boy, Secretary and Accountant) are required to go through a vetting by internal security. Forms have to be filled and delivered to Dr ElZarka. This is also valid for the Team Leader's assistant.

3 Purchase of equipment

JMH informed that intensive equipment purchase activities (tendering and evaluation) are ongoing regarding monitoring and analytic equipment. Deliveries of the first part of the equipment will probably take place in February 1997. The issue of storage upon arrival will have to be resolved.

4 Contracts with Monitoring Institutions

Contract formats have been prepared for use in the relation between EEAA and the monitoring institutions. These formats were approved by the 1 November, 1996. A detailed scope of work has to be prepared and agreed upon together with a cost of contract. This is envisaged to take a fair amount of time. In the meantime a Memo of Understanding between the parties will mutually commit them towards entering into a contract. This commitment is desirable because of the large investment in equipment tailored for the specific institutions. There should be commitments before contracts with suppliers are signed between Danida in Copenhagen and the Danish suppliers. So far, TIMS and NRC have signed the Memo of Understanding.

5 State of the Environment

The time schedule for preparation is appended. Dr El Zarka informed that the first contributions in terms of draft chapters are expected soon, latest on the 1 December, 1996. Payments to working group leaders have taken place (50%) except for Group B1: Population and Group B7: Tourism. Contracts, not yet signed, with working group leaders were handed over to MZ for his further action.

6 Other business

MZ informed that EEAA wanted to undertake a hazardous waste survey and asked in what way EIMP could contribute. JMH proposed that the project idea be developed in cooperation with EIMP and possibly submitted to Danida for their consideration. The idea of establishing an accreditation body is still being developed and will eventually be considered by Danida.

MZ asked EIMP to prepare to move office to Maadi before 13 December, 1996.

Appendix C

Working group meeting 21 November 1996

EIMP

Environmental Information
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Date
18 Nov 1996
Our ref.

EIMP Air Quality Monitoring Programme,Working group meeting

You have been proposed as a member of the EIMP Air Quality Monitoring Programme Working Group. Concerning the group's mandate, objectives, tasks and responsibilities, please see attached terms of reference.

The working group will be called for its first meeting on:

Thursday 21 November 1996 at 2:00 hrs, in the EIMP offices in Mohandessine.

A preliminary agenda contains:

1. Introduction of members,

2. Status of the Air Quality Monitoring Programme,

3. Monitoring laboratory and sub contracting institutions,

4. Discussions on site selections and air quality indicators,

5. Schedule of next meetings,

6. Any other business.

We look forward to fruitful discussions and a good future co-operation

Yours sincerely

Jan Hassing
Team Leader

EIMP

Minutes of Meeting

Environmental Information
and Monitoring Programme

EEAA - Danida - COWI

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E-mail:EIMP@intouch.com

Subject:	**Working Group on Air pollution Monitoring**
Date:	21 November 1996
Place:	EIMP Office , Mohandessin
Participants:	Dr ElZarka, EEAA, Dr. Abdel Latif, EEAA, Dr.ElRaey, IGSR Univ.Alex., Dr. M.I.Sultan and Dr Sharma, Cairo Univ., Dr. Seham M.H.Hendy, EMOHC, Dr. Mahaweb Abov ElAzm, EEAA/JICA proj., Dr Saad Hassan, Ain Shams Univ., Dr. Mokhtar S.A.Hamza, Atomic En.Auth., Dr. M Nasar, EEAA Counterpart, Jan Hassing EIMP Manager, Bjarne Sivertsen, Task Manager Air Pollution Mon.
Prepared by:	Bjarne Sivertsen
Distribution:	J Hassing + WG members

Dr. ElZarka, the EIMP Programme Manager Counterpart, was appointed **chairman** of the Working Group on Air Pollution Monitoring.

The **members of the Working Group** introduced themselves and the objectives, tasks and duties were referred to the working group members. The persons attending this meeting was to be considered future permanent members of the Working Group in addition to Dr. M Nasralla who was absent due to travels abroad. Other experts can also be invited ad.hoc. to discuss specific topics of future Working Group meetings.

A **status and background** for the Air Pollution Monitoring Programme to be established for Egypt on behalf of EEAA was presented. Written material with some of the selected overheads and conclusions were distributed

The **strategy for site selection** and the selection of indicators was approved by the Working Group. The indicators are in accordance with the Egyptian Air Quality Standards, and the future modern monitoring system will meet all the requirements of the standards. A minor comment was given to lead analyses. This will be considered as the programme proceeds.

The results of a **screening study** for SO_2 concentration distributions undertaken in Cairo in June 1996 was presented. The findings, which indicate higher SO_2 concentrations than normally measured in Cairo was approved. The discrepancies are due to inadequate sulphur analyses performed historically.

Concerning **personnel and experts** available at the Monitoring Institutions, it was stressed by several members that the staff at the Monitoring Laboratory has to be strengthened. At least 4 new experts have to be engaged before phase 2 of the programme starts with the installation of monitoring stations and performance of training. The training programme will start with a seminar in which experts from all monitoring institutions should participate.

The Air Quality **data flow and the QA/QC** requirements were discussed. The working group supported the initial plans presented. Some details concerning responsibilities for the weekly calibration and controls were clarified. Monitoring institutions like AEA, TIMS and the Universities will receive calibration gases from the Reference laboratory and undertake weekly checks and see that the monitors are operated properly. Data will be transferred daily to the Monitoring Laboratory from all stations, as soon as telephone lines will be available. In the beginning some of the data may be collected on floppy disks weekly.

The **contracts** with each of the monitoring institutions should be negotiated as soon as possible. The assignments and budgets will be prepared by Dr M Nasar together with the different institutions. A draft contract will be distributed and a final contract will be finalised for each institution and signed before the end of 1996.

The **sites selected** in Cairo and Alexandria were presented and discussed. No major comments changed any of the selections made, and the programme can start its installations as soon as instruments and experts are available.

Standard letters and **agreements** with site owners will also be prepared. Final agreements/contracts with site owners for the already selected sites, will also be prepared and signed before the end of January 1997.

The **next meeting** in the Working Group will take place after the installation and training has been undertaken at the Reference Laboratory and after start up of measurements at the Monitoring Laboratory.

Terms of reference
EIMP Air Quality Monitoring Working Group

1. Objectives

The main objectives of the working group will be to discuss, guide and follow up the work programme undertaken by the EIMP Air Quality Monitoring Programme.

The working group will advice the EIMP steering committee on design of the air monitoring programme, sampling sites, QC/QA, training and reporting. It will also undertake an annual evaluation of the programme and discuss indicators and parameters.
Further it will act as a forum for exchange of information concerning air pollution monitoring and reporting within the EIMP programme and in Egypt in general.

1. Members

The members elected for the working group will be representing institutions and bodies directly or indirectly involved in the Air Quality Monitoring Programme, or defined as users of data and results emerging from the monitoring programme.

As regular members of the working group the following have been proposed:

• EEAA EIMP counterpart	Dr. M El Zarka
• EEAA responsible for Air Quality	Dr. Abdil Latif Hafez
• NRC responsible for the reference Laboratory	Professor Mahmod Nasrallah
• IGSR the University of Alexandria	Professor M El-Raey (Air quality measurements Institute of Graduate Studies and Res., IGRS)
• Atomic Energy Authority	Dr. Mokhtar Hamza, responsible for the radiation monitoring network
• EEAA, JICA Minilab system	Dr. Mawaheb Abov el Azm
• EMOHC Director	Dr. Seham M.H. Hendy
• Cairo University	Dr. M.A. El Sharkawi
• Ain Shams University	Dr. Saad Hassan
• EEAA Air Quality Monitoring responsible	Dr. Mohammed Nasr
• EIMP team leader	Mr. Jan Hassing

3. Tasks and responsibilities

The working group should be involved in the selection of monitoring sites in Egypt. This work is going on at present, and the Air Quality Monitoring Programme team leader will present the site selection reports, discussions and reasoning for the selection of sites, and obtain some feedback from the working group.

The work programme and the available personnel and experts for undertaking the monitoring of air quality in Egypt will have to be discussed as soon as possible. Also possible training seminars and on the job training programmes have to be presented and discussed in the working group.

Further tasks by the working group will be defined by the project as it proceeds and by the working group itself. Typical major items should be:

- action plans,
- status and project reports,
- training programmes,
- status and performance of monitoring institutions,
- contracts and permits for site allocations,
- equipment performance, calibrations and QC/QA,
- air quality data reporting,
- data availability and openness,
- environmental status.

It should further be clarified at this stage of the project the role of audits and the results of calibration and proficiency tests in the relations between EEAA and the monitoring institutions. As part of this process, the distribution of reports from calibrations, controls and audits must be decided upon. This must be included in the foundation for the contract with the Reference Laboratory as well as with the monitoring institutions.

The working group should in the future also be involved in the discussions of the use of data and results coming out of the national air quality monitoring programme.

4. Working modality

Depending upon the tasks and work load defined for the working group, it will be necessary that the group meets at least 2 times a year. The meetings will also be dependent upon the participation of the EEAA team leader, who's functions are covered by only about two visits to Egypt each year.

Some of the work group meeting should also be initiated by the monitoring laboratory responsible scientist, as soon as this organisation is well defined and manned with proper experts.

5. Job description for working group chair person

The chair person of the working group should be experienced in air pollution work. The chair person should further hold a PhD degree and have worked with practical tasks related to air quality monitoring, air quality legislation and air quality planning included impact assessment. He/she should also have some knowledge in statistical and numerical modelling.

Draft/ BS/ 10 Oct. 1996

Air Quality Monitoring and Information System for Egypt

Bjarne Sivertsen

Task manager Air Quality

DANIDA EIMP project

Senior scientist at Norwegian Institute for Air Research

Air Quality Monitoring Programme for Egypt

- ❖ **Strategy for selection of sites**
- ❖ **Air quality indicators**
- ❖ **Sites selected**
- ❖ **Instrumentation**
- ❖ **Personnel**

B.SIVERTSEN: EIMP.PPT side 1

EIMP Environmental Information and Monitoring Programme NILU

Strategy for selection of sites

Different scales of air pollution, (ref: UNEP/GEMS programme);

- ❖ **central urban (kilometer scale)**
- ❖ **road side (kerbside)**
- ❖ **street canyons**
- ❖ **residential areas**
- ❖ **industrial areas.**
- ❖ **regional scale**
- ❖ **background area**

B.SIVERTSEN: EMP.PPT slide 2

EIMP Environmental Information and Monitoring Programme NILU

Environmental indicators

Will help to:

- ➔ identify the quality of environment
- ➔ quantify the impact
- ➔ harmonise data collection
- ➔ assess state and improvement
- ➔ identify needs for control strategies
- ➔ input to management and policy changes

Air quality indicators

The first priority air pollutants (UNEP/GEMS, WHO, OECD) are:

- Sulphur dioxide (SO_2)
- Total suspended particulate matter (TSP), or better PM10 (suspended particles with diameter less than 10 micrometer)
- Nitrogen dioxide (NO_2) and/or NO_X (nitrogen oxides)
- Ozone (O_3)
- Carbon monoxide (CO)
- Also NMHC and Pb will be measured at some sites.

B.SIVERTSEN: EIMP.PPT slide 3

EIMP Environmental Information and Monitoring Programme NILU

Egyptian Air Quality Standards,ug/m3

pollutant	period	cocentraion
sulpher dioxide	1 h 24 h annual	350 150 60
nitrogen dioxide	1 h 24 h	400 150
0zone	1 h 8 h	200 120
TSP	24 h annual	230 90
PM10	24 h	70
lead	annual	1
black smoke	24 h annual	150 60
carbon monoxide	1 h 8 h	30 mg/m3 10 mg/m3

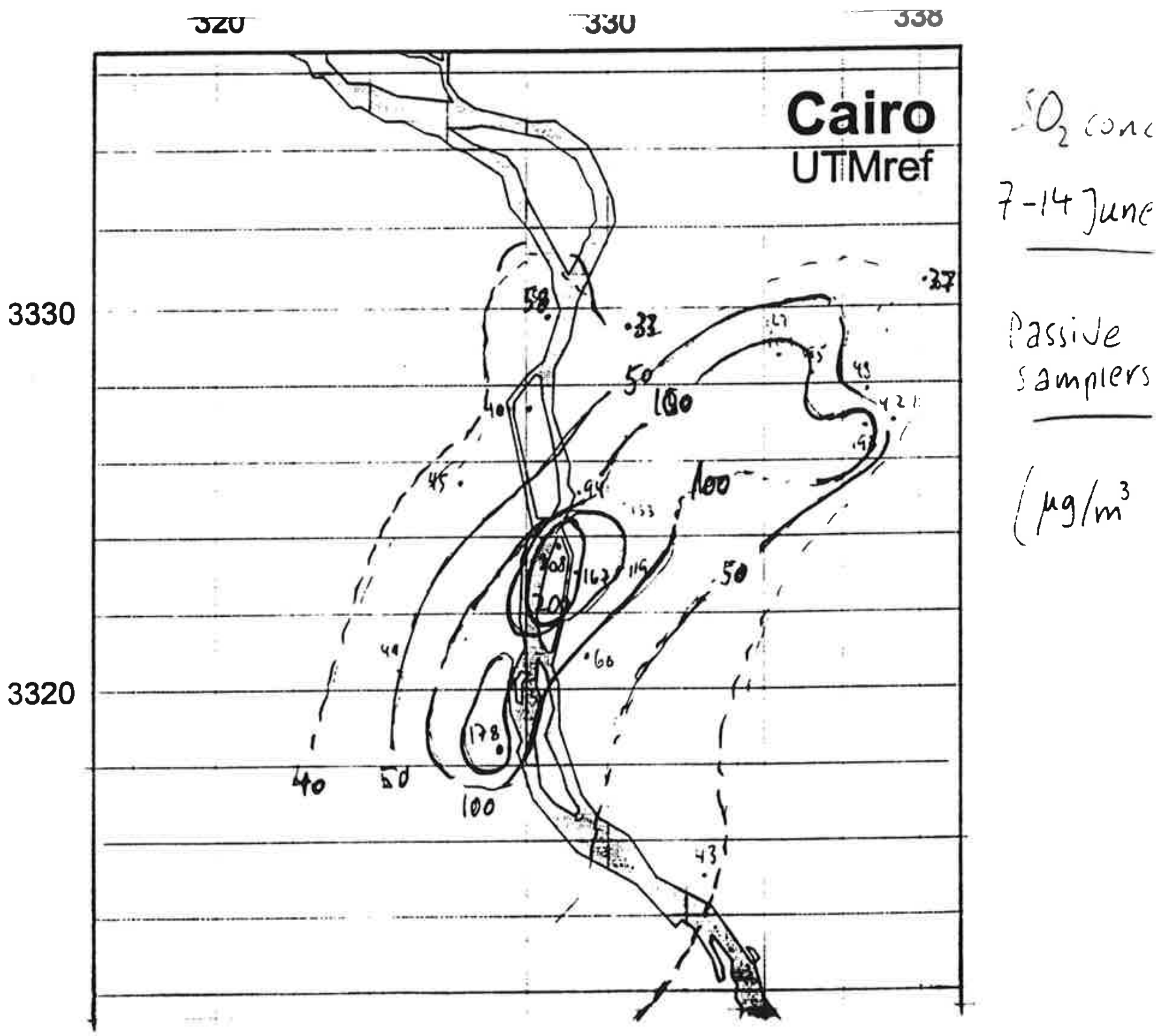
from: Nasrulla,
Monitoring Network and
Air Pollution Control in Egypt.
[illegible]

Site selection and site reports

- ❖ Site visits
- ❖ Present measurements and equipment
- ❖ Site representativeness
- ❖ Local sources
- ❖ Meteorology
- ❖ Air Intake

B.SIVERTSEN: EIMP.PPT slide 4

EIMP Environmental Information and Monitoring Programme NILU



Instrumentation

- **Air quality monitors for gases**
- **Air pollution samplers for suspended particles**
- **Air pollution samplers for selected gases and dust fall gages**
- **Meteorological equipment (Automatic weather stations)**
- **Data loggers and data transfer systems**
- **Telephone lines and modems**
- **Computers in field and at the central data collection unit**
- **Calibration equipment and spare parts**
- **Additional analytical laboratory equipment; ion chromatograph**

Monitoring station facilities; benches, shelves, air-condition, power, air intake facilities etc.

B.SIVERTSEN: EIMP.PPT slide 5

EIMP **Environmental Information and Monitoring Programme** NILU

Air Quality measurement methods

Method	Instruments
Manual and semi automatic sample collection.	Hi vol TSP, PM_{10}, sequential samplers for collector.
Air pollution monitor, automatic (electronical) sample collection.	Monitors measuring SO_2, NO, NO_2, NO_X, O_3, CO, NMHC, PM_{10} and meteorological parameters.

B.SIVERTSEN: EIMP.PPT slide 6

EIMP **Environmental Information and Monitoring Programme** NILU

Sampling frequency and time

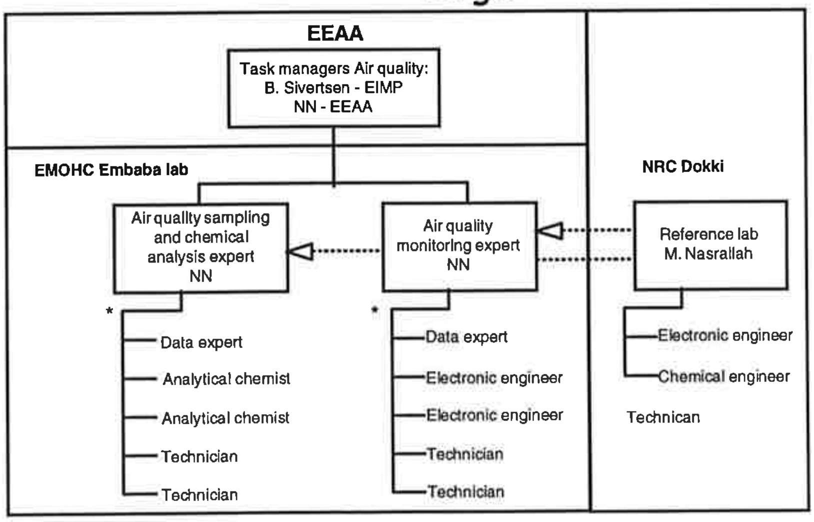
Instrument	Averaging time	Sample frequency	Site visit frequency	Maintenance frequency
Hi vol TSP	24 h	Ev. 6th day	Weekly	Ev. 3 months
PM_{10} sampler	24 h	Weekly	Weekly	Ev. 3 months
Sequential sampler SO_2	24 h	Weekly	Weekly	Yearly
Sequential sampler NO_2	24 h	Weekly	Weekly	Yearly
Sequential sampler BS	24 h	Weekly	Weekly	Yearly
Dust fall collector	1 month	Monthly	Monthly	Yearly
Monitor SO_2	1 h	Dayly/weekly	Weekly	Ev. 3 months
Monitor NO, NO_2, NO_x	1 h	Dayly/weekly	Weekly	Ev. 3 months
Monitor O_3	1 h	Dayly/weekly	Weekly	Ev. 3 months
Monitor CO	1 h	Dayly/weekly	Weekly	Ev. 3 months
Monitor NMHC	1 h	Dayly/weekly	Weekly	Ev. 3 months
Monitor PM_{10}	1 h	Dayly/weekly	Min. weekly	Ev. 3 months
Meteorology sensors	1 h	Dayly/weekly	Yearly	Yearly

B.SIVERTSEN: EIMP.PPT slide 7

EIMP Environmental Information and Monitoring Programme NILU

Personnel

Air Quality Management Organization Plan

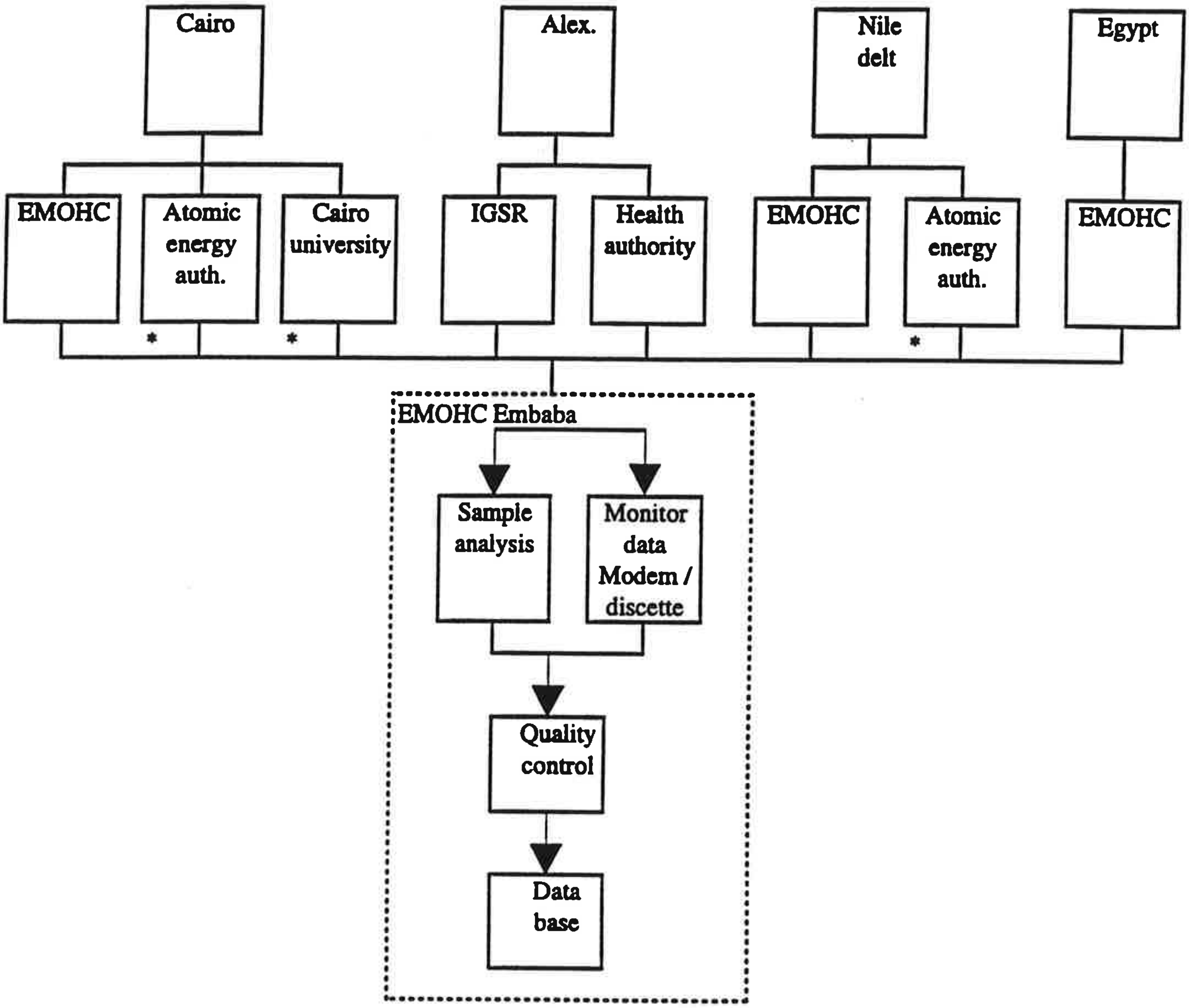


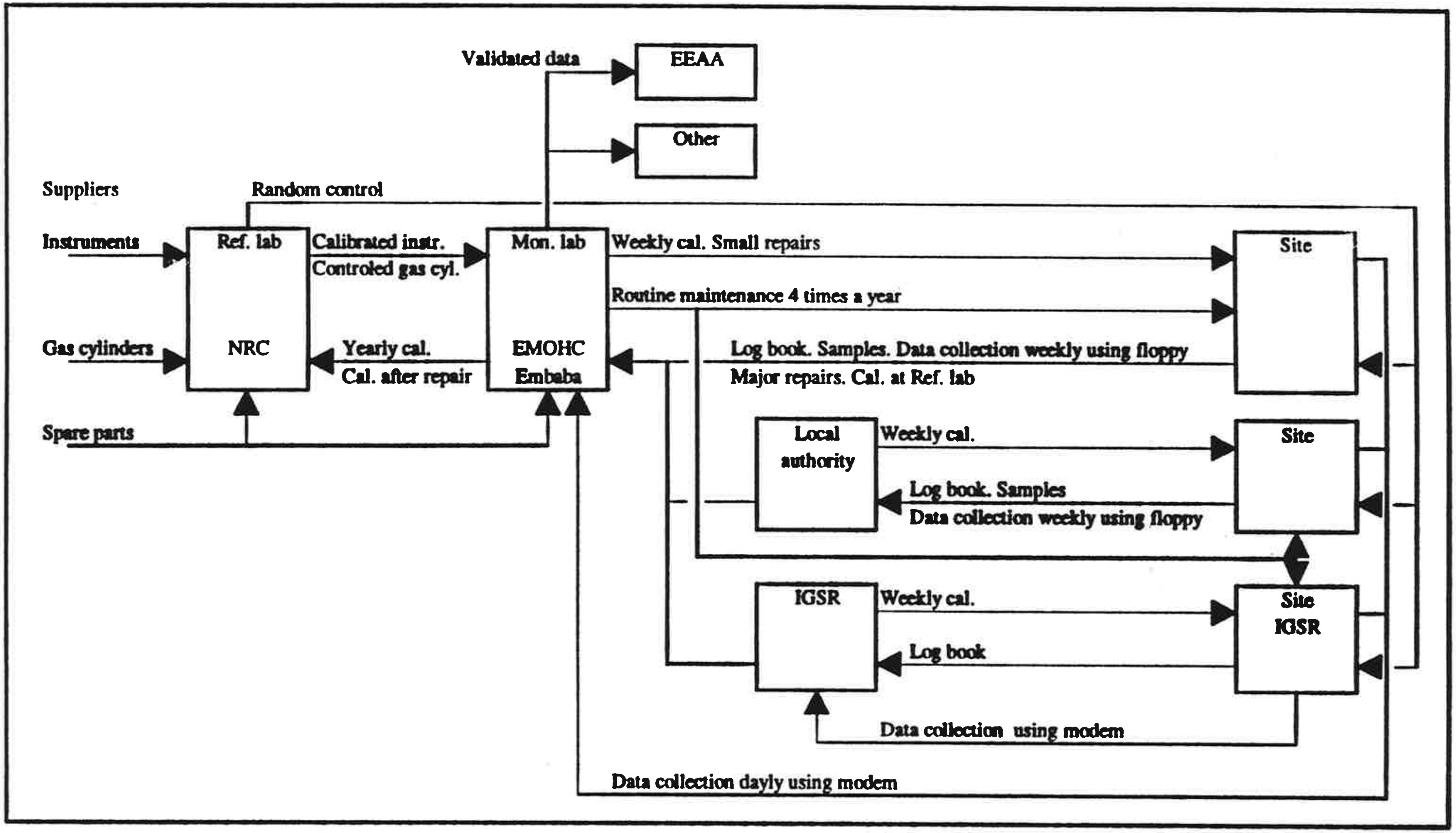
*) Personell will be assigned to specific sites / instruments
NN To be appointed

B.SIVERTSEN: EIMP.PPT slide 8

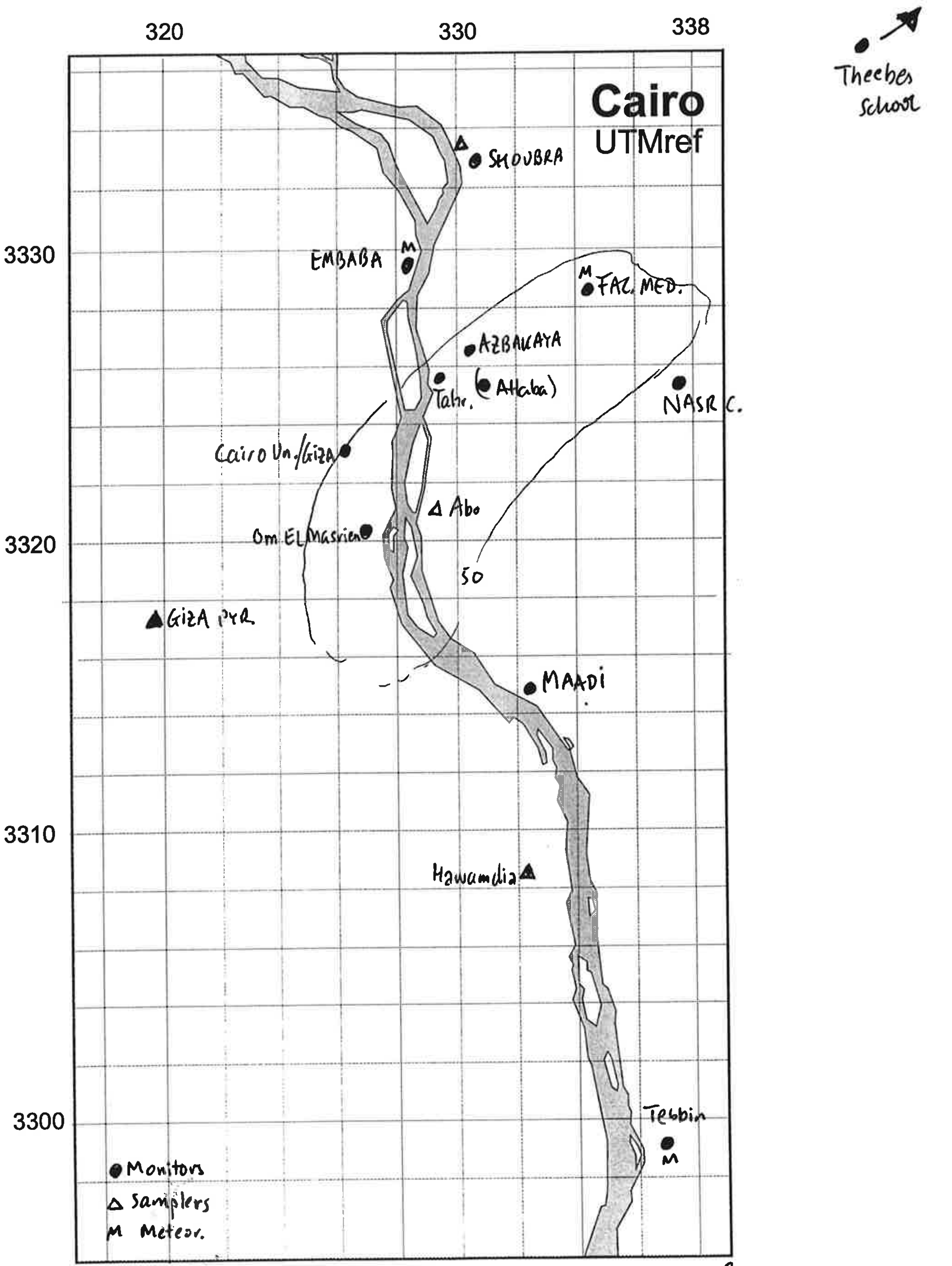
EIMP Environmental Information and Monitoring Programme NILU

Air Quality Management Data Flow Sheet





Air quality management QA/QC and data collection procedures



PROPOSED SITES CAIRO.

Appendix D

Note from Dr. Mohamed Nasar

EIMP

Note

Subject	**Air Quality Monitoring Programme**
Date	**11 Nov 1996**
To	**Jan Hassing**
Copy	**Bjarne Sivertsen**
From	**Mohamed Nassar**

Environmental Information and Monitoring Programme

EEAA - Danida - COWI

3, Abdel Aziz Selim Street
Mohandessin, Cairo, Egypt

Tel.: +202 361 5085
Fax: +202 361 5085

E-mail: eimp@intouch.com

Air Quality Monitoring Programme, tasks and duties given by B.Sivertsen during Oct - Nov. 1996

- I have familiarized myself with Air Quality Monitoring programme, organisation chart, job description, data collection scheme and description of data flow.Two boxes should be added to data flow chart one for TIMS and the other for Meteorological Authority .

- 22 October 1996

  A meeting was arranged with Dr. Mokhtar Hamza at El Dokki Institute to discuss the possibilities for cooperation between EEAA and Atomic Energy.
  Dr. Hamza was positive to cooperate with us. We succeeded to find a reasonable mean for this cooperation .

  I was invited to visit the AEA in Nasr City on 6 Nov. I was shown the multi gas monitoring station . A container contain :

  Thermo Environmental equipment for O3 monitor, Co analyser, SO2 analyser, NO - NO2 - NOx analyser , THC analyser and data logger, gas calibrator, zero air supplier, Hydrogen generator .
  There are three complete station of this kind , we suggest to locate one at El Tabbin. Highly polluted area (industrial area)
  The second at the Egyptian museum in El Tahrir square - City Center
  The third at industrial area in Shubra El Kheima - North Cairo.

  No telephone line until now but there is an agreement for 45 line in the future in addition to these three station there is one station in El Dakhla district - South West Egypt as a background site, which contain single gas analyser .

  They have also 10 station spread over Egypt with single gas analyser. We suggest that EEAA complete these station by EIMP equipment or by payment to AEA .

I will visit Dr. Hamza on 12 Nov to complete our discussion about personnel and format for sub-contract between EEAA and AEA.

- An agreement between EEAA and meteorological authority was discussed with Dr. Salah Abdel Hamid. The meteorological authority have six air quality monitoring stations spread over Egypt - one of these are located in Cairo at M.A a few hundred meters north Ein Shams university (E M O H C site) near El Abbasia Center.

  An important site is located at Hurghada, this site is considered a background site for Egypt.

  Dr Salah was interested in exchanging data between M.A air quality station and EIMP air quality stations and EIMP air quality monitoring programme in addition to meteorological and climatological data.

  A visit to M.A was arranged on 24 Nov for me and Bjarne Sivertsen.

- Ozone be measured at Giza Pyramid beside SO2, NO-NO2-NOx, BS measurements but not as background site.

- Building and construction can't start before contract or payment for Authorities also I prefer after the first working group meeting on 21 Nov.

- As of Nov 9 I am still waiting for my contract with EEAA

Appendix E

Task and duties

EIMP

Environmental Information
and Monitoring Programme
3 Abdil Aziz Selim street
Mohandessin, Cairo, Egypt
Tel/Fax: +20 2 361 5085

Note

To: Dr. Mohamed Nasar
Copy: Jan Hassing
From Bjarne Sivertsen
Date: 27 November1996

Air Quality Monitoring Programme, Tasks and duties , Updated November 1996

As the EEAA counterpart for the EIMP air quality monitoring programme task manager, there are several tasks and duties that have to be undertaken during the next few months.

The following list should be considered a check list for tasks that have to be fulfilled before the monitoring programme is being installed and the training can start in Egypt. The list is not organised in any priority.

- Consider the personnel sitiation at Embaba (Monitoring Laboratory). Use the simplified CV questionnair. Who will fulfil requirements?, -What new personnel is needed? can these be obtained? (at what price?)
- Start the process advertising for new relevant experts. The 4 experts identified in the Activity plan for 1997 have to be available as soon as possible (before the start up of phase 2).
- Discuss and develop agreements (included annual financial support) between EEAA and Monitoring Institutions. The final agreement will be developed with the Monitoring laboratory at Embaba. This work is expected to be fulfilled and contracts should be available for signing before the end of 1996!
- From the evaluation of the procurement document on air quality instrumentation, can you identify missing items that should be included specificly for egypt?.
- Follow up meeting with Meteorological Authority concerning:
  Climatological survey of data to be available in December?
  Status of 60 m tower north east of Cairo,
  List of meteorlogical stations in Egypt,
  Which sites can be used for air quality, and what does it require?

- Prepare building and construction work at different sites:

1. **Embaba,** sampling room at roof; a wall with a door that can be locked has to be built on the roof top room. Telephone line and power has to be made available in the room.
2. Two rooms identified as a computer room and as a repair/storage room in the Embaba laboratory building have to cleaned and clarified before the end of February 1997.
3. **Samoha, Alexandria**, at the health office roof room; a new roof and some improvements have to be undertaken at the office to be used for the sampling station.
4. At the **Emergency station El-Saaf, Alexandria**, a shelter has to be constructed at the roof of the building closest to the road. A sketch has been made of the layout..
5. At the site in **El-Max area**, Alexandria west, a wall has to be constructed (with a door that can be locked) in the northern room at the roof level. Intakes for SO_2 through the wall and PM_{10} through the roof has to be prepared.
6. **At Abu el-Darda , Alexandria**,. the steep ladder makes the access to the roof difficult, and this should be replaced by a better stair leading to the roof from inside the building backyard. A shelter/container can be lifted to the 3 m high roof of the security room at the entrance. This roof has to be prepared with a ladder.
7. **At Tebbin institute:**
   Prepare the small room at the roof of the Tebbin Instirute. Clean- door - close windows- air.con. - intake for gas samples and PM_{10} samples. The room need telephone and power.At the flat roof of the Tebbin institute there is a small house made of concrete (former toilet?).

   This room seems to be well suited for an air quality monitoring site. The entrance to the house is from the roof. The house includes three rooms of which two have small windows. A brick table in the largest room inside the entrance can be refurnished to hold a working bench.

   The rooms must ble cleaned. The water closets must be removed and the holes in the floor must be closed. The windows must be shut and a door with lock must be installed. A new table (not concrete) 80 cm deep must be built along the wall on top of the existing concrete table.

   An air condition must be installed in the first room through the western wall but not above the table. Openings between the walls and the roof must be closed. Power and light must be installed in all three rooms. Telephone lines must be made available in one room.

   The meteorological mast must be placed in the middle of the flat roof. It can be connected directly to the data logger in the shelter by electrical cables. The power supply to the room must contain a minimum of two 16 Ampere supply lines each with its own separate switch breakers.

8: At Attaba:

At the top of the stairs next to the exit to the flat roof there was an open space of approx. 3 m^2 (150 x 200 cm). There where a window on one wall. The height of the room was approx. 3 m and around the roof top there was a 0.5 m high wall. The walls and the roof where made of thick concrete. The area is suitable for housing a station.

Three walls must be built to close the room, one towards the stairs, one towards the floor at the top of the stairs and one wall towards the door. The exit to the roof must not be blocked. Electrical power must be supplied to the room (minimum two 16 Ampere supply lines each with its own separate switch breakers). An air condition must be installed. The window must be made impossible to open. Holes must be drilled through wall and roof as necessary.

9: At Azbakeya

Two doors situated in 40 cm deep recesses where leading to a small balcony (approx. 1 m wide) outside the room. The right half of the balcony was filled with rubbish. A small room for instrumentation could be built in front of the right balcony door inside the office.

Two walls extending from each side of the right recess into the room must be built so that the total depth of the recess becomes 90 cm. The front of the recess must be closed using two doors. The doors must have a lock. The walls and doors must be 2 m high. An air condition must be installed. Electrical power must be supplied to the room (minimum two 16 Ampere supply lines each with its own separate switch breakers). The PM_{10} monitor can be placed on the balcony. The rubbish on the balcony must be removed.

For future changes concerning any construction work or rebuilding allowance and contracts has to be prepared with the ownert of the building, which was told to not be the Ministry of Health or local health authorities.

The EIMP air quality team leader and monitoring expert will be back in Cairo when instruments and personnel are available in Cairo. In the time schedule we have indicated March 1997, at which time we would hope to start installing monitors. This work will start at Reference Lab. (NRC).
Check that rooms and laboratories are available here, and that also adequate personnel are available. I consider at the moment 3 experts adequate for the operations to be undertaken by RefLab Air.

Appendix F

Siting study

Air quality monitoring network
Site visit report

Site **Name:Theebes language school, Ismailia road**
Co-ordinates:. UTM: 354 788 , 3338 680

Access/ availability: Very easy to get to along the Ismailia road about 7 km north-east of Salem City and about 2 km west of Horabi.. There are plenty of parking space available.

Buildings and rooms available: The monitoring site is proposed at the roof of the 3 storey building located about 300 m from the road (upwind). Walls have to be built at the top of the stair case to make this a nice room.. A similar solution has already been constructed at another stairway on the opposite side of the building.

Area description: Background area close to the desert. The roof site will represent an open type background area normally up-wind from Cairo. Some fine dust might be expected blown from the dessert.

Local sources: None, the traffic along Ismailia road is down-wind and far away.

Representativity: Representative for the regional scale background impact

Parameters to be measured in the future:, Ozone, SO_2 , PM_{10} ? (TSP?).

Infrastructure: Power: 220 V available at the roof.
Telephone lines: New line has to be installed .
Sampler/monitor locations: In the room.
. **Air intake**: About 2 m above the roof, 12 m above the ground.

Personnel: The discussions were with Dr Arfifa and Adm. Dir. Imad ElKhadi, who agreed that we could establish the site at the school Dr Nasar will be responsible for obtaining formal permissions..

Air quality monitoring network
Site visit report

Site **Name:Om ElMasrien**
Coordinates:. UTM: 327239, 3320746

Access/ availability: Easy to get through the gate to the hospital, where there are parking space available.

Buildings and rooms available: The hospital has several lnice buildings that could be suited for location of a monitoring station. We propose that the monitors and samplers will be located in a room on the roof of a 5 storey building, about 25 m above the ground. The room was locked and has to be renovated, but will be very well suited for the purpose.

Area description: Residential area. Roof site open area. Impacted on regional scale down-wind from Cairo city.

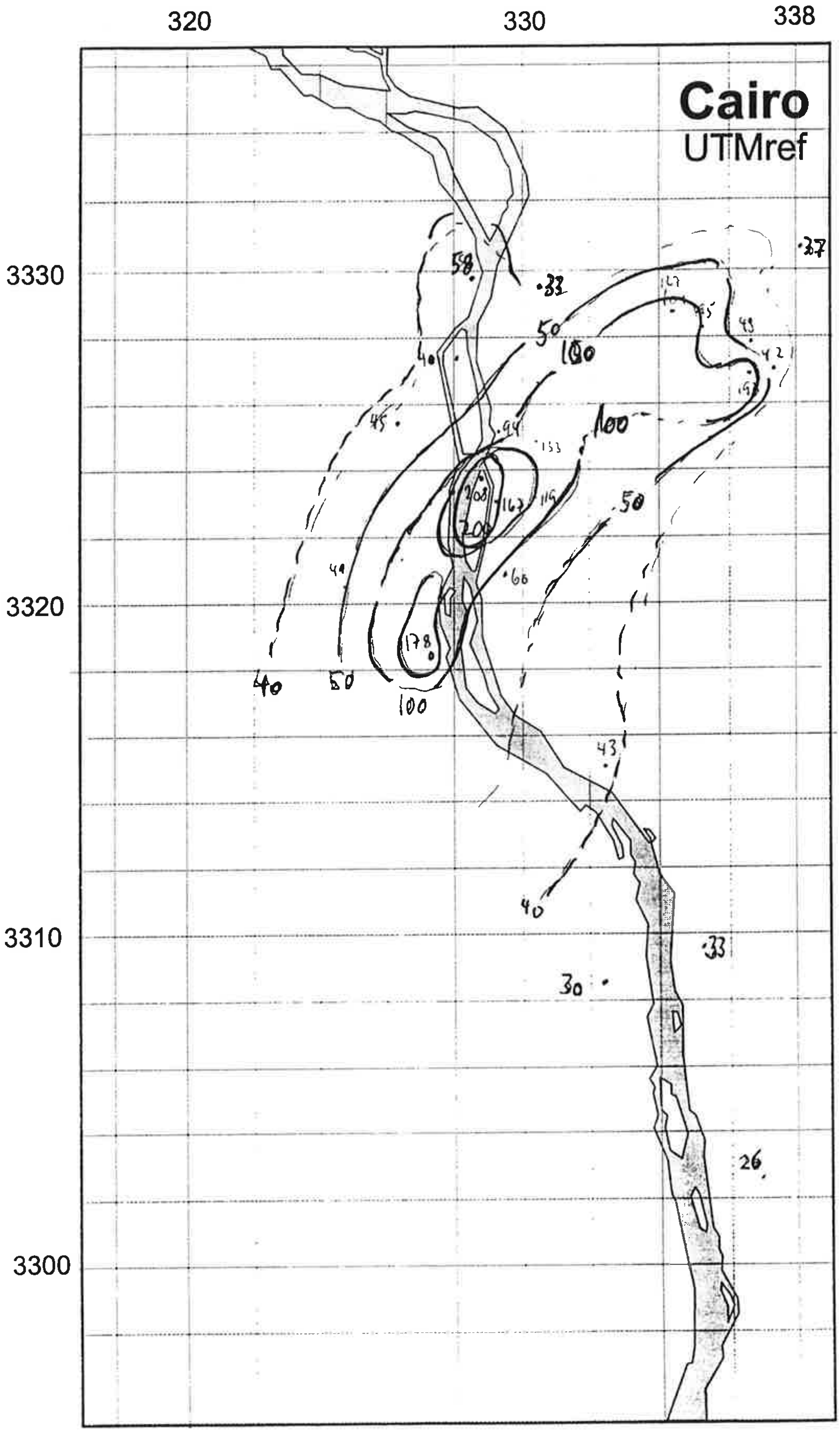
Local sources: Mostly traffic along al Rabi-al Gizi (SalahSalem) street 100 m west of the site. Regional impact down-wind from the city of Cairo..

Representativity: Representative for the kilometre scale regional impact in a residential area..

Parameters to be measured in the future: SO_2 , Ozone, PM_{10} (TSP?).

Infrastructure: Power: 220 V available in the room and at the roof.
Telephone lines: New line has to be installed .
Sampler/monitor locations: In the room.
. **Air intake**: About 2 m above the roof, 25 m above the ground.

Personnel: The discussions were with Dr Makram Goma, who agreed that we could establish the site at the hospital Dr Nasar will be responsible for obtaining formal permissions..



SO_2 concentr.
7-14 June 1996

Passive NILU samplers.

($\mu g/m^3$ SO_2)

EIMP

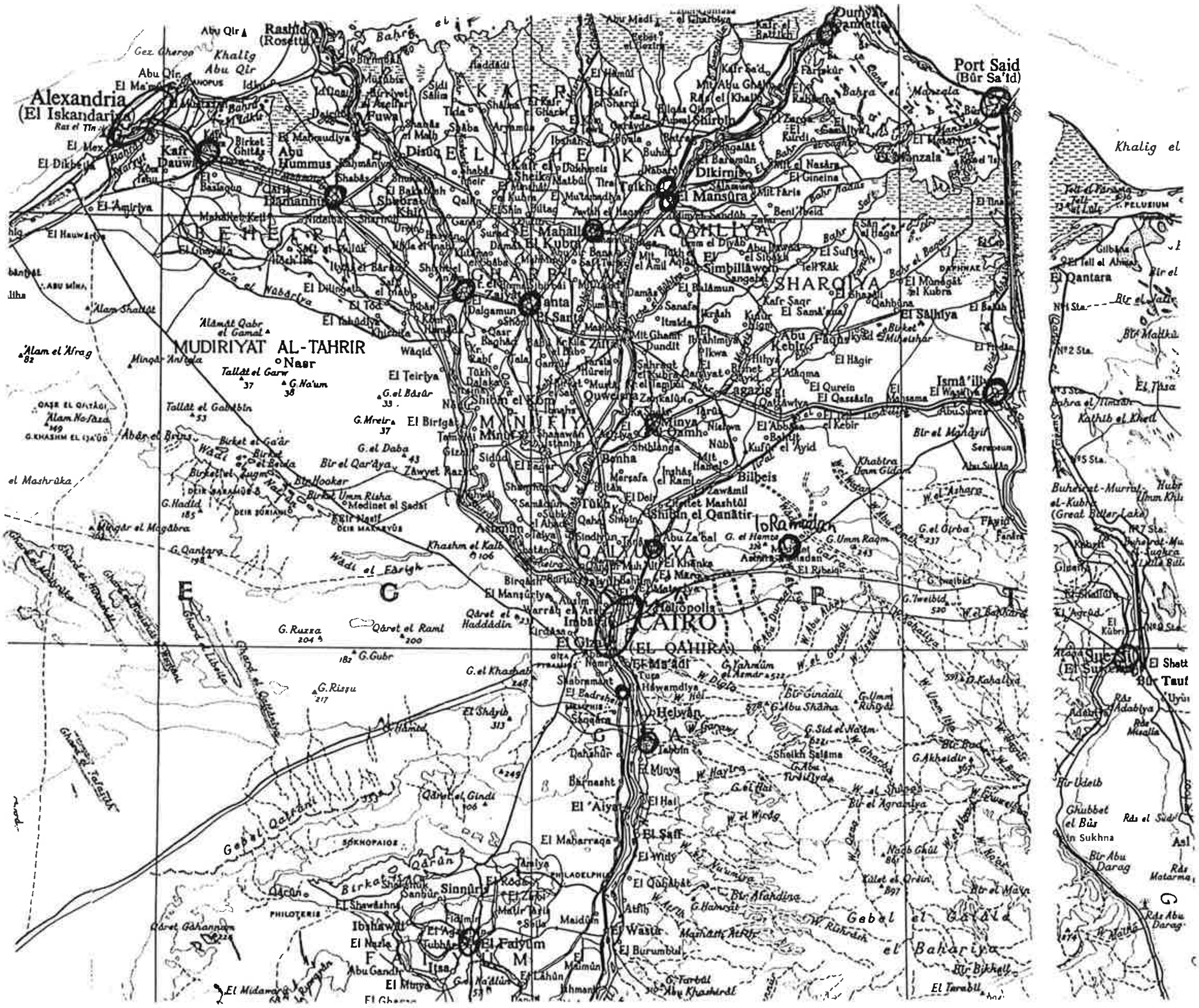
**Environmental Information
and Monitoring Programme
3 Abdil Aziz Selim street
Mohandessin, Cairo, Egypt
Tel/Fax: +20 2 361 5085**

Air quality measurement sites in greater Cairo

Name	Area type	UTM coordinates X	Y	Parameters	Instrument	Comm.
Azbakaya	Street canyon	330,5	3326,62	NOx,CO,NMHC, PM10	Gas monitors, Hivol	
Embaba	Residential	328,73	3329,25	NOx, SO2, O3, PM10, dustfall, meteorology	Gas monitors, hivol, bucket, AWS	
Embaba road	Road side	328,74	3329,25	NOx, CO, NMHC, PM_{10}	Gas monitors, Hivol	
Tahrir square	Urban centre	329,3	3325,3	NOx, SO2, O3, NMHC, TSP, PM_{10}	gas monitors, hivol	AEC
Fac. Medicine	Urban/ residential	334,0	3329,25	NOx, SO2, TSP, PM10?, meteorolgy	gas monitors, hivol, AWS	
Nasr City	Residential	337,8	3327,45	NOx, SO2, PM10/TSP	gas monitors, hivol	
Shoubra el K.	Industrial	331,?	3333,?	SO2, NOx, PM10/TSP, dustfall, (VOC?)	gas monitors, hivol, dustfall bucket	
Maadi	Residential	332,4	3315,15	SO2, NOx, PM_{10}	gas monitors, hivol	
Tebbin	Industrial	337,2	3395,26	SO2, PM10, TSP, dustfall, meteorology	gas monitors, hivol, bucket, AWS	
Giza, C.Univ.	Residential	326,6	3323,2	SO2, NOx, O3	gas monitors	Cairo Universit
OmElMasrien	Residential	327,23	3320,74	SO2, PM10/TSP, O3	gas monitors, hivol	
Theebes lang. school	Background	354,79	3338,67	SO2, O3, PM_{10}	gas monitors, hivol	
Giza pyramids	*impact?*	*319,9*	*3317,5*	*SO2, NO2, BS/TSP*	*Sequental Samplers*	*weekly*
Abo elSaaoud	*Residential*	*329,20*	*3321,85*	*SO2, BS*	*Seq.sampler*	*weekly*
Hawamdia	*Residential*	*332,37*	*3308,56*	*SO2, BS, TSP*	*Seq.samplers*	*weekly*
Shoubra west	*Industrial*	*330,5*	*3333,40*	*SO2, BS,*	*Seq.sampler*	*weekly*

EIMP

Possible measurement sites for Air Quality Monitoring in Egypt



Appendix G

Example: Memo of understanding and basic training

a) **First draft to establish a service contract with institutions to be used by EIMP.**

b) **Training with objectives**

EIMP

Note

Memorandum of Understanding

Subject Intent to establish a service contract for a point sources monitoring pilot project

Date 17 Nov 1996

Environmental Information and Monitoring Programme

EEAA - Danida - COWI

3, Abdel Aziz Selim Street
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E-mail: eimp@intouch.com

1 Introduction

EEAA is implementing an Environmental Information and Monitoring Programme (EIMP) in cooperation with Danish International Development Assistance (Danida). The programme aims to improve the knowledge of the state of the environment and of sources and impacts of pollution, and to enable EEAA to develop a more efficient and cost-effective pollution control strategy, and to coordinate environmental interventions. The five-year programme comprises five major components:

- Institutional support to EEAA regarding data management and interpretation
- Coastal water monitoring
- Ambient air pollution monitoring
- Pollution source database with a point source monitoring pilot project
- Reference laboratory for standardisation and quality assurance

Various competent organisations will be contracted to do the monitoring work and the quality assurance work. The Tabbin Institute for Metallurgical Studies (TIMS) has been selected as the main contractor for the point source monitoring pilot project.

2 Purpose of the Memorandum of Understanding (MOU)

This MOU constitutes a mutual commitment by the TIMS and EEAA to enter into a contract covering data collection, analyses, calculations and interpretation and data transfer, with TIMS as the consultant and EEAA as the client. It further constitutes an acceptance by both parties of the contract format and the outline of Scope of Services, personnel, equipment, facilities to be provided by the Consultant and the equipment and services of others to be provided by the Client. In addition, the principles of payment for the services are included.

3 Issues agreed upon

The parties agree that:

- Part I - Standard Conditions and Part II - Conditions of Particular Application constitutes a framework contract applicable to the relation between the Client (EEAA) and the Consultant (TIMS)

- Appendix A - Scope of Services; is a suitable outline of the services to be delivered, with the understanding that a detailing of this outline shall be made and discussed between the two parties. The outline comprises contact with plant managers to obtain permission to conduct monitoring, provision or sub-contracting of industrial engineering specialists, field data collection and sampling, laboratory analysis of samples, storage and quality control of primary data, certain engineering calculations and estimates, data reduction, storage of secondary data and quality control, transfer of primary and secondary data to EEAA, record keeping and reporting, management and administration, facilities and equipment to be provided by the consultant and additional work

- Appendix B - Personnel, equipment, facilities and services of others to be provided by the Client; is a suitable outline of the items to be provided by the client and a detailing of this outline shall be made and discussed between the two parties

- Appendix C - Payments; is a suitable outline of the principles of payment for the services rendered by the Consultant. The outline shall be detailed and discussed between the two parties. The remuneration will be performance based and take into account physical, measurable progress and unit rates. Professional personnel can be invoiced according to hours worked and lump sums will cover management and administration. The payment schedule will comprise an advance payment and quarterly adjustments and is based on quarterly invoices accompanied by progress reports. A final annual payment will be made upon receipt of a final annual report and dataset.

Agreed date ....

S. Khalil

....

Professor Dr Saied Khalil, TIMS

S. Hafez.

....

Dr Salah Hafez, CEO EEAA

TO: Douglas Clark EIMP
FROM: M G BLACKBURN EETP
DATE: 18 November 1996
SUBJECT: Monitoring Training

Attached is an explanatory note about writing training objectives. Please pass a copy to all the EIMP staff who are involved in preparing training objectives.

Thanks.

M G BLACKBURN

copy to: Jan
Jacob
Bjarne
Arne
Ulla

SYSTEMATIC TRAINING WITH OBJECTIVES

In the systematic method your technical and vocational training procedure is quite simple:

(A) set a realistic objective which your participants can achieve in the time available,
(B) show your participants how to achieve that objective,
(C) get the participants doing it by themselves,
(D) Note 'objective achieved' when you observe the participants doing it right.

Some very simple objectives could be: CALCULATE a cost; SCHEDULE some maintenance; PLAN a process; WRITE a report; MEASURE a pH value.

Simple objectives like these state what the participant will be able to do after training that he could not do before training.

But the objective - measure a pH value - is not enough. You need to state under what condition the participant will achieve this objective and to what standard.

Given a pH meter and a sample of river water measure the pH value without error.

Now we have: **task** - measure a pH value; **condition** - using a pH meter; **standard** - without error.

Another example: Calculate the area of a regular plot of land to the nearest square metre given a plan with dimensions and an electronic calculator.

Here we have: **task** - calculate a regular area; **condition** - given a plan with dimensions and a calculator; **standard** - without error to the nearest square metre.

Once you have set an objective like this show your participants how to do it and get them doing it.

Take the last example. You show your participants how to calculate the area of some typical regular plots - land plots shaped like rectangles and triangles. Do a few examples. Then get them doing it. Get them practising making sure that they do the calculations without error and use the calculator correctly. When you are sure they can do this - you see them doing this correctly - you can state that the objective has been achieved.You have now measured your training effectiveness and you have checked the performance of the participant against that in the objective.

The result of a performance check will be either: the participant has achieved the objective or the participant needs more training. Note that there is no mention of testing, no talk of 'pass' or 'fail' and no grade issued. So there is no half-way; no almost qualified; no 40% passmark; in short - no uncertainty. When the participant achieves the objective the participant can do the job, the participant has proved it and the employer can rely on the participant's performance at work.

Appendix H

Plans for Phase 2

4. Air Pollution Monitoring

4.1. Revised logical framework matrix for Phase 2

The LFA matrix for the air pollution monitoring component is presented below as Exhibit 4.1

Exhibit 4.1 - Revised LFA for air pollution monitoring

Outputs for air pollution monitoring component, Phase 2:				
Project Document		Extended Description		Verifiable Indicators
		A.	**Institutional support and co-ordination**	
1	Egyptian Environmental Monitoring Committee and related working group are established	A.1	Working group meetings held	
2	Monitoring institution contracted by EEAA	A.2	Contract between EEAA and monitoring institution	
		B.	**Design of monitoring programme**	
4	Monitoring sites selected			
5	Logistics for sampling procedures worked out	B.1	Existing monitoring stations and data evaluated	
		B.2	Monitoring programme designed	
		C.	**Procurement of equipment, hardware and software**	
3	Monitoring institution equipped with necessary new instruments and existing equipment for the programme is tested	C.1	Equipment, hardware and software specified	
		C.2	Monitoring equipment procured and installed	

		D.	**Data management**	
		D.1	Data management system designed	
		D.2	Local data bases at Monitoring Laboratory	
		E.	**Training**	
3	Staff from Monitoring Laboratory and and assistaants from Governorates are trained in logistics, sampling preliminary QA/QC and reprots of data	E.1	Training needs assessed for Phase 2	
		E.2	Programme prepared	
		E.3	Training in prerequisite skills	
		E.4	Training seminar	
		F	**QA/QC**	
		F.1	QA/QC personnel at monitoring institution identified	
		F.2	Standard operations procedures (SOPs) and QA/QC manuals prepared	
		F.3	On the job QC/QA training procedures	
		G.	**Monitoring**	
		G.1	Plans for 1998	
1	Monitoring data are encoded and transferred to EEAA	G.2	Monitoring programme	
2	Sites to be monitored each year are monitored for the first time	G.3	New monitoring stations installed	
		G.4	Data evaluation	
		H.	**Reference Laboratory**	
		H.1	Support installation of monitors at Reference Laboratory.	
		H.2	Support training for Reference Laboratory. personnel	

Exhibit 4.1 - Revised LFA for air pollution monitoring (continued)

Activities for air pollution monitoring component, Phase 2				
Project Document		**Extended Description**		**Verifiable Indicators**
		A.	**Institutional support and co-ordination**	
1	Appointment of members for EEMC and working groups	A.1.1	Air pollution monitoring working group (APMWG)	• Minutes of meeting
2	Contract negociations/appointment of monitoring unit	A.2.1	Assist in technical input to contract with monitoring lab	
		A.2.2	Assist in describing work functions for new experts	• On the job definitions
		B.	**Design of monitoring programme**	
		B.1.1	Evaluate existing measurement sites	• Site description report
3.1	Build up of sampling and analytical units by combination of new equipment and existing equipment at monitoring institution.	B.2.1	Select representative monitoring sites for air quality measurements on all scales, work continued outside Cairo and Alex.	• Site description report
		B.2.2	Define site characteristics	
		B.2.3	Assess emission sources in co-operation with point source database component	• Report on important sources
		B.2.5	Select sites for meteorological measurements at some of the AQ sites	• Monitoring programme report
		B.2.6	Specify meteorological parameters	
		B.2.7	Use of existing equipment	
4	Contracting areas for monitoring sites	B.2.8	Establish contracts/ agreements with monitoring site owners	• Contracts available

	C. Procurement of equipment, hardware and software C.1.1 Evaluate existing equipment C.1.3 Assist equipment specification for the reference laboratory C.2.1 Procure instruments and equipment C.2.2. Prepare instruments for installation	• Instruments available
1.1 Establishment of communication lines and data transfer. Transferring data	**D. Data Management** D.1.1 Specify data collection and data transfer D.1.2 Specify data retrieval and local data base at Monitoring Laboratory D.1.3 Specify data quality check and control procedures D.1.4 Identify sources for supplementary data D.2.1 Prepare database for manual analysed data from sequential and hivol samplers D.2.2. Establish local databases for monitors at Monitoring Laboratory	• Specification report • Report and manuals • Manuals Mission Report • Data base at Monitoring Laboratory • Local database available
1.2 Training of EEAA staff on interpreting and reporting data 3 Training of staff from monitoring institutions	**E. Training** E.1.1 Assess training needs for Phase 2 E.2.1 Prepare on-the-job training E.2.2 Prepare training programme for instrument maintenance, calibration and data collection E.2.3 On-the-job training at Reference Laboratory and on Monitoring Laboratory E.2.4 Support training to Reference Laboratory E.3.1 Training in English and computer applications E.4.1 Training seminar	• Training plan • Training programmes and preliminary schedules described. • Training on its way • Certificate of participation

	F QA/QC	
	F.1.2 Appoint QA/QC responsible officer	QA officer appointed
	F.2.1 Specify instrument calibration procedures	• Manuals
	F.2.2 Design quality control and quality assurance proce-dures at Monitoring Laboratory	• Manuals
	F.2.3 Establish Standard Operational Procedures (SOP) as part of QA/QC	• Written SOPs •
	F.3.1 QC and calibration routines as part of on-the-job training	• Quality check schemes developed and used
	G. Monitoring	
5 Detail planning of practical monitoring schedule	G.1.1 Prepare work plan for 1998 activities	• Report with work plan for 1998
	G.2.1 Specify sampling programme procedures	
	G.2.2 Specify monitoring programme procedures	• Monitoring programme
	G.2.3 Start monitoring programme and data retrieval	• First data collected, evaluated and reported
2 Monitoring permanent sites	G.3.1 Establish monitoring station infrastructures in Cairo and Alex	• Monitoring stations prepared
6 Gathering of existing ambiant air data	G.3.2 Establish the first monitors in Cairo and Alexandria	
	G.4.1 Data retrieval and data evaluation	• First data report
	G.4.2 Data presentation	
	H. Reference Laboratory	
	H.1.1 Installation of monitors at Reference Laboratory	
	H.1.2 Calibration of monitors initiated	• Calibration certificates
	H.2.1 Training of Reference Laboratory personnel in use of monitors and calibration	• Reference Laboratory experts trained

1.1 A. Institutional support and co-ordination

1.1.1 Activity A.1.1 Air Pollution Monitoring Working Group (APMWG)

The first working group meeting was held in October 1996.

The participants in the working group represent EEAA, the various monitoring institutions and EIMP (Team Leader and Air Pollution Task Manager Counterpart).

Further working group meetings will be held when the first instrumentation has been installed and the training has started at the Reference Laboratory and at the Monitoring Laboratory

1.1.2 Activity A.2.1 Assist in preparation of technical basis for contract with air pollution monitoring laboratory

A contract specifying the duties and responsibilities of EMOHC (Environmental Monitoring and Occupational Health Centre) as monitoring institution is being established at the end of Phase 1. The air pollution monitoring counterpart at EEAA will negotiate the contract as well as discuss the continuous adjustment of activities and needs of personnel and equipment included necessary annual finances.

Discussions of details concerning the duties and responsibilities of the Monitoring Institution's functions will be held, and the support of relevant expertise to the monitoring laboratory will be discussed.

1.1.3 Activity A.2.2 Assist in describing work functions for new experts

In addition to the earlier prepared job descriptions,the work to be undertaken by the new experts to be engaged by the monitoring institution will be described. A discussion of these functions will represent the input to finding these experts, which are not available at the EMOHC laboratory at present.

1.2 B. Design of monitoring programme

1.2.1 Activity B.1.1 Evaluate existing measurement sites

Existing measurement sites outside Cairo and Alexandria will be visited and evaluated in the same way as all sites in the two cities were evaluated during Phase 1.

Site visits will be paid to all potential measurement sites in the delta and at some locations in upper Egypt. The results of these evaluations will be presented in siting reports.

1.2.2 Activity B.2.1 Select representative monitoring sites for air quality measurements

The monitoring sites for the future national air quality monitoring programme will be selected based upon available information on:

- monitoring objectives,
- meteorological conditions, prevailing winds,
- existing air quality data,
- major air pollution sources

The measurement sites outside Cairo and Alexandria also will have to cover different scales of pollution.

To evaluate the representativeness of monitoring sites, it may be necessary to perform some simple field studies using inexpensive passive samplers. Site description reports will be presented.

1.2.3 Activity B.2.2 Define site characteristics

For each monitoring site the surrounding area, local sources and possible impacts will be described. The sites will be characterised according to standard reporting procedures as:

- road or street canyon
- urban scale area, average type
- industrial area,
- residential area,
- background area.

The site descriptions will be followed by local maps, co-ordinate specifications and photos where available. A site description report will be made.

1.2.4 Activity B.2.3 Assess emission sources in co-operation with point source database component.

As part of the site selection procedure, the air pollution sources in vicinity of the monitoring areas will be assessed. The source types, emission rates and stack heights will be considered where adequate information is available. The information will be reported as part of the site description report with a judgement of prevailing wind directions.

1.2.5 Activity B.2.5 Select sites for meteorological measurements

Meteorological data on an hourly basis will be needed to interpret the air quality data collected. Wind speeds, wind directions and atmospheric turbulence (stability conditions) are the most important parameters to explain the relationship between the air pollution sources and air quality. These data are essential to understand the pollution impact.

As part of the air quality monitoring programme a few automatic weather stations (AWS) will be established at representative air quality monitoring sites.

1.2.6 Activity B.2.6 Specify meteorological parameters

A few typical parameters have to be included in the meteorological measurement programme. These are typically:

- wind speed and wind direction,
- temperature at different levels along a 10 m high mast,
- stability; measured as the vertical temperature difference, or estimated from temperature and wind speeds,
- relative humidity.

The final specification prepared during the first Phase will be reported in the monitoring programme report.

1.2.7 Activity B.2.7 Use of existing equipment

Some of the air quality equipment in use in Egypt at present can be used in the future national monitoring programme. The status and quality of this equipment has to be evaluated and checked. These tasks will be undertaken in co-operation with experts at the reference laboratory. The monitoring stations operated by Atomic Energy Agency (AEA) will be visited, and some of the stations may be included in the EIMP programme.

A list of existing equipment to be used in the future programme will be prepared . The need for upgrading, repair and controls will be evaluated.

1.2.8 Activity B.2.8 Establish contracts/agreements with monitoring site owners

It will be necessary to establish formal agreements with the site owners about the use of their sites. This work will start at the beginning of Phase 2. The EEAA counterpart has taken the responsibility of contacting all site owners. A letter to the site owners describing the programme will be developed.

1.3 C. Procurement of equipment, hardware and software

1.3.1 Activity C.1.1 Evaluate existing equipment

The possible use of existing equipment will be based upon a quality control and quality assurance evaluation performed in co-operation with the reference laboratory experts as described under Activity B.2.7

1.3.2 Activity C.1.3 Assist equipment specification for the reference laboratory

Long term calibration, proficiency tests, quality assurance, audits and comparisons with standards will be the responsibility of the reference laboratory and will be specified in a QA manual. The reference laboratory will thus need some input from the air quality monitoring experts concerning the equipment used and the needs for QA and basic calibration of the monitoring systems.

All new gas monitors will be duplicated at the air pollution monitoring laboratory and at the reference laboratory. The first installations and training will be undertaken at the reference laboratory based upon the specifications given.

1.3.3 Activity C.2.1 Procure instruments and equipment

The technical evaluation of the last air quality monitoring equipment will have to be undertaken in Phase 2 of the programme

An evaluation of service arrangements proposed by the tenders for equipment will be an important feature in evaluation of offers. Equipment procured will be checked and calibrated upon arrival in Egypt.

1.3.4 Activity C.2.2 Prepare instruments for installation

All instruments arrived at the Monitoring Laboratory will be checked and verified before installation. Support from the reference laboratory is expected, and all monitors will have to be calibrated at the Reference Laboratory prior to use in the field.

1.4 D. Data management

1.4.1 Activity D.1.1 Specify data collection and data transfer

Different types of data will be collected by the monitoring programme. The first specification of the data collection procedures were developed in Phase 1. Further specifications of the various forms of data collection procedures will be established in Phase 2.

For air quality data sampling and analyses by semi-automatic samplers the collection procedures will contain:

- laboratory preparation procedures,
- sampling frequency/ sampling time specifications,
- field work; change of sampling units,
- identification, transfer to laboratory,
- sample preparation and storage.

At air quality monitoring stations each site will be equipped with a data logger unit. Depending upon the instruments that will be selected, the data are read as analogue data or digitally. Hourly average data will be transferred as raw data via modem and telephone lines (or by radio) to the central computer unit, or in the beginning collected on floppy disks.

1.4.2 Activity D.1.2 Specify data retrieval and local data base at Monitoring Laboratory

Details concerning specifications of data scaling, data storage, data quality control etc. will be established when technical manuals of the equipment to be used are available. Specifications will be developed and collected in a specification report or in manuals.

Training of expert personnel for this operation at the data retrieval computer will be important, and will be undertaken as an on-the-job effort together with an adviser. Routine control of all data retrieved is essential on an every day basis.

1.4.3 Activity D.1.3 Specify data quality check and control procedures

Data quality controls apply both to the automatic monitoring data and to semi automatic and manually collected data.

An initial description of the quality control procedures was prepared during Phase 1. The Monitoring Laboratory at EMOHC will be equipped with reference gases obtained from the reference laboratory. Graphical and statistical software to perform daily controls will be supported by the suppliers local representatives.

The technical tools will be supported by quality control descriptions , manuals and reporting procedures. Log books will have to be established for each instrument. The laboratory routine data monitoring, retrieval ,storage and quality control will start as soon as the first instruments are installed in the Reference Laboratory and further when the instrument park at the Monitoring Laboratory is installed. The training here will include all participating air quality data collectinginstitutions as on-the job training.

Manuals and reporting procedures for collected samples analysed in the analytical lab will be developed. This development will take place in close co-operation with the Reference Laboratory experts. This work will also be done as an on-the-job training effort, and will also make use of parallel analyses with the Reference Laboratory.

1.4.4 Activity D.1.4 Identify sources for supplementary data

In Phase 1 a lmited amount of existing data have been collected and studied. In addition to these historical air quality data or data collected occasionally for industries or local authorities or at universities will be identified and collected (when possible) and used for trend evaluation or comparisons.

Data of this kind will be considered for entry into the data base at EEAA. However it will also be necessary to study the quality, representativeness and content of the data. Needs and requirements for data to be entered will be specified.

1.4.5 Activity D.2.1 Prepare database for manually analysed data

A laboratory database for samples that are being prepared for chemical analyses, quality controls and calibration may be needed. Preliminary data (raw data) will be entered into a data base for automatic control. The data may be stored on a preliminary basis while the responsible experts are checking the data against other information available. Final data approvals have to be issued before the data are entered into the main data base.

Descriptions and manuals for the use of such chemical data will be prepared for use at the responsible analytical laboratory.

1.4.6 Activity D.2.2. Local database for monitor data the Monitoring Laboratory

A local data base for the data retrieved from the monitoring system will be established. The details and content of this database will depend upon specifications given by the instrument suppliers The specifications will be part of the report and manuals developed for this part of the monitoring centre.

The local database will contain all one-hour average data ; concentrations of gases and particles as well as all meteorological data. These data will be quality assured and controlled in the final version of the local database. The same amount of data may be transferred to the EEAA database. The frequency and methods for this transfer will have to be decided upon during Phase 2.

1.5 E. Training

1.5.1 Activity E.1.1 Assess training needs for Phase 2

Training Needs Assessment (TNA) will be prepared in co-operation with the Danida assisted Environmental Education and Training Project (EETP). As soon as more is known about the personnel available at the Monitoring Laboratory and at the Reference Laboratory training needs for selected experts from other monitoring institutions will also be considered. The training needs assessment and a functional analysis with job descriptions will give the requirements for training of both the present staff and the new experts hired for this project.

An overview of the staff available for data management and interpretation at EEAA will also be prepared including background and experience also with QA/QC. Based on this overview a future training programme will be indicated to be implemented at the end of Phase 2 or in Phase 3.

1.5.2 Activity E.2.1 Prepare on-the-job training

An important part of the training programme will be based upon on-the-job training. It is essential that the personnel at the monitoring laboratory, who will have the responsibility for the future monitoring system, is appointed and aware of their tasks and responsibilities before this training starts.

These experts will have to participate in training from the beginning of the project which means that the kick off of Phase 2 of the programme can not take place until all key staff members are appointed.

The training will take part both at the Reference Laboratory and at the Monitoring Laboratory Most important for the monitoring staff will both at the Monitoring Laboratory. Background will be given for the site selection operations and some selected experts will have to participate in the in the field establishment of instruments.

An on-the-job training programme will also be developed for daily instrument checks, calibration and maintenance.

1.5.3 Activity E.2.2 Training programme for instrument operation and maintenance.

When the instruments are ready to collect and transfer data the following topics will be included in the training programme:

- instrument calibrations,
- control and maintenance,
- data transfer procedures ,
- data retrieval programme,
- data handling at the Monitoring Laboratory,

data storage and presentation.

1.5.4 Activity E.2.3. On-the-job training at Monitoring Laboratory

As described in subsection.1.5.2. on-the-job training will be undertaken both at the Monitoring Laboratory and at the Reference Laboratory

Concerning the monitoring system all training will be undertaken by monitor experts from EIMP (NILU) and in some cases supported by instrument experts from the suppliers (local experts or international experts).

Training in the use of monitors and in check and controls will be undertaken as a on-the-job training effort at the Monitoring Laboratory after a similar introduction has been undertaken for selected experts at the Reference Laboratory Similar training will also be performed for selected experts from the other monitoring institutions. This training will take place with installed instruments in Cairo, and be continued in Alexandria.

Concerning the sampling equipment included in the programme, training in chemical analyses and use of laboratory equipment will be given by experts at the Reference Laboratory to personnel at the Monitoring Laboratory. Local experts for specific instruments such as Atomic Absorption Spectrometre and Ion Chromatographs may be used for special training courses.

1.5.5 Activity E.2.4 Support training to Reference Laboratory personnel

The first training in the use of monitors and in the calibration of monitors will be undertaken at the Reference Laboratory during installation, tests and calibrations.

The EIMP instrument/monitoring expert together with some of the instrument suppliers will perform this training. The Reference Laboratory personnel will have to become experts in all kind of calibration procedures, and should also follow some of the on-the-job training that is undertaken at the Monitoring Laboratory

1.5.6 Activity E.3.1 Training in English and computer applications

Training in prerequisite skills such as English and computer applications will be evaluated. Personnel that need such training will be selected and will undergo such training as part of general training supplied and in co-operation with the Danida assisted Environmental Education and Training Project (EETP).

1.5.7 Activity E.4.1 Monitoring introductory seminar

A introductory seminar will be held at the beginning of Phase 2 of the programme. This seminar will give an introduction to modern air pollution monitoring and information systems. As many as possible of the personnel that will be involved in the EIMP air pollution monitoring programme will have to attend this 3-4 day seminar.

This apply to the Monitoring Laboratory personnel, to the monitoring institution's personnel, to selected Reference Laboratory experts and to key personnel at the EEAA, who in the final Phase will receive the data for further application.

1.6 F. QA/QC

1.6.1 Activity F.1.1 Appoint QA/QC responsible officer at Monitoring Laboratory

For a QA/QC system to function, its use must be supervised and procedures continuously adjusted to needs and changing conditions within the monitoring institution.

A QA/QC manager or supervisor must therefore be appointed. The responsible air quality sampling and monitoring manager described in Phase 1, will be the most appropriate person for this position. However, this expert had not been identified during Phase 1. It is important that the QA/QC functions are clearly stressed and described as part of the contract with EMOHC.

A prerequisite for the successful functioning of the QA/QC supervisor, however, is the commitment by the management of the institution to provide sufficient time and resources for the laboratory staff to do QA/QC work.

The Reference Laboratory and the air pollution advisers will assist in defining the role of a QA/QC supervisor. The Reference Laboratory will also organise workshops in QA/QC for both management staff and laboratory staff.

1.6.2 Activity F.2.1 Instrument calibration procedures

Specifications for instrument calibration and descriptions of measurement and sampling procedures (SOP; Standard Operation Procedures) will be developed. This work was briefly started in Phase 1 during the instrument procurement preparation.

A further elaboration of these procedures will be undertaken in Phase 2 starting with the air pollution reference laboratory.

Notes, schemes and SOPs will be developed as part of the training in calibration of monitors at the Reference Laboratory A co-operation between the instrument supplier's experts, the Reference Laboratory experts and the Monitoring Laboratory experts will be established to obtain the best practical and most efficient calibration and span/zero check procedures.

The basic monitor calibrations and controls will always be undertaken by the Reference Laboratory experts.

1.6.3 Activity F.2.2 Design QA / QC procedures at Monitoring Laboratory

Well defined descriptions of day by day analytical routines, including quality control, are essential for generating reproducible results. The monitoring laboratory will have to handle both automatically monitored data received via telephone communication direct to the local computers and manually collected samples that will be analysed by wet chemical or other analytical methods.

A QA/QC programme will be prepared for both types of data. The procedures will be quite different. The content in the performance of work will also be quite different. The staff assigned to undertake the different tasks will have to have different backgrounds and will be working on quite different operations.

It is important that the responsible laboratory team is committed to include QA/QC as routine part of their tasks. Sufficient time and resources for this part of the work has to be provided from the start.

For the monitoring system the QA/QC adviser together with the EIMP instrument expert will undertake the necessary training relating to the data retrieved by computer aided systems.

For the sampling system the Reference Laboratory expert together with the EIMP Reference Laboratory manager will support the design of QA/QC procedures for the analytical programme.

1.6.4 F.2.3 Establish Standard Operational Procedures as part of QA/QC

Standard Operational Procedures (SOP) will be developed as an important part of the QA/QC procedures.

A template (standard list of information to be collected) for the preparation of SOPs will be supplied by the Air Pollution Specialist. This can be used for checking existing procedures and form a basis for updating and supplementing the procedures.

More detailed procedures will be developed during the establishment of the monitoring and sampling programme in Phase 2 and 3.

1.6.5 Activity F.3.1 QC and calibration routines as part of the on-the-job training

The Monitoring Laboratory personnel will have the responsibility for the operation of monitors and samplers, and for undertaking weekly controls in field.

For samplers this includes flow controls, time check, cleaning, handling etc..

For samplers it includes zero and span controls, flow controls and various check lists that will be part of the on-the-job training. Manuals and check lists will have to be followed at every visit. All these manuals will be presented, used and repeated during the training in field.

1.7 G. Monitoring

1.7.1 Activity G.1.1 Prepare work plan for 1998 activities .

The detailed planning of the activities of Phase 2 covering 1998 will be made taking into account the experience gained during Phase 1 and 2.

1.7.2 Activity G.2.1 Specify sampling programme procedures

The sampling programme consists of integrated (sequential or individual) samplers, from which samples have to be collected and brought to the laboratory for analyses. A list of parameters including sampling times and frequencies was presented in Phase 1. This represent an important input to the final sampling programme design. The Egyptian Air Quality Standards already indicate some of the averaging times requested for reporting the air quality in Egypt. These specifications have also been applied in the design procedures.

Frequencies and averaging time will vary dependent upon instrumentation at each site. The monitors linked to on-line data transfer will meet all requirements, while integrated sequential and manual samplers at its best will be based upon 24 h average samples.

When the personnel has been allocated at the Monitoring Laboratory, and the instruments are procured and being installed, the sampling programme will be developed in detail. This will also depend upon available instruments in Egypt. Especially high volume samplers (for TSP) and some sequential samplers can be used. However, these instruments will have to be collected for maintenance, controls, repair and calibrations. This work will not be started until the end of Phase 2. After rehabilitation these instruments should meet the specifications given by the QA/QC requirements and by the need of data specified.

1.7.3 Activity G.2.2 Specify monitoring programme procedures

A list of parameters including sampling times and frequencies was developed in Phase 1. This represents an important input to the final monitoring programme design. The Egyptian Air Quality Standards already indicate some of the averaging times requested for reporting the air quality in Egypt , and these specifications have been applied in the design procedures. The use of monitors will meet all these requirements.

When the personnel has been allocated at the Monitoring Laboratory, and the instruments are procured and being installed, a complete monitoring programme will have been formed. It will important that the sites selected and the procedures developed for the operation of the monitoring programme meet the QA/QC requirements.

1.7.4 Activity G.2.3 Start monitoring programme and data retrieval

The first monitoring stations to be installed and started will be located at Embaba (Monitoring Laboratory facilities). These stations, one residential at the roof and one road/curb side at the Delta Road, will be used for the on-the-job training programme.

Data retrieval routines will be tested and verified. If possible both telephone lines and a floppy diskette retrieval system will be tested here. After some days/week(s) operation at this site, further sites will be instrumented in the Cairo area. The sequence for the opening of new monitoring stations will depend upon available telephone lines.

Data retrieval from other monitoring institutions such as Cairo University will be tested. The station at the University should be on-line by March 1997 . Another possibility will be to verify the retrieval of data from Atomic Energy Authority..

1.7.5 Activity G.3.1 Establish monitoring station infrastructure

During Phase 1 a list of construction work, repair, maintenance, cleaning etc. at the selected monitoring sites was specified. During the site inspections and site visits all these tasks were described in details. The EIMP counterpart has taken the responsibility for undertaking all these preparations.

At most of the sites no telephone lines have been available. These lines have to be ordered as soon as possible, and they have to be made available during Phase 2. No on-line data will be possible until telephone line are installed.

Most of the sites have 220 V electrical power sockets. The possibility of using this has to be verified through the agreements established with the site owners. These agreements also have to be established at the very beginning of Phase 2.

1.7.6 Activity G.4.1. Data evaluation

As soon as the first data are retrieved at the monitoring laboratory a data evaluation will start. This will also be part of the on-the-job training.

First of all calibration factors will have to checked. Next span check points, errors, peak values, false data and other peculiarities in the retrieved data have to be taken out.

A time plot of the data will be produced to evaluate the diurnal, weekly and spatial variation in concentrations.

Training in the judgement of concentration levels and units will be undertaken.

1.7.7 Activity G.4.2 Data presentation

After the first air quality data have been evaluated, and the QA/QC procedures have been undertaken and verified, the first data presentation will be prepared.

A brief report will be written describing the background, data availability, data quality and the data itself. A validation/discussion of the results will follow the data presentations.

1.8 H. Reference Laboratory

1.8.1 Activity H.1.1 Installation of monitors at Reference Laboratory

As soon as the instruments are available in Egypt the installation of air pollution monitors can start at the Reference Laboratory. The installation will be undertaken by the EIMP air pollution monitoring expert together with experts from the instrument suppliers.

1.8.2 Activity H.1.2 Calibration of monitors at Reference Laboratory

The first calibration of monitors in the EIMP air quality monitoring programme will be undertaken at the Reference Laboratory's own monitors. This will also be performed as a training activity.

When the first monitors are installed and calibrated, calibration will also start at the Reference Laboratory for other monitors. The next set of monitors will thus be prepared for the two Monitoring Laboratory sites at Embaba.

Calibration will then be the routine operation at the Reference Laboratory, as all monitors that will be installed will have to undergo a calibration and check at the Reference Laboratory, before installation in field.

1.8.3 Activity H.2.1 Training of Reference Laboratory personnel

Training will be undertaken by the EIMP monitoring expert and by some of the instrument support experts in the performance of calibrations and the use of air pollution monitors.

These activities will have to take place in an early stage of Phase 2.

1.9 Workplan for Phase 2

The workplan for air pollution monitoring is given as Exhibit 4.2 overleaf

The work plan is based upon the assumption that sufficient equipment has been delivered in Cairo by 1 March 1997, and that the personnel has been allocated at the Monitoring Laboratory.

This means that at least four new experts have to be assigned to the Embaba Laboratory before 1 March 1997. These experts have been described in Terms of Reference for the Monitoring laboratory personnel. The 4 persons cover the following positions.

- the air pollution sampling and monitoring manager responsible for QA/QC
- a computer expert for the sampling system data base
- a computer expert for the monitoring programme data retrieval and controls
- an electronic engineer for monitor control, check and maintenance

In addition to these persons we have identified the need for one more electronic/technician with instrument background. The other persons may be recruited from the present staff at Embaba lab.

It appears from the staff plan that the EIMP Air Quality Monitoring experts will not arrive in Egypt until the above mentioned requirements have been fulfilled.

Exhibit 4.2 Workplan for air pollution monitoring.

EIMP Air Pollution Monitoring Programme
Annual Plan of Action 1997

ACTIVITY month	1	2	3	4	5	6	7	8	9	10	11	12
A. Institutional support												
A.1.1 Air pollution monitoring working group						■					■	
A.2.1. Assist technical input to contact with mon.lab			■									
A.2.2 Assist in describibng work functions for new experts			■	■	■							
B. Design of monitoring programme												
B.1.1.Evaluate exixting measurement sires				■	■					■	■	
B.2.1 Select monitoring sites for air quality measurements					■						■	
B.2.2 Define site characteristics				■	■					■	■	
B.2.3 Assess emission sources				■						■		
B.2.5 Select sites for meteorological measurements					■						■	
B.2.6 Specify meteorological data					■						■	
B.2.7 Specify use of exisiting equipment					■						■	
B.2.8 Establish agreements with site owners		■	■	■	■						■	■
B.2.9 Input to future activities											■	■
C. Procurement, equipment, hardware and software												
C.1.1 Evaluate existing equipment		■		■	■	■					■	
C.1.3 Assist in selecting equipment for RefLab		■	■	■								
C.2.1 Procure instruments and equipment		■	■									
C.2.2. Prepare instruments for installation			■	■	■	■						
D. Data management												
D.1.1 Specify data collection/data transfer				■	■	■				■	■	
D.1.2 Specify data retrieval and local database at Mon Lab			■	■	■							
D.1.3 Specify data quality check and control procedures			■	■	■	■	■					
D.1.4 Identify sources of supplementary data				■	■							
D.2.1. Prepare database for manual data (seq. & hivol.)				■	■	■						
D.2.2. Establish local data base for monitoring data at MonLab				■	■	■	■			■	■	
E. Training												
E.1.1 Assess training needs for phase 2		■	■	■								
E.2.1 Prepare on-the-job training			■	■	■	■						
E.2.2. Prepare training programme for instrument calibration etc.			■	■								
E.2.3. On-the-job training at RefLab and at MonLab			■	■	■	■	■	■	■	■	■	■
E.2.4. Support training at Reference Laboratory			■	■								
E.3.1. Training in English and Computer applications		■	■	■								
E.4.1. Training seminar			■									
F. QA/QC												
F.1.2. Appoint QA/QC responsible officer		■										
F.2.1 Specify instrument calibration procedures			■	■	■	■						
F.2.2 Design QA/AC procedures at monitoring labs.				■	■	■	■					■
F.2.3. Establish Standard Operational Procedures as part of QA/QC.				■	■							
F.3.1. QC and calibration routines as part on on-the-job training.			■	■	■	■	■	■	■	■	■	■

EIMP Air Pollution Monitoring Programme
Annual Plan of Action 1997

ACTIVITY month	1	2	3	4	5	6	7	8	9	10	11	12
G.1.1 Prepare plan of action for 1998											■	■
G.2.1. Specify sampling programme procedures			■	■								
G.2.2. Specify monitoring programme and data retrieval				■	■	■						
G.2.3. Start monitoring programme and data retrieval				■	■	■	■	■	■	■	■	■
G.3.1. Establish monitoring station infrastructures in Cairo and Alex.	■	■	■	■	■	■	■					
G.3.2. Establish first monitors in Cairo and Alexandria			■		■							
G.4.1. Data retrieval and data evaluation				■	■	■	■	■	■	■	■	■
G.4.2. Data presentations						■					■	■
H. Reference Laboratory												
H.1.1. Installation of monitors at Reference Laboratory			■									
H.1.2. Calibration of monitors initiated			■	■								
H.2.1. Training RefLab personnel in use of monitors and calibration			■	■	■							

EIMP Air Quality Monitoring Staff	1	2	3	4	5	6	7	8	9	10	11	12	Total
Bjarne Sivertsen			■	■						■	■		4
Leif Marsteen			■	■	■	■			■	■	■		6

EIMP

Environmental Information
and Monitoring Programme
3 Abdil Aziz Selim street
Mohandessin, Cairo, Egypt
Tel/Fax: +20 2 361 5085

Note

To: Jan Hassing
Copy:
From Bjarne Sivertsen
Date: 11 October 1996

Air Quality Monitoring Programme 1997 budgets

To establish a detailed budget for the requirements of manpower, equioment, analyses etc. during 1997 is difficult per. November 1996.

Changes in startup date, in actual personnel needs, in how to contract new experts etcc all will influence the final costs.

The first indications are presented below.

Building and construction work
Building and construction will have to be undertaken at most monitoring sites.

For Cairo:	9 sites (3000 EL each)	total	27000 EL
For Alexandria	4 sites (3000 EL each)	total	12000 EL
Total for phase 2			**39000 EL**

Chemical analyses
When the sampling programme starts (May 1997??) several analyses will be requred at the Monitoring Laboratories. No unit prices are available at the time.

Following assumptions are made

SO_2 (200 days x 4sites x 20EL)	16000 EL	
TSP (40 days x 8sites x 30 EL)	9600 EL	
PM_{10} (40 days x 4 sites x 30)	4800 EL	
Lead analyse (?)	3000 EL	
Total for analyses at Monitoring Laboratory		**33400 EL**

Total costs for building and analyses **72400 EL**

Air Pollution Monitoring Programme

Budget for Activities 1997

Operation, QA/QC at Monitoring Laboratory

Type of person	Number of experts	Monthly fee LE	Annual costs LE
Sampling expert (manager) (new)	1	1200	14400
Monitoring expert (new)	1	1500	18000
Computer experts (new)	2	800	19200
Engineers (elctr/instrum.)(1 new)	2	300	7200
Chemists	2	200	4800
Technicians	4	200	9600
Total annual cost for operation of MonLab AQ programme			**73200**

Cost for additional equipment for the Monitoring Laboratory

Telephone lines at 10 stations	10	3000	30000
Air cons for phase 2	6	2500	15000
Total for MonLab additionals			**45000**

Operations QA/QC at Atomic Energy Authority

4 stations in Cairo			
Estimate of 6 experts	6	300	21600
Administration	1	400	4800
Total operational costs AEA			**26400**

Operational costs for Univ. of Alexandria (Dr ElRaey) and Cairo Univ.

Estimated annual costs			
Alex Univ	4	500	24000
Cairo Univ	1	500	6000
Total at Universities			**30000**

Operational costs Tebbin Institute

One station at Tebbin	1	500	6000
Construction work			4000
Total at Tebbin			**10000**

Total annual costs for Air Quality Monitoring programme operatio	**184600**

Appendix I

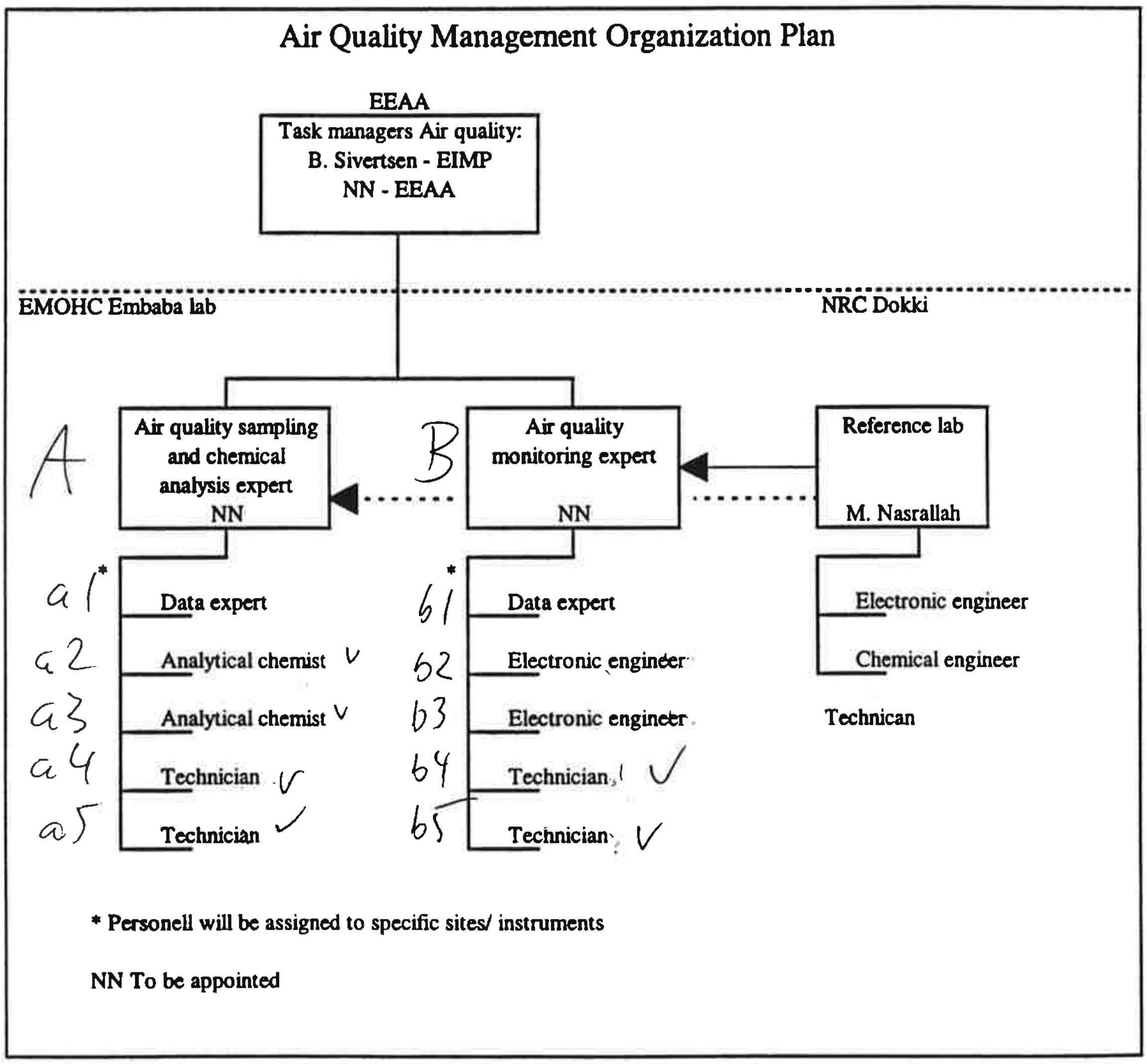
Organization and personnel

A.2.1. Assist in job descriptions for A.Q. monitoring personnel

EIMP Air Quality Monitoring Programme

Organization Chart and Job Descriptions

A draft organisational chart has been developed for the EIMP Air Quality Monitoring Programme. The link between EEAA and the monitor laboratory is represented by the EEAA task manager who will be the counterpart for the EIMP task manager on air pollution monitoring. His responsibilities are described below and in an earlier job description document for this person.



The positions to be filled at the monitor laboratory (at EMOHC in Embaba lab.) require a staff of experts with responsibilities, duties, and qualifications as described in the following.

Position:

Task Manager Air Quality Monitoring EEAA/ Monitoring laboratory.

Counterpart

Responsibilities and duties

- Undertake the EEAA obligations and duties as the counterpart for the EIMP air quality monitoring task manager.
- Manage, plan and be responsible for all air quality data collected from the monitoring programme and from the sampling programme.
- Main responsible for QC/QA at monitoring institutions.
- Participate in the planning and establishment of the air quality monitoring system for Egypt.
- Update and maintain the quality of the monitoring system and be responsible for adequate operation and good quality of the collected data.
- Be responsible for contacts to EEAA, and report the results to EEAA and to other organisations,
- Assign duties to appropriate members of the staff and ensure that necessary equipment, spare parts and facilities are available.

Qualifications:

University degree (PhD) with at least 5 years of experience in scientific oriented work or a Civil Engineer/ MSc with at least ten years experience. Preferably the person should also have experience in management and some background related to environmental issues. Must be english speaking.

Position:

A

Air Quality sampling and chemical analyses manager

Responsibilities and duties

- Manage, plan and be responsible for the air quality sampling programme included preparation of samples and analyses.
- Participate in the planning and establishment of the air quality monitoring system for Egypt.
- Update and maintain the quality of the sampling programme and be responsible for adequate operation and good quality of the collected data.
- Assign duties to appropriate members of the staff and ensure that necessary equipment, spare parts and facilities are available.
- Be responsible for analytical equipment in the lab.
- Assure that manual obtained data from the sampling programme are properly entered into the data base for further applications.

Qualifications:

University degree or a Civil Engineer with at least five to ten years experience. The person should be an experienced chemist with preferably background in air quality sampling and analyses. He must be trained in using advanced analytical equipment (ion chromatographs or AA spectrometres) and should have some background in computer technology. He/she must understand english.

Position:

Air Quality monitor programme manager

Responsibilities and duties

- Manage, plan and be responsible for the air quality monitoring programme included calibration and data retrieval.
- Participate in the planning and establishment of the air quality monitoring system for Egypt.
- Update and maintain the quality of the monitoring system and be responsible for adequate operation and good quality of the collected data.
- Assign duties to appropriate members of the staff and ensure that necessary equipment, spare parts and facilities are available.
- Responsible for QC/QA activities
- Assure that good quality data from the automatic monitoring programme are properly entered into the data base for further applications.

Qualifications:

University degree or a Civil Engineer with at least five to ten years experience. The person should have some computer background and preferably experience in electronics or automatic instrumentation. He/she must uderstand english.

Position:

Senior engineer, data responsible **(two computer experts)**.

Responsibilities and duties

Responsible for the daily data retrieval, data quality control and data transfer to the final data base. The persons will be responsible for following up daily routines on transferring sampling data into the data base and reporting errors and mistakes, check data, prepare print outs, introduce calibration factors and correct data.

One of the xperts will be responsible for a small PC computer network at the monitoring lab. One expert will be responsible for manually sampled data the other automatic monitored data.

Qualifications:

University degree or engineer with computer experience. One of the two must have some experience in PC network applications.

Position:

(b2-3) **Computer engineer , electrical engineer (2 instrument experts)**

Responsibilities and duties

Responsible for the monitors at the sites and for daily data retrieval. They will be assigned to a defined set of monitors and monitoring sites. The persons will be responsible for following up daily routines and weekly calibrations at the monitoring sites. They will have to report all errors and mistakes, check instruments, maintain and undertake minor repairs.

Qualifications:

Engineer or BSc with computer experience and some experience in use of automatic instruments. They should both understand some english.

Position:

(a2-3) **Analytical chemists (2-3-persons)**

Responsibilities and duties

Prepare samples, undertake analyses and calibrate instruments, correct data, prepare various filters and evaluate results of analyses. Responsible for the daily routines in the laboratory, reporting all errors and mistakes.

Qualifications:

Chemical engineers or MSc with experience in analytical chemistry. Should have background in work at a "clean" laboratory and used to handle low concentration environmental samples.

Position:

(a 4-5, b 4-5) **Technicians/ engineers (at least 4 persons)**

Responsibilities and duties

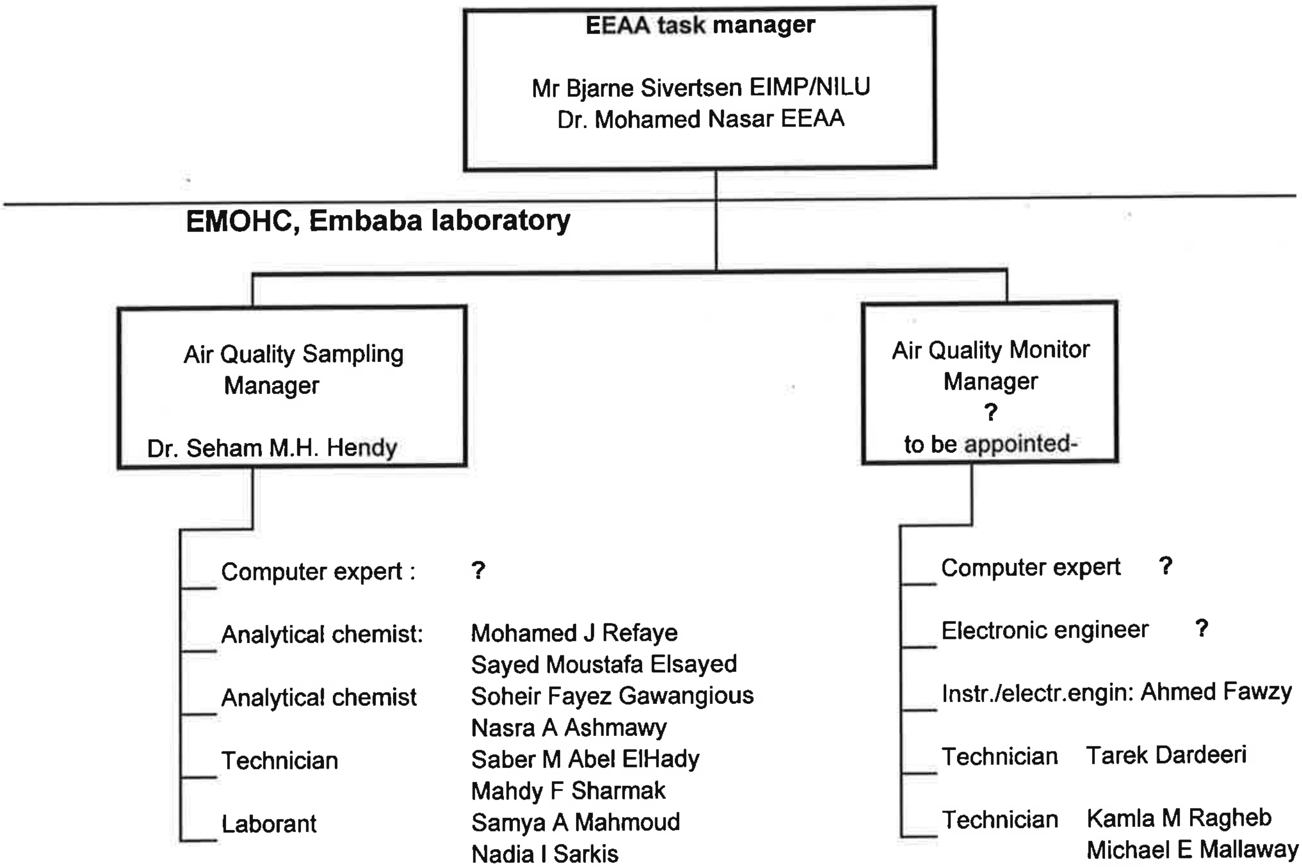
Responsible for daily data retrieval at different sampling and monitoring sites. They will be trained in calibration and sample collection from the various samplers and monitors at specific asigned sites. The persons will be responsible for following up daily routines and weekly calibrations at the monitoring sites. They will have to report all errors and mistakes, check instruments, maintain and undertake minor repairs.

Qualifications:

Engineers with electronic, technical and/or chemical background. He/she should have some technical or instrument background, and have insight or interest in automatic instrumentation.
The technicians will undergo a training programme through on-the-job training and should understand some english..

Air Quality Monitoring

Monitoring Laboratory Organisational Chart



The personnel will be appointed to specific sites, and will also be trained to handle specific types of instruments. Each person will have his specialities.

Prepared by EIMP 96-11-27

Mr.Mohamed I. R.Elamawi'

****

Director of air pollution monitoring laboratory ,EMOHC, Ministry of Health. He has M.Sc. in air pollution chemistry and public health science ,he hasmore than 15 years experience of air pollution works such as the choosing of the site sampling ,chemical analysis of air pollutants and statistical analyse the data of results and discussion, interpretation of the result.

He also supervisor of the national air pollution monitoring network in Egypt and the focal point for GEMS, WHO in Egypt since 1994 .

He investigate any complain about air pollution problems in Egypt and make data base studies for the enivronmental studies .

He has good knowledge about mathematical statistical background . He will share with Mrs., Soheir in her responsibilities

3 - Position : Technicians / engineers (at least 6 persons)

Reponsibilities and duties :

Each expert will be responsible for a number of specified sites / stations.Daily check and control of field monitors,field caliberations, repair of equipment, contact with local station keepers .they should be available for quick repairs in case of problems .

1 - Mr. Micheal Erian Mallaway

B.Sc of science physics 1981 .He experience from 1985 in sampling and supervisor of group of collecting and look after air monitoring sites to update.

2 - Mr. Mahidi F. Sharmoukh 1986

3 - Mr. Tarek Dardery (1987) and

4 - Mr.Saber M.Abdelhady (1991).

5 - Mr. Ismail M. Abbass (1984) and

6 - Mr. Ahmed Fawzy (1991).Both of them are graduated from Technical Health Institute branch of Maintainance and repair of equipment.

4 - position; calibration lab responsible engineer or MSc

Responsibilities: Have the overall responsibiliy in the Monitoring lab calibration room for repair calibration updating of equipment support reference gases and contact to the international expert organizations for intercalibrations and reference controls

Mrs. Kamla M. Ragheb : B.Sc. of Physics (1983), Also ,has a Diploma of Environmental Science (1993) .
she has experience 7 years of instrumentation especially AAS & GC from 1989,and experience about air equipment since 1993 to update .
Mrs., Samya A. Mohamed , B.Sc of Physics (1984),five years of experience in instrumentation specific GLC, HPLC and AAS.
5 - Position : Analytical Chemists . (3 persons)
Responsibilities : to prepare samples undertake analysis and calibrate instruments correct data preparae and impreganate filters evaluate results .

(1) Mr. Mohamed I. R. Elamawi

Director of air pollution monitoring laboratory ,EMOHC, Ministry of Health. He has M.Sc. in air pollution chemistry and public health science ,he has more than 15 years experience of air pollution works such as the choosing of the site sampling ,chemical analysis of air pollutants and statistical analyse the data of results and discussion, interpretation of the result.
He also supervisor of the national air pollution monitoring network in Egypt , and the focal point for GEMS, WHO in Egypt since 1994 .
He investigate any complain about air pollution problems in Egypt and make data base studies for the enivronmental studies .

(2) Mrs. Nasra A. Ashmawy

B.Sc. 1979 and Diploma of Analytical Chemistry 1992 .
She has 14 years experience in toxicology laboratory ,especially in trace element analysis .

(3)Mrs Nadia L. Sarkis

B.Sc of chemistry 1982 .

She has about 9 years experience of espicially trace elments analysis .

(4) Mrs. Soheir Fayez

She will share or help in chemical analysis .

6 - Position Laboratory assistants (2 persons)
Responsibilities: Clean, wash and prepare equipment for field use .and for labratory analyses Prepare filter and various work in the lab .

1 - . Mr. Bakhit W. Bernaba .(1982)
2 - Mr. Alaa A. Amr (1991).

Both of them ,Diplome of Technical Health Institute ,they have experience in various work in laboratory.

Air Pollution Monitoring Laboratory
Environmental Monitoring & Occuptional Health Center

1 - Position : Head of air pollution Monitoring Laboratory

Responsibilities : Manage,plan and be responsible for the air quality monitoring programme included reporting.

Participate in the planning and establishment of the air quality monitoring system for Egypt.

Update and maintain the quality of the monitoring system and be responsible for adequate operation and good quality of the collected data.

Be responsible for contacts to EEAA,and report the results to EEAA & to other organizations.

Assing duties to appropriate members of the staff and ensure that necessary equipment ,spare parts and facilities are available.

Dr. Seham M.H.Hendy

****

General Director of Environmental Health Department,MOH &General Director of Environmental Monitoring & Occuptional Health Center MOH .

MD in community ,Environ.,& Occupat.,Health Medicin .

20 years experience in environment (indoor & outdoor) supervision and control within the Ministry of Health .

And two years experience in management of Air Monitoring Network.

2 - Position : Senior engineer (MSc:), data responsible

Responsibities& duties : Responsible for the daily data retrivel ,data transfer to the final data base .the person will be responsible for following up daily routines in the laboratory ,reporting all errors and mistakes, check data ,prepare print outs ,introduce calibration factors and correct data.

Mrs : Soheir F. Gawargious

****

BSc .of chemistry 1981 ,Diploma of analytical chemistry 1992.

Eleven years experience in environment science .

Computer experience in data prossessing and analysis.

Appendix J

Ambient air quality monitoring equipment

a) Monitoring equipment to be provided by Danida
b) Reference Laboratory layout

AMBIENT AIR QUALITY MONITORING EQUIPMENT

To be provided by Danida through EEAA)

ITEM DESCRIPTION	QUANTITY	INSTITUTION
Field equipment		
SO2 monitor	18	MOH. Imbaba
NO.NOx.NO2 ambient air monitor	14	MOH. Imbaba
PM10 suspended particulate monitor	9	MOH, Imbaba
O3 monitor	7	MOH. Imbaba
CO monitor	5	MOH. Imbaba
HC monitor	5	MOH, Imbaba
Remote controlled two point calibration unit	20	MOH. Imbaba
Air intake with manifold	24	MOH. Imbaba
Meteorology sensors	7	MOH, Imbaba
Shelter data acquisition and control system	23	MOH, Imbaba
Sequential air sampler	19	MOH, Imbaba
High volume PM10 sampler	21	MOH. Imbaba
High volume TSP sampler	5	MOH, Imbaba
Volatile organic compound (VOC) sampler	5	MOH, Imbaba
Dust fall sampler	9	MOH. Imbaba
Table or rack for monitors	-	MOH, Imbaba
Desk for papers and shelf for manuals	-	MOH, Imbaba
Shelter	10	MOH, Imbaba
Portable Meteorology sensors	1	MOH, Imbaba
Monitoring lab equipment		
Monitor lab backup monitor and met.sensors	17	MOH. Imbaba
Table for maintenance and repair of ambient air monitors etc.	5	MOH. Imbaba
Shelf for manuals and accessories	1	MOH. Imbaba
Stainless steel sink	1	MOH. Imbaba
Monitor lab repair and maintenance tools kit	7	MOH. Imbaba
Monitor Laboratory Items (minor)	-	MOH. Imbaba
Shelves for backup instruments in storage room	1	MOH, Imbaba
Computerized communication and data display system	2	MOH. Imbaba
Computer Center computer	2	MOH, Imbaba
Computer centre printer no 1	1	MOH. Imbaba
Computer Center printer no 2	1	MOH. Imbaba

REFERENCE LABORATORY AIR EQUIPMENT
(To be provided by Danida through EEAA)

ITEM DESCRIPTION	QUANTITY	INSTITUTION
Reference Lab equipment		
Thermometer for measuring room temperature	1	NRC
Barometer for measuring room pressure	1	NRC
Hygrometer for measuring room humidity	1	NRC
CO detector	1	NRC
Pressure calibrator for measuring inline pressure in instruments	1	NRC
Zero air generator	1	NRC
Multigas multipoint calibration system	1	NRC
Reference lab monitors	8	NRC
Wet gas meter 3 1/min	1	NRC
Wet gas meter 20 1/min	1	NRC
Rack for monitors, calibrators, etc	1	NRC
Table for wet gas meters and monitors	8	NRC
Reference lab data acquisition and control system	1	NRC
Reference lab repair and maintenance tools kit	1	NRC
Reference laboratory Items		NRC
Reference lab computer	1	NRC
Reference lab printer	1	NRC
Chair and desk for PC, printer and papers	1	NRC
Shelf for manuals	1	NRC
Reference lab air conditioner	1	NRC

Memo EIMP Procurement

Subject IFB No.: 18/96 - Bid Opening

Date 19 Nov. 1996, at 12:00

To EIMP Office in Cairo

Copy Procurement Secretariat DK

From DAR

Consulting Engineers and Planners AS

Parallelvej 15
DK-2800 Lyngby
Denmark

Tel +45 45 97 22 11
Fax +45 45 97 22 12

Suspended particulate monitors (Group 2)

Bids Invited from	*Bids received*	*Bid Price*	*Remarks*
Kontram	Yes	802.940 + 10.800 £.E.	CIF Cairo Installation.
Oleico AB	No	-	Consortium with C.K. Environment
Eberline	No	-	Quoted via Instrumatic
Grimm	Yes	1,158.950	Free Cairo
C.K. Environment	Yes	1,732.470 alt. 1,495.290	FOB/CIF
Instrumatic	Yes	783.805 alt. 1,218.616	

Signatures by Opening Officer and witnesses:

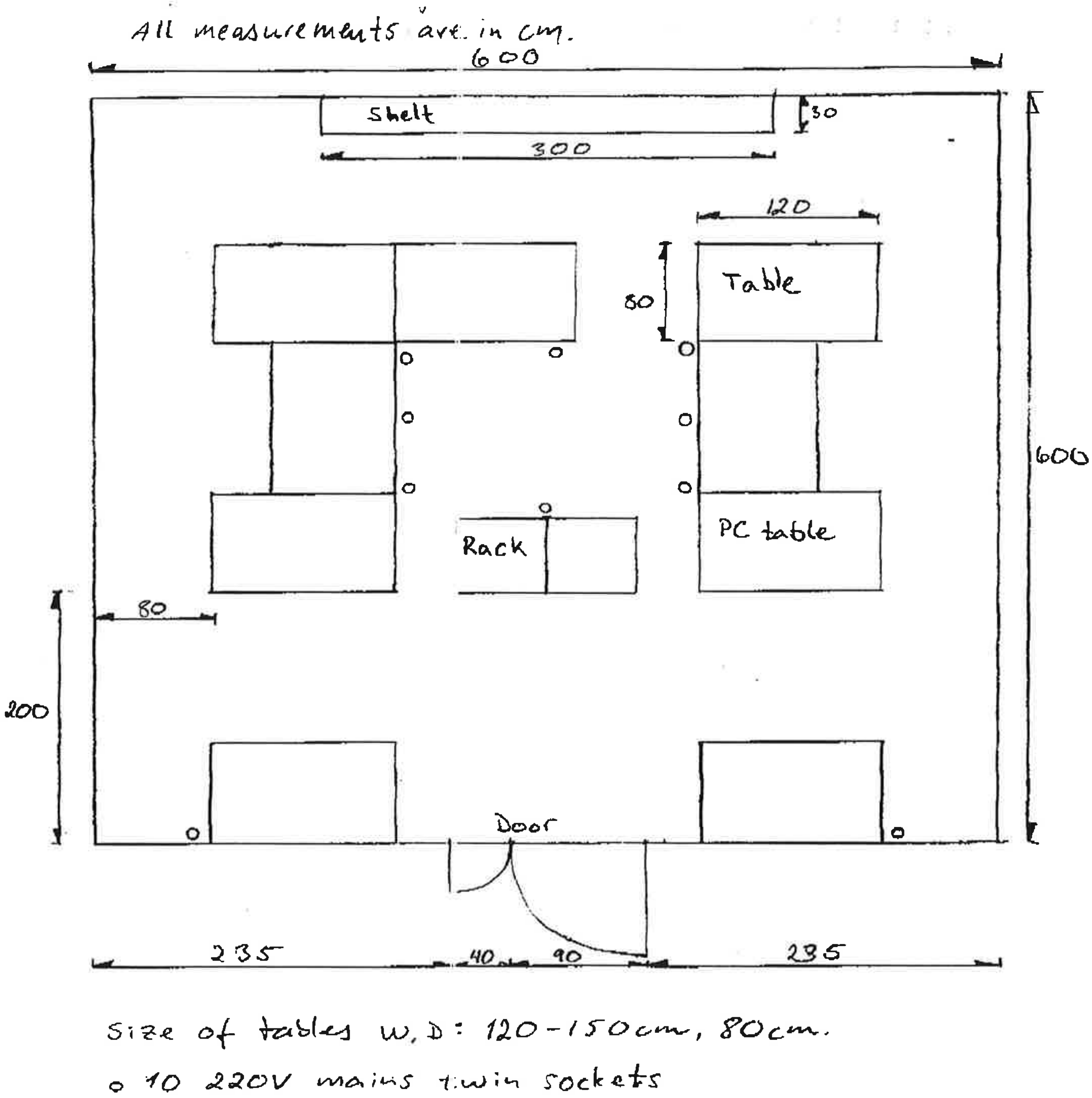
Shiraz A. Dar:

J. Borch Jacobsen:

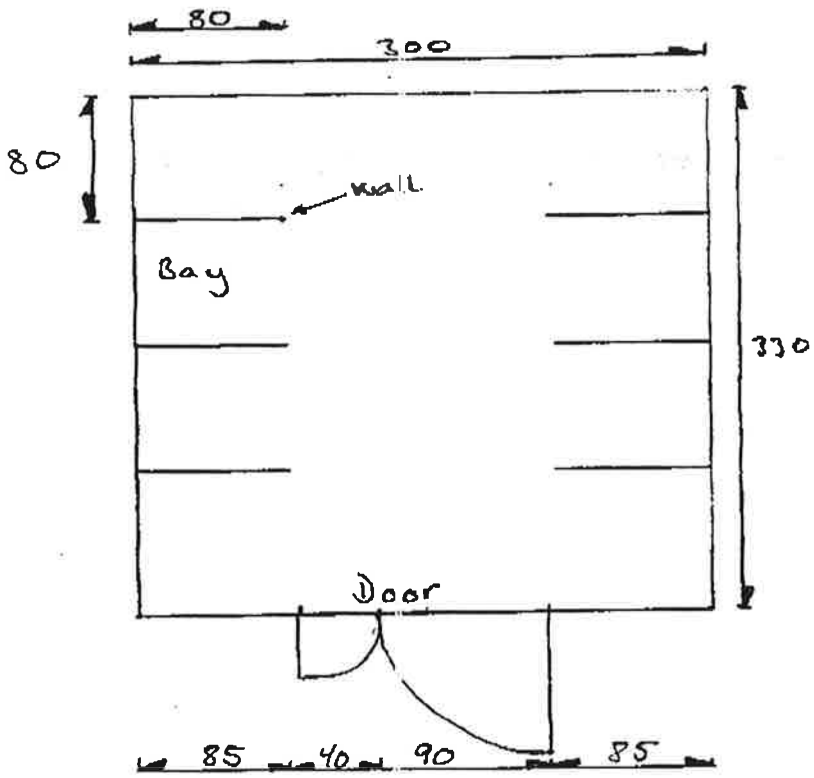
Claus Andersen:

EIMP

Reference Laboratory
Air Quality part, layout



Reference lab storage room layout
All measurements are in cm.



There are 4 bays along the left and right wall. The bays are separated by 100cm high walls made of iron or wood. The walls must be fixed to the floor and wall of the room. If the bay walls are made of wood they must be 2cm thick. The bays are closed by chains.

Appendix K

Cairo University - Instruments available

Information and Data Analysis Laboratory

of

Environmental Hazard Mitigation Center

Cairo University

1997

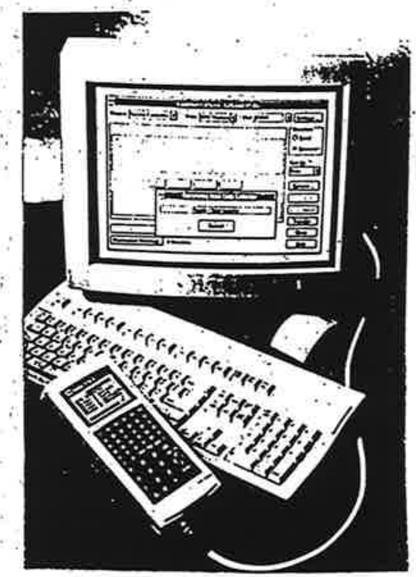
Overview:

Cairo University, in conjunction with Argonne National Laboratory and Washington University in the USA, has established a state-of-the-art Center for Environmental Hazard Mitigation (CEHM) at Cairo university. This project is funded by a LE 10 million grant from the US Department of Agriculture and the Egyptian Ministry of International Cooperation. Construction of the CEHM Laboratory facility is near completion, and will be located in Cairo University's new Chemistry Building at the main campus in Giza. This will host all four major laboratories: Information and Data Analysis, Chemistry (water, air, soil pollution), Meteorology, and Geophysics.
The CEHM is currently located on the third floor of the MIT building within the Cairo University campus.

The Information & Data Analysis Lab.

A- Staff:

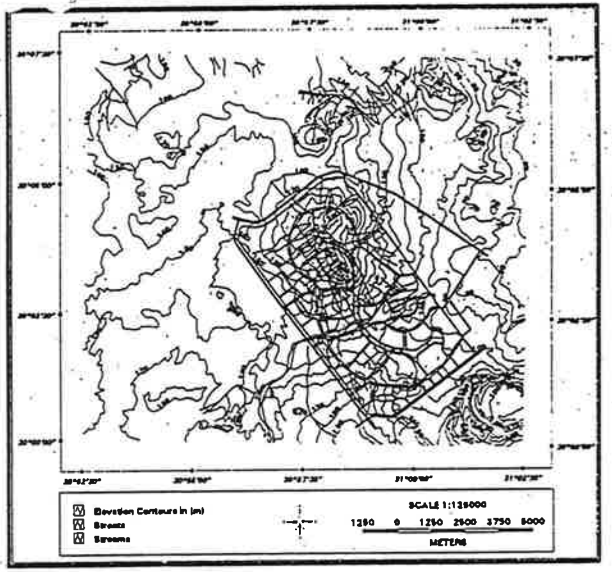
The Laboratory is run by a group of carefully selected members of Cairo University. Their expertise are in the areas of Computer Science, Geophysics, Geology, Astronomy, Meteorology, GIS and Remote Sensing. Members of this group has successfully completed advanced short-term training courses at Washington University. Since the laboratory was initiated, its staff has received training every 3 months, in Egypt, by USA experts on the up-to-date advances in the fields of Computation, Remote Sensing, GIS, and image processing. Egyptian and American team members stay in constant communication to discuss operations, review results, and ensure that the CEHM laboratory's high standards are consistently met.



B- Equipment:

The Lab. comprises a network of advanced computers and input/ output devices that include:

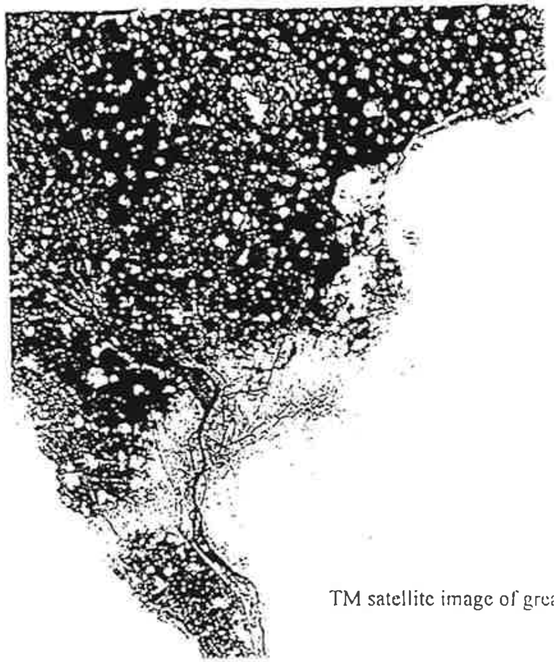
1- Two Sun Sparc 20 work stations with a 27 Gigabyte hard disk storage capacity
2- Two Pentium PC Computers
3- One Apple Mackintosh Computer
4- One flat-bed A3 color Scanner
5- A0 Digitizer
6- One A0 size color Hp Plotter
7- One A0 size Scanner
8- One Laser Printer
9- CD Read - Write drive
10- 8mm Tape drive
11- Slide maker



C- Fields of Activity:

1- Geographic Information System GIS Projects

The Geographic Information System (GIS) is useful for management, display, and analysis of large multi-dimensional data sets pertaining to geographical areas. The most popular and widely used GIS commercial software package (ARCINFO) is currently used by our team to address a wide range of environmental problems. An example of such problems is watershed analysis used to predict areas most likely to be affected by flash floods and to select suitable locations for urban development that are less susceptible to flooding.
The software could be used to create digital maps with appropriate attributes, locate sources of pollution, etc.
The Laboratory organizes training courses in GIS and ARCINFO.
The Lab. is equipped also with Global Positioning System (GPS) units to acquire precise geographical locations.



TM satellite image of great Cairo

2- Remote Sensing Projects:-

The advanced PCI remote sensing package is used on the Sun workstations to process digital satellite, geophysical and digitized map data.
Satellite images are used in many fields such as geological, environmental, land use, right-of-way planning, digital elevation mapping, mineral resource exploration, agricultural and environmental assessment.
Our team is currently assessing urban encroachment over the Egyptian Delta throughout the past 18 years using archived satellite data. In addition to this project is the assessment of Mediterranean sea-shore line erosion in relation to the erection of the High Dam.

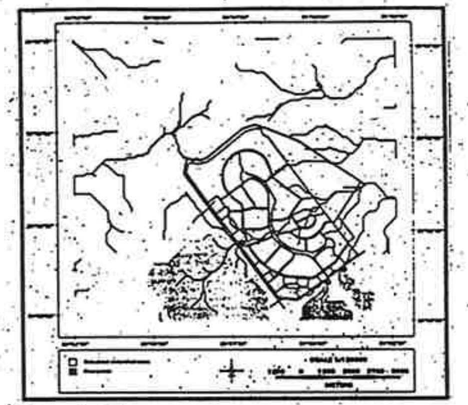
Internet, the international computer network is your passport to the information highway.

3- Computer Sciences:-

The Laboratory offers training courses in:-

1- UNIX Operating system
2- FORTRAN Language
3- C Language
4- Internet
5- Commercial Packages (e.g. DOS, Windows, Microsoft word, Excel, Access data base packages)

- The Laboratory offers data base solutions for any task by designing a special program to guide the required application.
- Laboratory facilities can be used by outsiders for nominal fees for CPU time and for production of various outputs e.g. (hardcopy, tapes, C.D., color separates, etc.)
- The Laboratory offers scientific products such as thesis word processing, producing graphs, contour maps, figures ..etc.



D- CEHM Achievements Sept. '95- Sept. '96

1- Monitoring 18 years of Urbanization in the Nile Delta for Ministry of International Cooperation and United States Department of Agriculture.
2- Sea shore Erosion for the Ministry of International Co-operation and United States Department of Agriculture.
3- Watershed analysis for Ministry of Housing & Urbanization
4- Watershed analysis for the El Maadi Company for Housing
5- Greater Cairo Map for Ministry of Communications

E- Correspondence:

For more information, please contact:

Dr. Hesham El-Araby
Head of Information & Data Analysis Lab.
Cairo University Center for Environmental Hazard Mitigation
Tel: (202) 5719687 - 5719688
Fax: (202) 5717565 - 5727556
E-Mail: Hmaraby@frcu.eun.eg

AIR QUALITY EQUPMENT

Cairo University + GIS ArcInfo program on Sun Workstation

1- THERMO ENVIROMENTAL MODEL 43C PULSED FLUORESCENCE SO_2 ANALYZER

- EPA Approved (EQSA-0486-060).
- Core Microprocessor Based Controller with dedicated Communications Processor and Electronic Transducers to allow critical Instrument Parameters to be accessed Remotely.
- Pulsed Fluoresence Technique providing Specificity to SO_2,Ease of Operation,Precision,Reliability,Longterm Zero and Span Stability,Linear Response through all ranges and increases the optical intensity whereby a greater U.V. energy throughput and lower detectable SO_2 concentration are realized.

- Ranges : (Auto-Ranging / User Selectable)
  - 0 to 50,100,200,500,1000 ppb
  - 0 to 1,2,10,20,50,100 ppm

- Noise :
  - 1.0 ppb RMS (10 second time setting)
  - 0.5 ppb RMS (60 second time setting)
  - 0.25 ppb RMS (300 second time setting)

- Lower Detectable Limit :
  - 2.0 ppb (10 second time setting)
  - 1.0 ppb (60 second time setting)
  - 0.5 ppb (300 second time setting)

- Zero Drift (24 hour) : less than 1 ppb
- Span Drift : ± 0.5% per week
- Response Time : - 80 sec (10 second time setting)
  - 110 sec (60 second time setting)
  - 320 sec (300 second time setting)
- Precision : 1% of reading or 1 ppb
- Linearity : ± 1% Fullscale
- Outputs : Bidirectional RS 232 and Selectable Voltage
- Communlation : DB 25 Connector (Optional DB 50)
- User Software Facilities ; include field programmable measurement ranges and SO_2 concentration value storage by date and time.
- Status Output Identification.
- Extended Trouble Shooting Diagnostics providing Instantaneous Indication of Instrument Operating Parameter Status.
- Data Storage of 128K with Useable Selectable Averages,2 weeks capacity (5 minutes Averages) and Data System Back-up.
- Band pass filters for more selective wavelength isolation
- (220V/50Hz).

Delivered complet with:

- Internal Zero / Span Solenoid Valves with I/O Activities
- Sample Particulate Filter Hodler plus Five Filtes
- 6 pack (25 per pack) Filter elements
- Set of spare parts and consumables for one.
- Two Sets of Manuals
- Rack Mount.

2- THERMO ENVIROMENTAL MODEL 42C CHEMILUMINESCENCE NO-NO_2-NO_X ANALYZER

- EPA Approved (RFNA-1289-074)
- Core Microprocessor Controlled in conjuction with a dedicated communications processor and electronic transducers to allow critical instrument parameters to be accessed remotely.
- The analyzer utilizes One Small Diameter Photomultiplier Tube and One Reaction Chamber which are time-multiplexed for NO and NO_2 Measurements.
- Thermally Stabilized Flow System and Reaction Chamber.
- Long Life/ easily replaceable NO_2 Converter Cartridge.
- Internally Mounted Pump.
- Integral Sample Filter.
- Extended Troubleshooting Diagnostics providing Instantaneous indication of instrument operating parameters status, including; Pressure, Flow,DC Supply Voltages, Internal Temperature,Reaction Chamber temperature,Reaction chamber Temperature PMT Operating Voltage, and Converter Temperature.
- Converter Efficiency Temperature.
- Independent Selection of both Measurement Ranges and Display for NO,NO_2 and NO_X.
- Ranges : (Auto-Ranging / User Selectable)
  - 0 to 50,100,200,500,1000 ppb
  - 0 to 1,2,5,10,50,100 ppm.
- Noise : 0.20 ppb RMS (60 second time setting)
- Lower Detectable Limit : 0.40 ppb (60 second time setting)
- Zero Drift (24 hour) : less than 0.40 ppb
- Span Drift (24 hours) : ± 1% Full Scale
- Response Time :
  - 40 sec. (10 second time setting)
  - 80 sec. (60 second time setting)
  - 300 sec.(300 second time setting)
- Precision : ± 0.4 ppb (500 ppb range)
- Linearity : ± 1% Full Scale
- Outputs : NO,NO2 and NOx
  - Seletable Voltage
  - 4-20 mA isolated
  - RS-232 Bi-directional
- Communication : DB 25 connector (Optional DB 50)
- Status Output Identification.
- Data Storage of 128K with Useable Selectable Averages,2 weeks capacity (5 minutes Averages) and Data System Back-up.
- Specially designed Flow Sensor prior to the Reaction Chamber measures the total sample flow.

Delivered complete with:

- Rack Mount.
- Internal Zero/ Span Solenoid Valves with Remote I / O Activation.
- Sample Particulate Filter Holder plus Five Filters.
- 6 packs (25 per pack) Filter elements.
- Set of Spare Parts and consumbales for one year.
- Two Sets of Manuals.

3 - THERMO ENVIROMENTAL MODEL 49C U.V. PHOTOMETRIC BASED OZONE ANALYZER.

- EPA Approved (EQOA-0880-047)
- Core Microprocessor Based Controller with dedicated communications Processor and electronic Transducers to allow critical Instrment Parameters to be accessed Remotely.
- Unique Time-Shared Dual Cell Design. The Outcome is a Powerful Easy-to-Use, U.V. Photometric Based Analyzer which offers Increased Specificity via its Balanced Optical System.
- Automatic Temperature and Pressure Compensation.
- Short lag time.
- Real-time cancellation of potential interferent species occurs via the Cyclic Process.
  In the begining of the cyle, sample enters one cell and reference air (sample with the ozone catalytically removed) enters the second cell. Detectors then measure the light intensity transmitted through each cell.
  During the second half of the cycle, the roles of the two cells are **Interchanged** by appropriate **Switching of the Selonid valves**
- Powerful Diagnostics
- Remote Programming
- Data Storage of 128K with Useable- Selectable Averages, 2 weeks capacity (5 minutes Averges) and Data System Back-up.
- User Programmable Software Capabilities allows selection of Frequency at which internal Zero/Span Activation and instrument calibration and instrument calibration checks will occur. Addionally, Field Programmable Measurement Range Settings can be stored in memory for Subsequent recall.
- Extended Troubleshooting Diagnostics providing Instantaneous Indication of Instrument Operating Parameter Status, including; Pressrue, Flow , DC Supply Voltages, Internal Temperature, Ozonator Power Supply Voltage, and Lamp Voltage.
- (220V/50Hz)

- Ranges	: (Auto Ranging/ User Selectable) - 0 to 50,100,200,500,1000 ppb - 0 to 1,5,10,20,50,100,200 ppm
- Noise	: 0.5 ppb RMS
- Lower Detectable Limit	: 1.0 ppb
- Zero Drift	: - less than 1 ppb / 24 hour - less than 2 ppb / 7 days
- Span Drift	: less than 1% per month (including drift of transducer)
- Response Time	: 20 sec (10 seconds lag time)
- Precision	: 1 ppb
- Linearity	: ± 1% full scale
- Sample Flow Rate	: 1- 3 liters/min
- Outputs	: - Selectable Voltage - 4-20mA Isolated - Bidirectional RS-232
- Communication	: DB 25 (Optional DB 50)

Delivered Complete with :

- Internal Ozone Generator with Remote I/O Activation.
- Rack Mount
- Sample Prticulate Filter Holder plus Five Filters.
- 6 packs (25 per pack) Filter Elements
- Set of Spare Parts and Consumables for one year.
- Permeation Air Dryer for Azonator Input.
- Two Sets of Manuals.

4 - THERMO ENVIROMENTAL MODEL 48C GAS FILTER CORRLEATION CO ANALYZER.

- EPA Approved (RFCA-0981-054)
- Core Microprocessor Based Controller with dedicated Communications Processor and Electronic Transducers to allow critical Instrument Paratmeters to be accessed Remotely.
- CO Specific Gas Filter Correlation non-dispersive spectrometer,self-aligning optics,Heated Multipass Optical Bench,and Vibration Protection.
- Cancells any interference from other gases. Other gases do not cause modulation of the detector signal since they absorb the reference and measure beams equally. Thus,the Gas Filter Correlation System Responds Specifically to CO.
- Remote Programming; User Software include Field Programmable measurement ranges and CO concentration value storage by date and time.

5- THERMO ENVIROMENTAL MODEL 146 MULTIGAS CALIBRATION SYSTEM

- Designed to Supply the Required Levels of O3 , CO,SO2,NO/NO2/NOx to perform Zero, Precision and Level 1 Span checks,Audits,as well as Multipoint Calibration of these gases.

- Designed to meet or exceed all published U.S. Enviromental Protection Agency Requirements for Mutlipoint Calibration, Audit,Level 1 Span and Precision checks.

- Mass Flow Controlled Gas Dilution System.
- Constant Purge Flow Through Permeation Tube Oven during Stand-by.
- Positive Shut off of Zero Air during Stand-by Operation.
- Remote Operation Via Contact Closure or TTL.
- Can be programmed to perform Level 1 Span and Precision checks remotely.
- Direct Read-out of Temperature of Permeation Tube Oven.
- Can be used to Control External Zero/ Span Solenoids.

Accuracy of Mass Flow Measurement : ± 1% of Full Scale
Linearity of Mass Flow Measurement : ± 0.5% of Full Scale
Repeatability of Mass Flow Measurement : ± 2% of Full Scale
Ranges:

- Zero Air : 0 to 5; 0 to 10,0 to 20 liters per minute
- Span Gas : 0 to 50; 0 to 100,0-200 SCCM

Rangeability : 100 : 1
Dilution Ratio : Depends upon choice of Mass Flow Controllers Response Time as Measured at Output of Manifold Les to 99% of Final Value : Less than one minute for low flows. Faster for high flow (for Gas - Phase Titration Mode Response Time Increases to 4 minutes)

Remote Operation:

- Input Mode Commands : Contact Closure to ground or TTL Logic Levels.
- Ozone Levels Available : Two independent levels can be separately commanded.
- Flow Levels Available Through Logic Commands : Each Flow Controller has two independent levels that can be commanded remotely.

- Flow levels Available
  Through Voltage Commands : 0 - 100% Continuous with 0-5 VDC Voltage input

- Output :
  - Measurement of Flow Levels : 0-5 VDC output for each Flow Controller corresponding to 0-100 % of Full Scale
  - External Solenoid Controller : Up to (5) 24 VDC external solenoids can be controlled by 146
  - Temperature Range : 10-30°C
- (220V/50Hz)

Delivered Complete with:

- Permeation TubeOven and GPT :

  - Temperature Control : Single Point 35° C or 30°C
  - Temperature Stability : ± 0.1°C indicated by front panel deviation meter
  - Warm-up Time - Oven : 1 hr
  - Carrier Gas Flow : 100 SCCM nominal
  - Chamber Size : Accepts permeation tube up to 12 cm in total length; 1 cm in diameter.
  - Rack Mount.
  - Set of Spare Parts and consumables for 1 year.

6 - THERMO ENVIROMENTAL MODEL 111 ZERO AIR SUPPLY

- Generates Pollutent Free "Zero" Gas for NO-NOx-O3-SO2-CO and hydrocarbon requirements.
- Pressure : 10-30 PS1
- Water Vapor : 0°C Dew Point

- **Delivered Complete :**

  - CO-Reactor (HC-CO Catalytic Oxidizer)
  - Rack Mount
  - Compressor, 0-20 LPM
  - Spare Parts and Consumables for one year for Model III
  - Calibration Standard Gas Cylinders, approximately 5 cubic Meters Capacity. Each Cylinder is delivered complete with a Dual Stage Stainless Steel Regulator.
    * SO_2 50 to 100 ppm
    * NO 50 to 100 ppm
    * CO 5000 to 10.000 ppm
    * HC 5000 to 10.000 ppm
  - P/N # SM-7 Sample Manifold Assembly
    * 7 Ports
    * Teflon Inlet Protected by an Outer PVC Pipe
    * Glass Manifold
    * Air Blower with bleed Adapter
    * Filter and Calibration Valve Assembly
    * The Filter Holder and the Manifold is connected to a two way solanoid valve through with calibration gas to pass through the filter which is the recommended U.S. EPA procedure.

- Dual Bay Enclosure to accomodate all the Gas Analyzers, Multipoint Calibrator, Zero Air Supply and Data Aquisition System. The Enclosure Feates:
  - Exhaust Manifold and Ventillation Fans
  - All plumbing
  - Wiring, Wire Trays and Circuit braker
  - Front plexiglass Inserts so that the instrument could be seen without
  - Opening the doors
  - Rear and Front Doors.

7 - METEOROLOGICAL EQUIMENTS

These are Met-One Products Including:
- Translator Rack Mount Model 12D-6, 6-Channels
- P/N # 1220-4 Power Supply 220V, H2
- P/N # 2223-2 AC Surge Protection 220 VAC
- P/N # 1180 WS Wind Speed Translator
- P/N # 1190 WD Wind Direction Translator
- P/N # 1760 TS Single Range Temp. Translator
- Translators for BP and Rain Guage.
- Model 014A Wind Speed Sensor with cable
- Model 020C-1 Wind Direction Sensor with Cable
- Model 083C-1-35, Relative Humidity/Temperature Sensor
- Model 090D, Barometic Pressure Sensor

- Model 370, Rain Guage
- Model 073B Radiation Shield; Narural Aspirated.
- Model 191-5 Cross Arm Assembly
- Cables for Connecting Sensors to transfator
- P/N # 970666 Tower 10 meter Foldover
- P/N # 5284 Tower Grounding System
- P/N # 193 Universal Tower Mount
- Recorder.

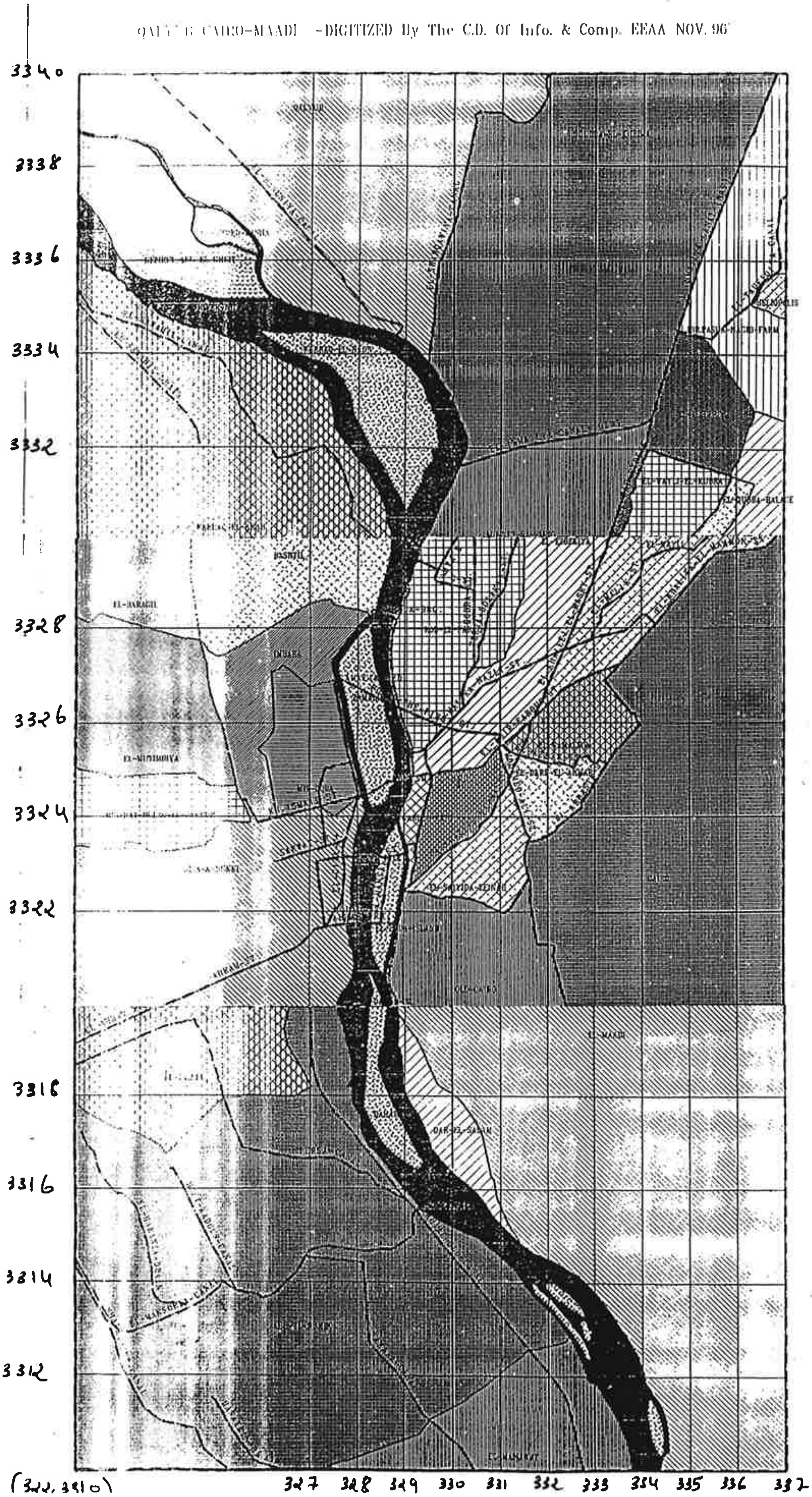
8 - ODESSA MODEL DSM 3260-AQM DATA LOGGER

- Inputs:
  - Analog : - 16 Single - Ended
    - 16 Differential, Fully Isolated Voltage
  - Digital : Status, 40 Digital Inputs Detects Contact Closures (Dry Relay) or Voltage to Ground (24 VDC Max)
- Outputs :
  - Digital : 16 TTL Contact Closures 12 VDC 50 mA Maximum,

- Serial I/O Ports : Two RS-232
- Parallel Port : Standard Centronics Ports, DB 25 Connector

Appendix L

Digitalized maps of Greater Cairo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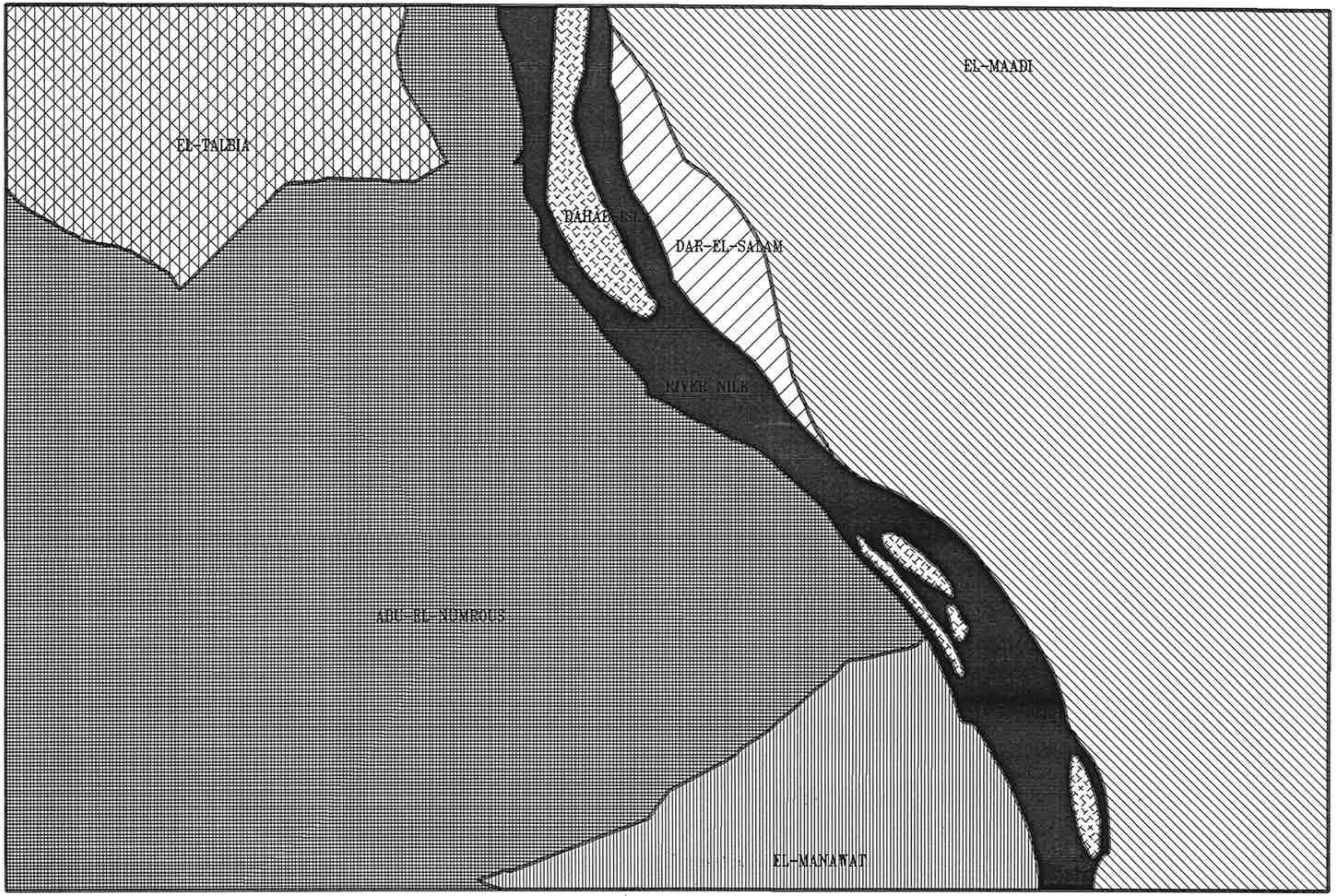

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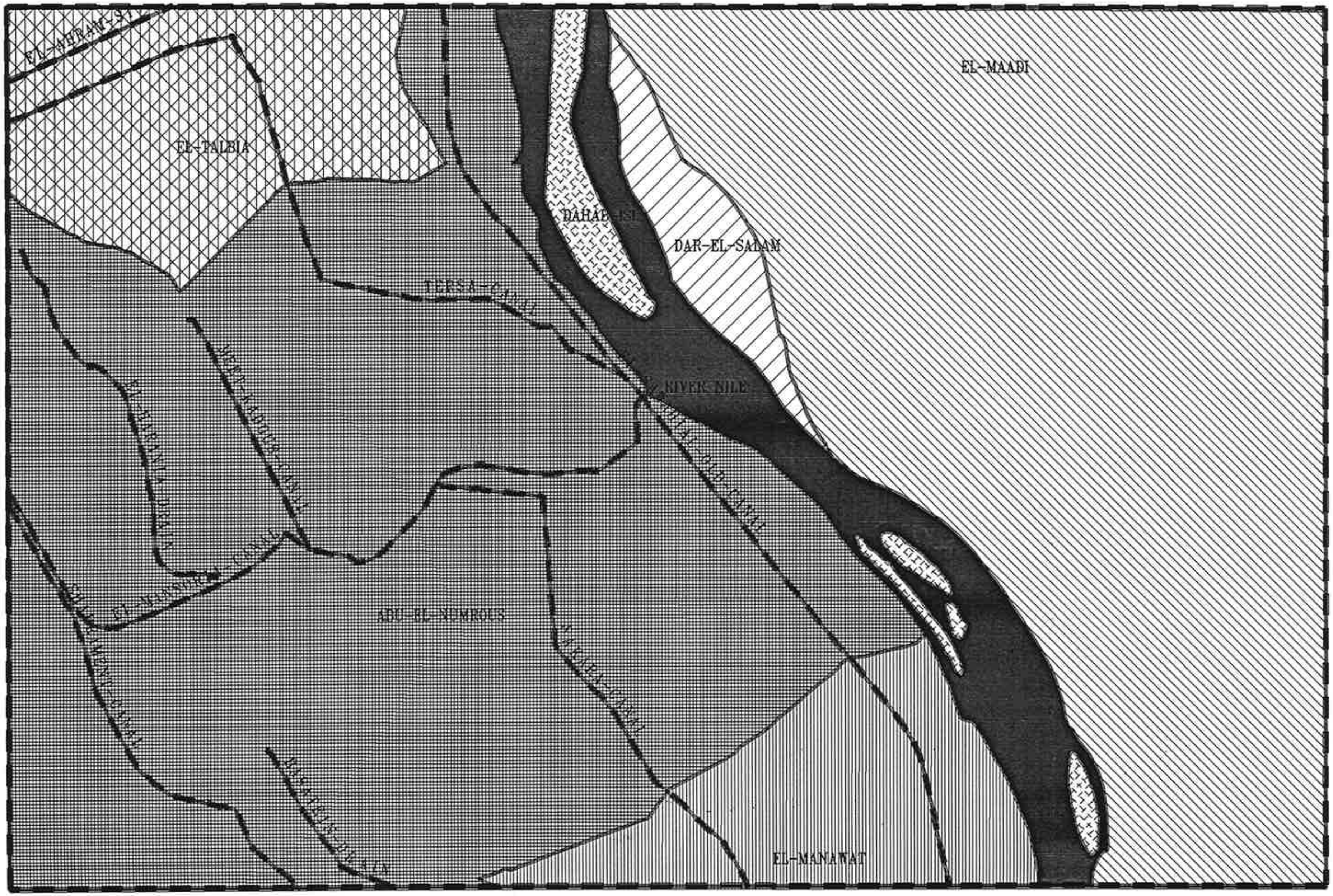

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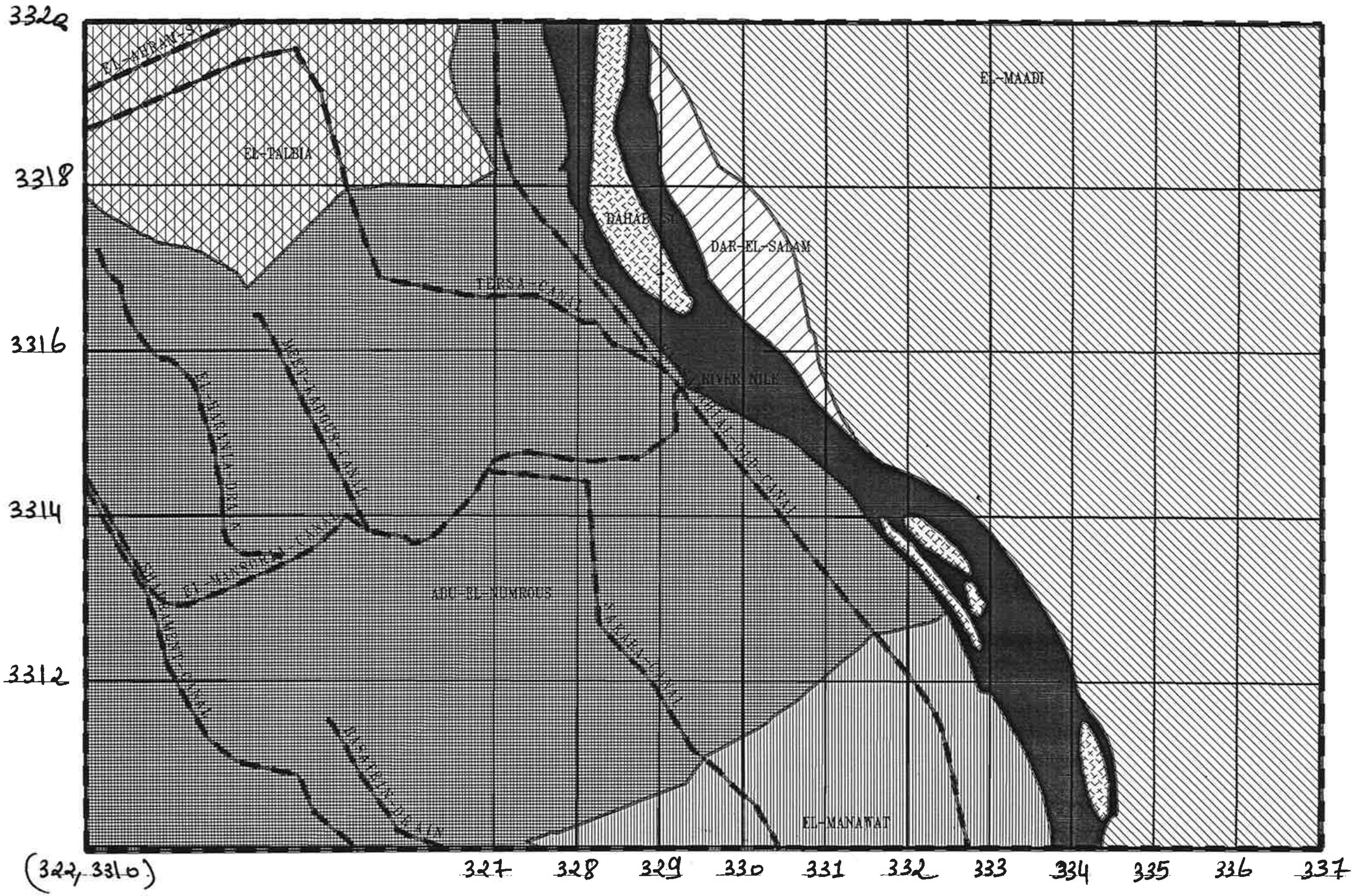

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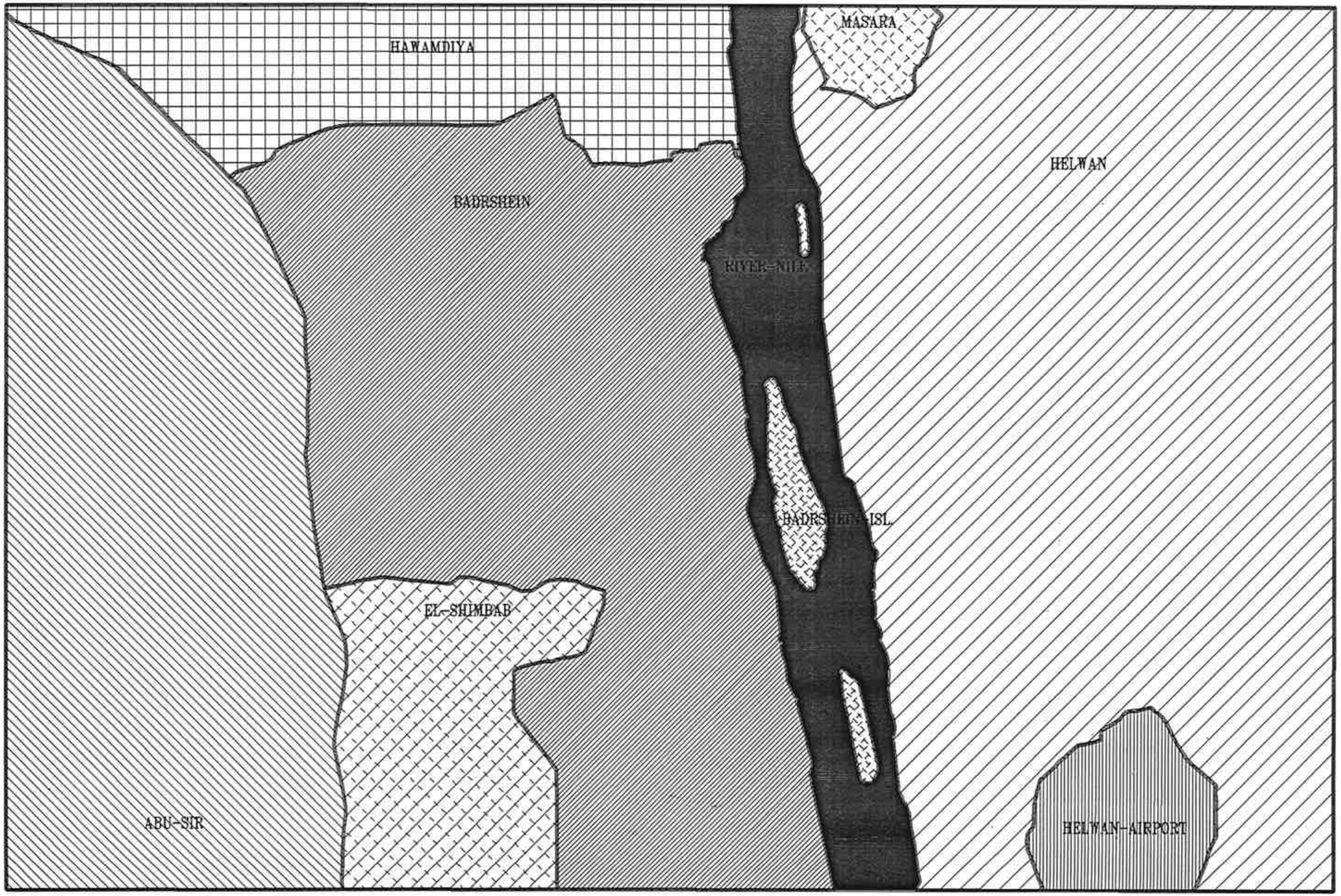

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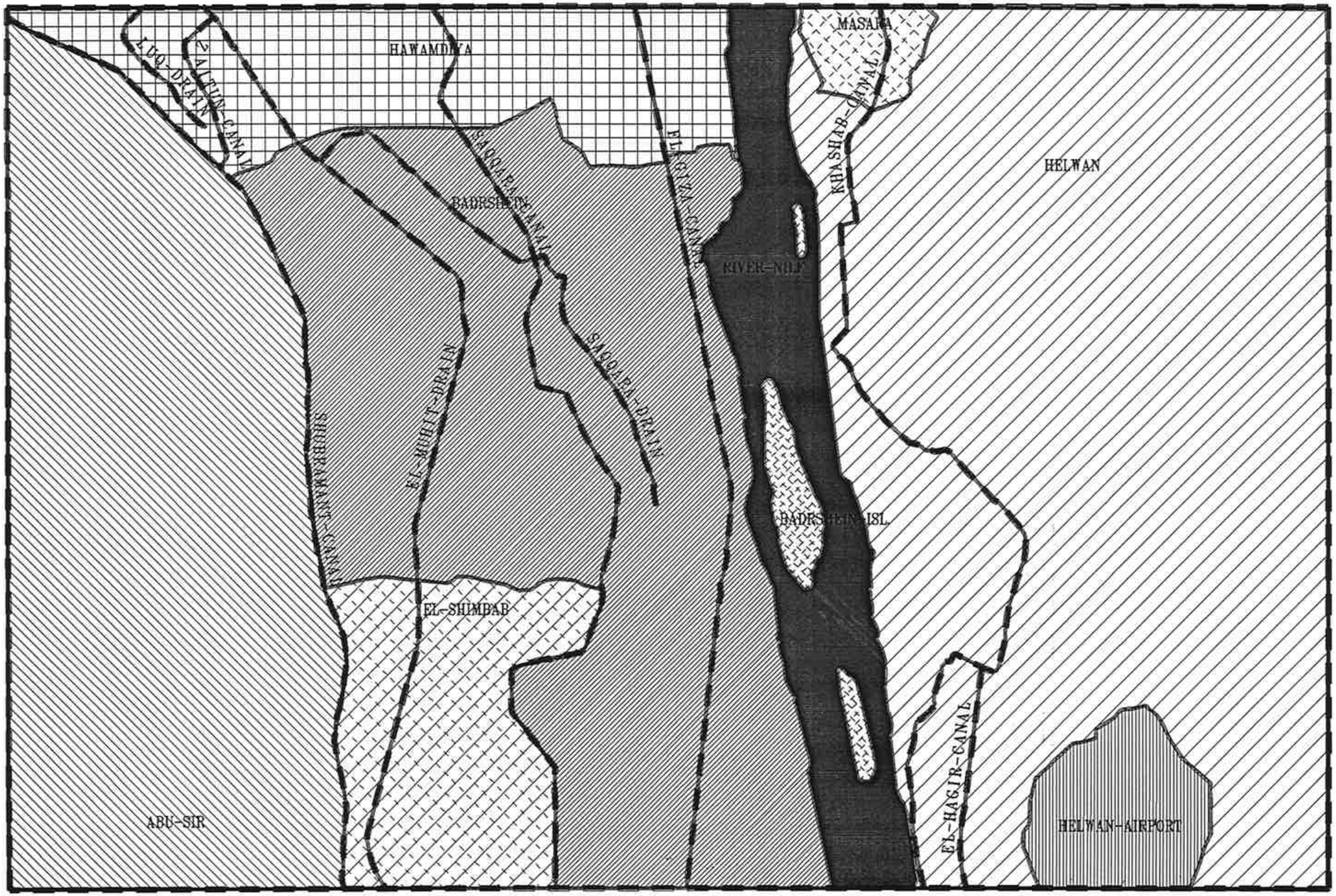

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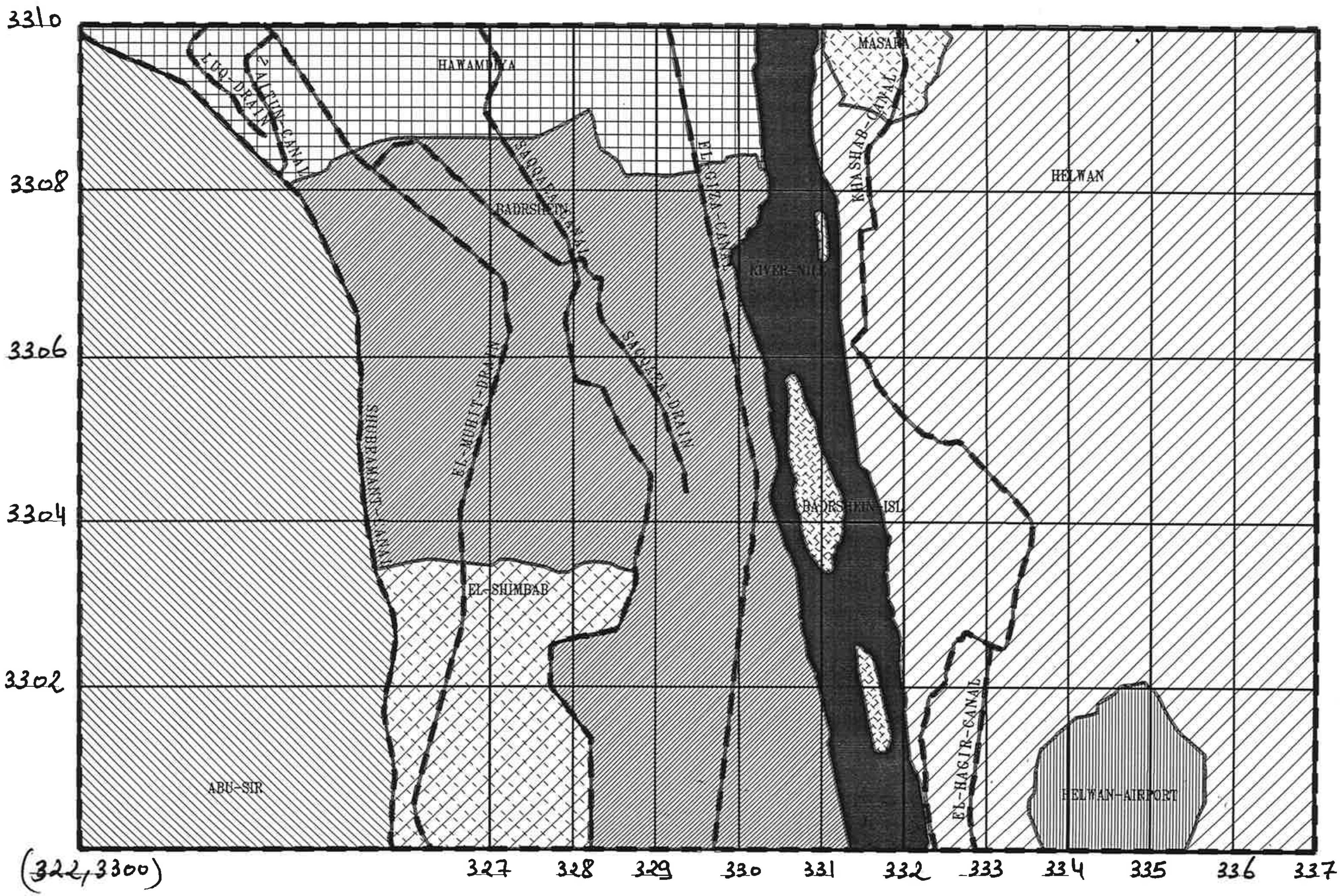

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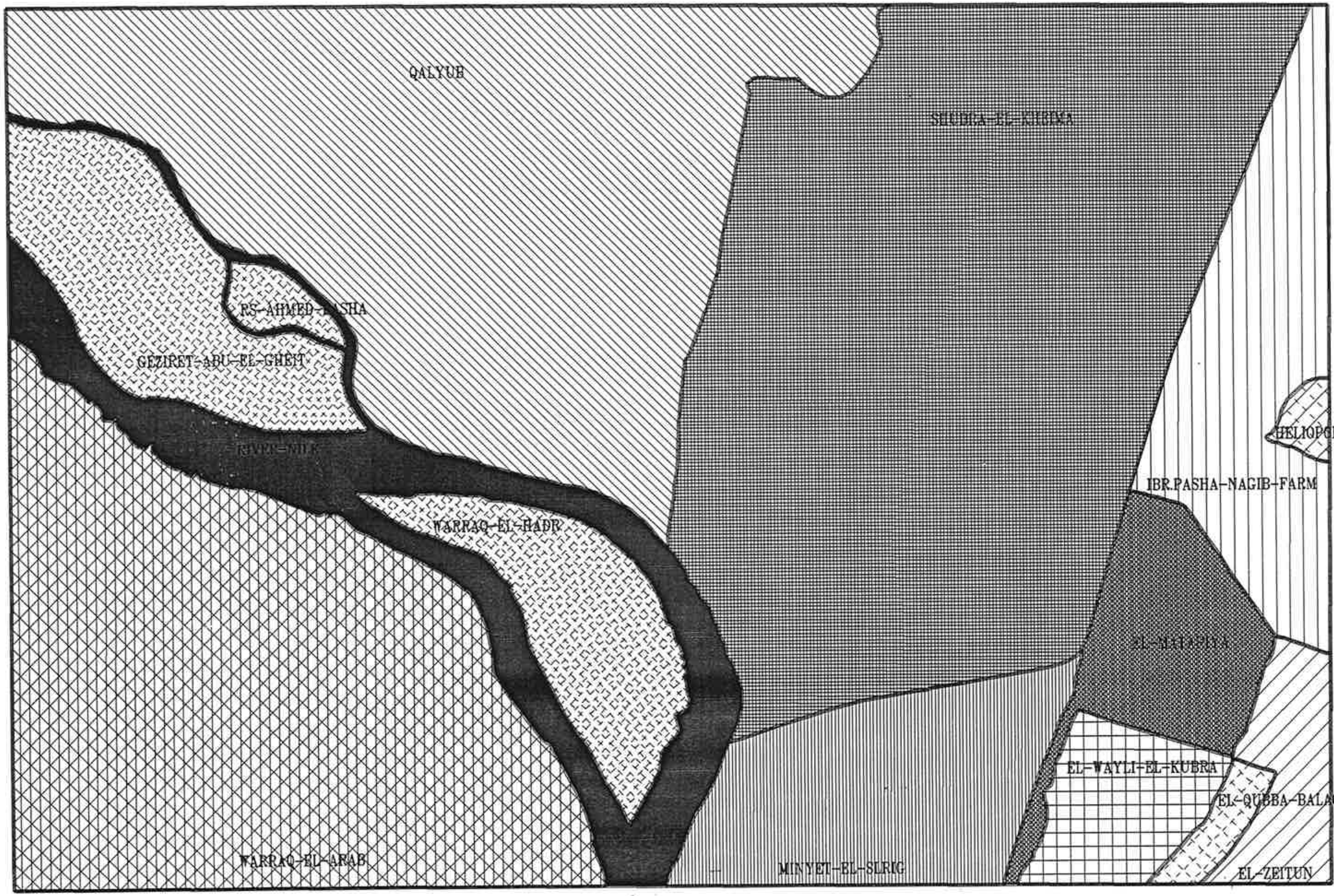

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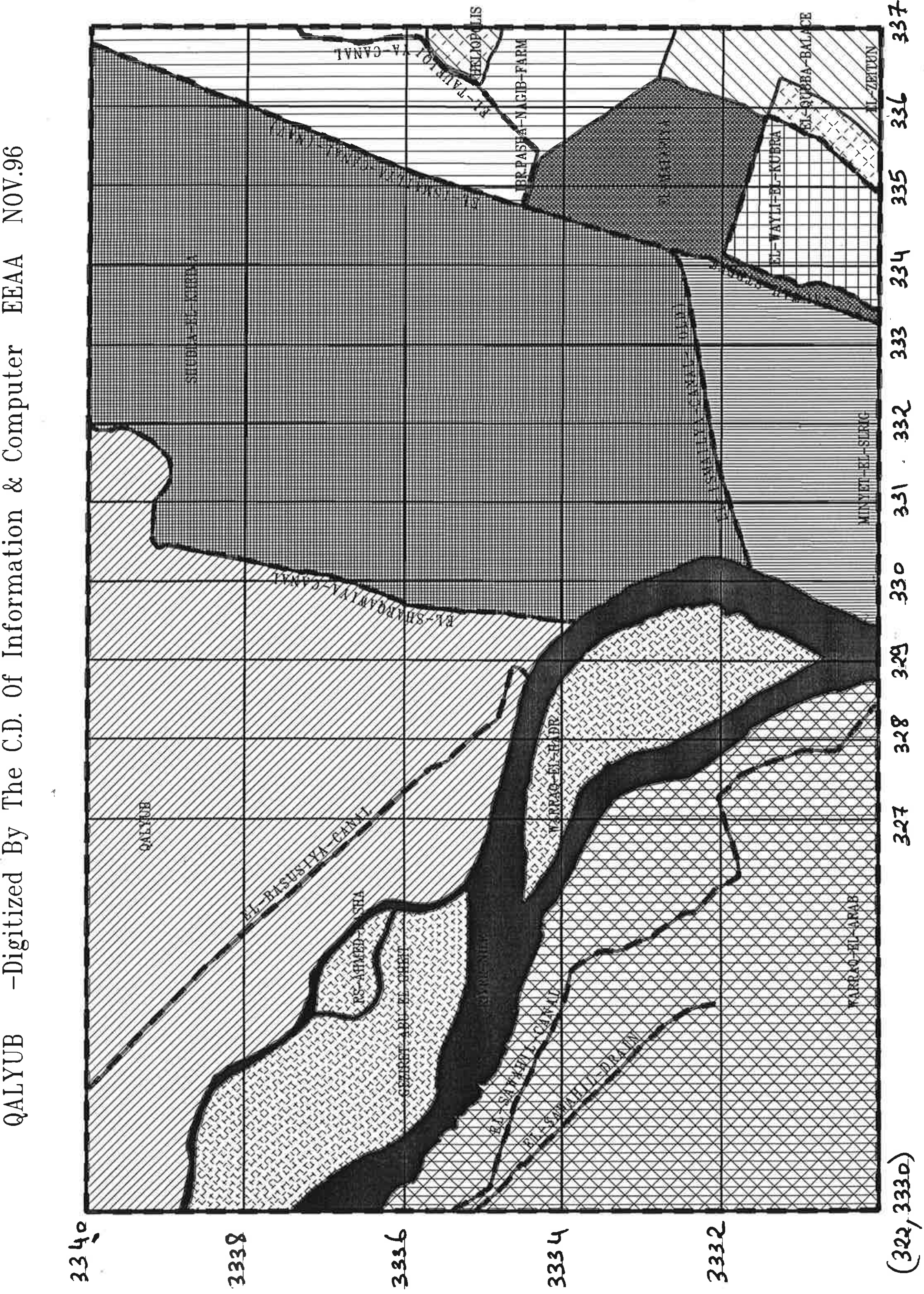
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EL-SHARQAWIYA-CANAL
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EL-ISMAILIYA-CANAL
HELIOPOLIS
IBR.PASHA-NAGIB-FARM
EL-WAYLI-EL-KUBRA
EL-QUBBA-BALACE
EL-ZEITUN
MINYET-EL-SIRIG
WARRAQ-EL-HADR
WARRAQ-EL-ARAB
RIVER-NILE
EL-SAHELI-CANAL
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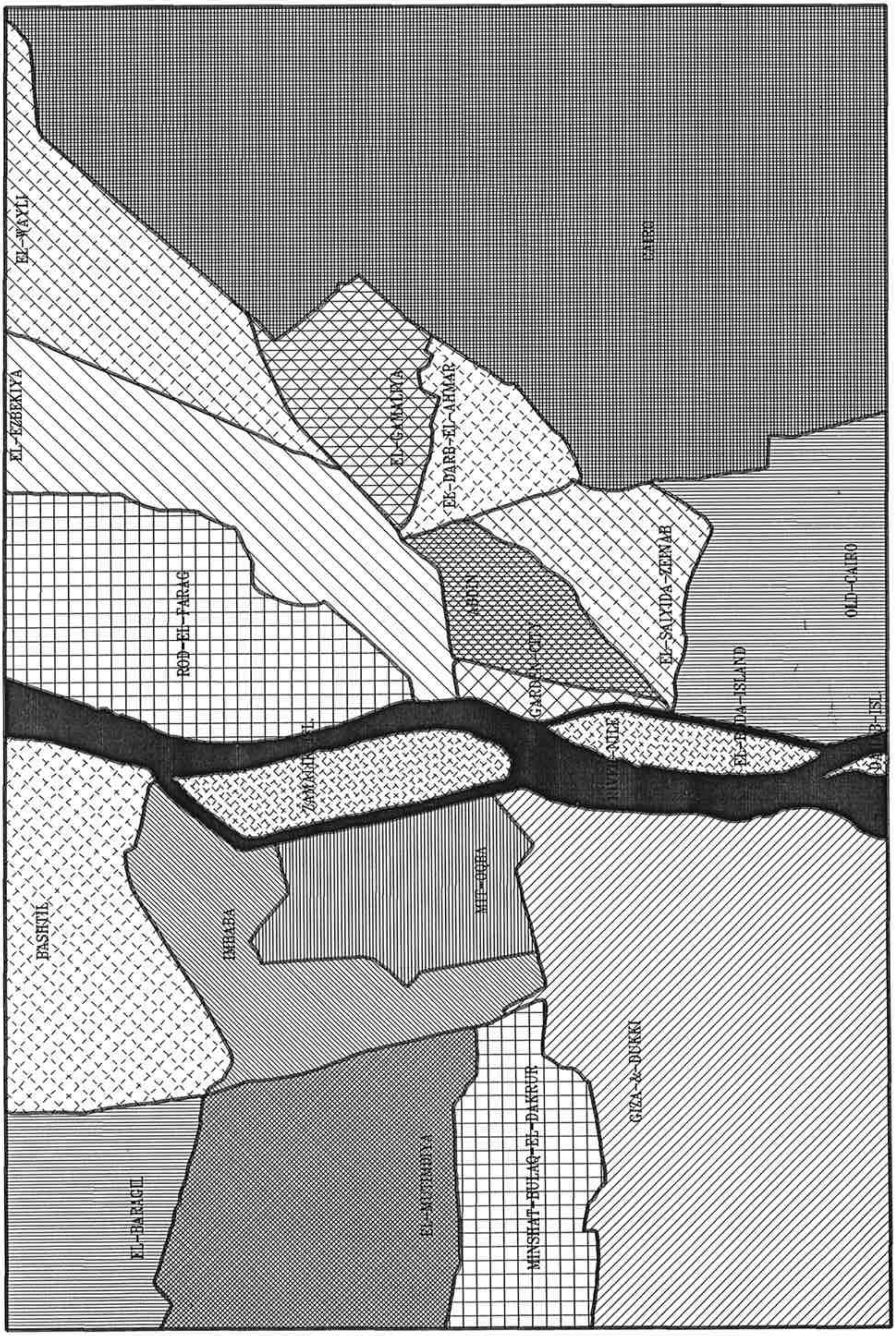

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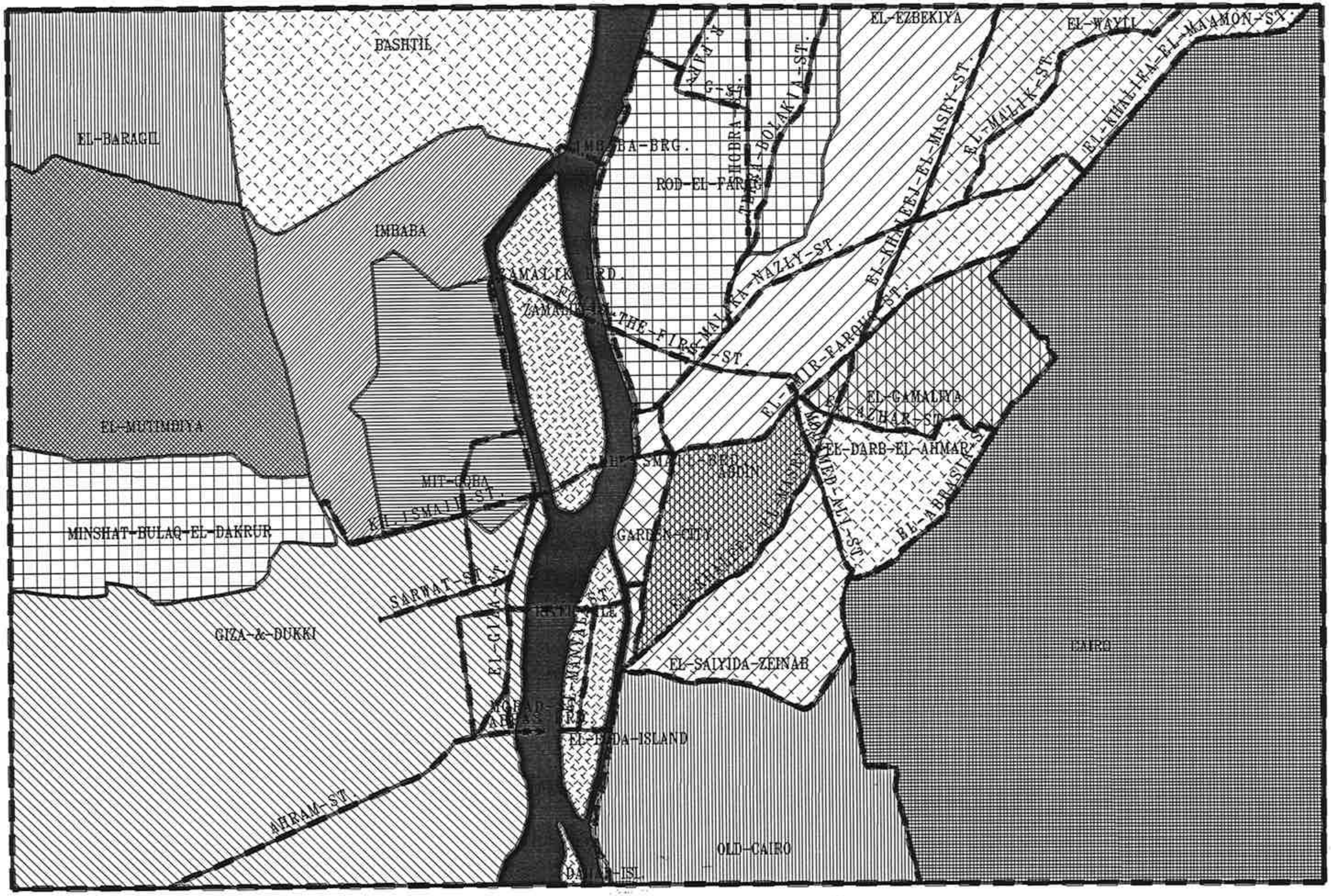

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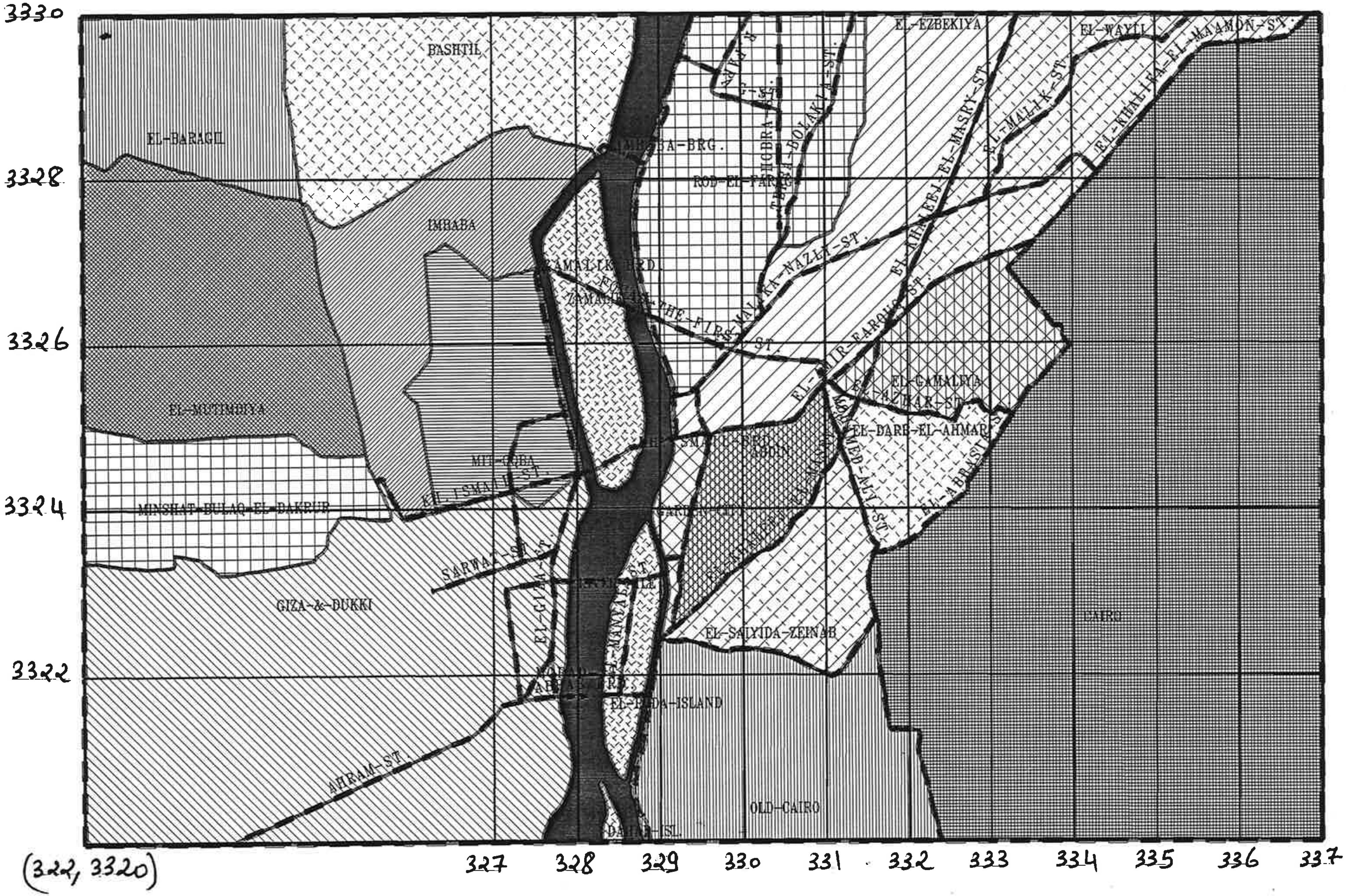
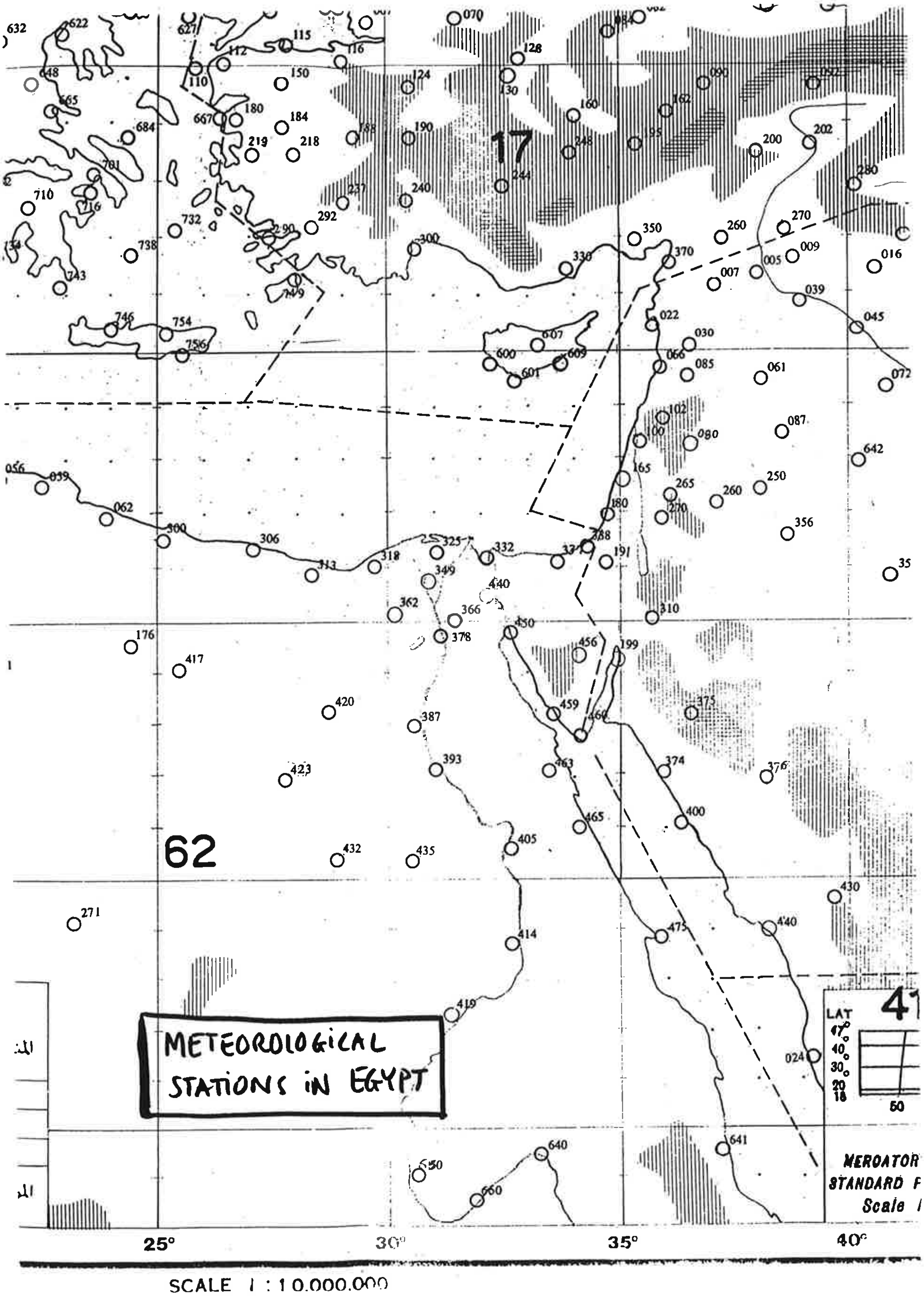


Appendix M

Egypt Meteorology Authority

a) Measurement stations
b) Ozone in the Greater Cairo area


METEOROLOGICAL STATIONS IN EGYPT
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Ozone formation in the greater Cairo area

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Abstract

Ozone formation in the greater Cairo area was studied in 1990 in a 3-week measurement period performed at three sites (Shoubra El-Kheima, Mokattam Hill, Helwan), covering a north-south direction of 27 km, and in 1991, from the beginning of April until the end of October, by measurement of the seasonal variation of ozone at one site at El-Kobba. The sinusoidal shape in the diurnal volume fraction plots with peak values of 120 ppb and daily mean value of 50 ppb throughout the year indicate a substantial contribution of photochemistry to the ozone content of the atmosphere. Ozone is produced predominantly over the industrial area in the north and in the centre of Cairo and transported southward by the prevailing northerly winds. Contrary to many urban areas in Europe and in North America, fairly high average ozone levels of 40 ppb are observed during the night throughout the spring and the summer. This may imply that health hazards and crop damage are higher in the greater Cairo area than in Central Europe.

Keywords: Ozone; Photochemical smog; Khamasin wind; Total suspended particulate matter

1. Introduction

As early as the 1940s the phenomenon of photochemical smog was first observed in the Los Angeles Basin, manifesting itself as reduced visibility, irritation of the eyes, and damage to vegetation [1]. In the meantime, photochemical smog formation has been observed in large metropolitan areas throughout the world [2,3]. Photochemical smog is a complex mixture of atmospheric pollutants termed photo-oxidants, which are rapidly formed on warm sunny days through reactions of volatile hydrocarbons and other oxidisable organic compounds with nitrogen oxide(s) under the influence of sunlight [3,4]. In quantitative terms, ozone is the most important product of this complex mixture and thus an indicator of the general level of photochemical pollution. There is growing evidence that the amount of

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tropospheric ozone over populated areas of Europe and North America has doubled during the last century [5] and is currently increasing at an annual rate of about 1% [6,7].

Ozone measurements in the Mediterranean region [8] and Greece in particular [9,10], indicate the serious problems of photochemical air pollution in areas with more sunny days per year than Central Europe. Under a German-Egyptian project of scientific cooperation, ozone levels in greater Cairo were measured. The greater Cairo area encompasses 27% (about 13 million) of the Egyptian population, 64% of the industry and 45% of the motor vehicles (about 1 million in 1991). Low energy prices have encouraged the rapid growth of industry and wasteful use of energy. The number of vehicles increased by 10% per annum and the electricity consumption by 8.7% per annum during the decade from 1980 to 1990. Thus, greater Cairo, already one of the largest cities in the world, is expected to attain a population of almost 20 million by the year 2000. It is clear from these statistics that the population of greater Cairo is exposed to an alarming level of air pollution. Because of the situation outlined above and Cairo's location at latitude 30°N with more than 340 days of sunshine per year, it is expected that high levels of photochemical smog occur in the greater Cairo area today, with higher levels predicted for the near future. This is a report of the results of ozone measurements performed in greater Cairo in the years 1990 and 1991.

2. Methods

A measurement period of 3-weeks duration, from March 1 to 21, 1990 was carried out. Three sites at slightly elevated altitudes in different parts of greater Cairo had been selected. Since the prevailing wind direction in Cairo is northeast, one station was set up in the industrial area of Shoubra El-Kheima to the north of Cairo at 80 m height on the roof of a large building. The second station was erected at the steep edge of Mokattam Hill, 205 m above sea level, on the roof of a private house. This station is 9 km south of Shoubra El-Kheima. The third measurement site

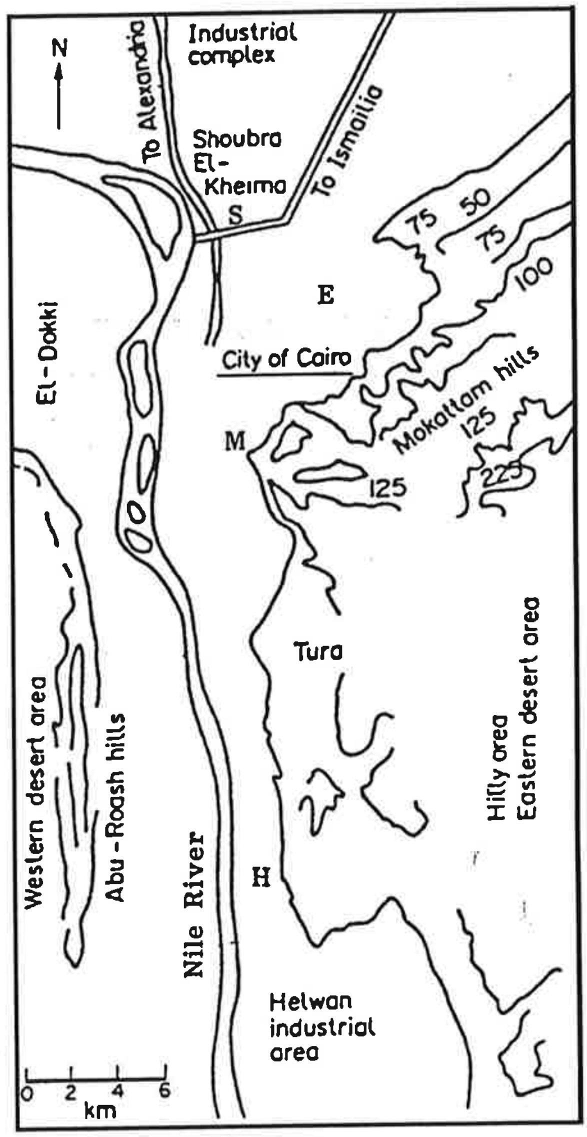

Fig. 1. Map of Cairo with the monitoring sites and height contour lines. S, Shoubra El-Kheima; E, El-Kobba; M, Mokattam Hill; H, Helwan.

was 18 km south of Mokattam Hill at 114 m above sea level at the meteorological observatory in Helwan. The three sites are indicated on the map of Cairo in Fig. 1. Thus, the three stations cover a north-south distance of 27 km over the greater Cairo area.

Ozone was continuously monitored at the three stations using commercially available ozone monitors (Dasibi, Type 1008 AH and 1008 RS). Before and after the measurement period, the ozone analysers were calibrated against the 1008 PC ozone generator (Dasibi) used as a transfer standard which was calibrated in Germany, using the neutral potassium iodide method [11]. The ozone analysers together with data loggers (Campbell Scientific, model 21 X) were placed in wooden weather huts which were painted white. The Teflon inlet tube was attached to a pole about 1 metre away from the nearest surface. All data was collected as 5-min averages in the data loggers and transferred once every week by a buffer module to a personal computer for further processing. Unfortunately, the last transfer of ozone data measured over 6 days from Mokattam Hill failed. Meteorological data of wind velocity and wind direction, temperature and solar irradiation were measured at the Meteorological Observatory in Cairo at El Kobba, as well as at the Helwan meteorological station (Fig. 1).

In 1991 ozone was measured at one site, on the roof of the Meteorological Observatory at El-Kobba, from the beginning of April until the end of October. A new ozone analyser (Environnement SA, model O_3 41 M) was used in combination with a data logger. This half-year period of continuous ozone monitoring in 1991 was divided into three terms:

Term I:	April 7–May 31
Term II:	June 17–July 25
Term III:	September 9–October 30

After each measuring term the ozone analyser was recalibrated.

In 1991, during the Khamasin season, the daily dust concentration was measured at the El-Kobba site from April 14 until May 31 using a high-volume air sampler (Model HVS-150, Ströhlein, Göttingen). Air was aspirated over 24-h periods through a filter at a volume flow rate of 1.5 m^3 min^{-1}.

3. Results and discussion

The geographical location of the city of Cairo, about 120 km south of the Mediterranean coast, is at 30°N. Greater Cairo is located between two hills of about 200 m height forming a valley through which the Nile River flows (Fig. 1). The valley may affect the prevailing northerly wind by channelling it along the north-south axis of the valley (Fig. 1). The total area of the city of Cairo is about 250 km^2. Since Cairo is surrounded by the Sahara desert, the West and the Eastern desert, the meteorological situation is largely determined by these vast deserts. During the measurement period in 1991, from April until the end of October, the atmospheric pressure was remarkably constant. The mean value was 1012 mbar, the minimum was 998 mbar and the maximum value only 1022 mbar. The relative humidity during that period varied steadily between 15 and 85% during day and night with a mean value of 55%. This was accompanied by temperature fluctuations between 13 and 42°C, with a mean value of 24°C. A 10 year average indicates that the mean total annual precipitation in greater Cairo is only 29 mm. The prevailing wind direction was northeast 63% of the time, during the measuring period in 1991. Spring in greater Cairo is the season which is characterised by occasional passages of strong hot Khamasin southerly winds loaded with dust and desert sand [12].

3.1. Ozone concentration in greater Cairo during March 1990

The hourly average volume fractions of ozone measured at the three sites (Shoubra El-Kheima, Mokattam Hill and Helwan) in greater Cairo during March 1990 are shown in Fig. 2. The daily formation of ozone in the early morning hours and the fairly rapid decrease in the late afternoon at about 18:00 h LST result in the typical sinusoidal curve of diurnal ozone formation, as depicted in Fig. 2, due to the photochemical smog cycle [3,4]. According to Singh et al. [13] typical ozone concentrations in clean remote atmospheres range from 20–40 ppb, therefore concentrations above 40 ppb are undoubtedly anthropogenic or 'manmade' ozone levels. Ozone production results from the photochemical reaction of the primary pollutants NO_x (NO and NO_2) and unburned hydrocarbons from industry, traffic and thermal power plants. In the evening and at night,

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ozone is destroyed by NO generated locally by these sources. In Fig. 3 the distribution of ozone concentrations measured at the three sites in greater Cairo are given in the form of histograms on the left and the average diurnal behaviour of the ozone concentrations over the 3 weeks of the measurement period are indicated on the right. Since normal Gaussian distribution does not apply to the diurnal behaviour of atmospheric ozone concentrations in an urban environment, the data obtained in Cairo was analysed using robust statistical methods [14,15]. In Table 1 the maximum and minimum values of the ozone concentrations at the three sites are given for the day-time hours from 08:00 until 18:00 h LST — the time span of photochemical ozone production — and from 18:00 h LST through the night until 08:00 h LST for the time span of ozone destruction.

High ozone concentrations were monitored at all three sites (Fig. 2), reaching 90 ppb in Helwan, with similar average ozone concentrations at Shoubra El-Kheima and Mokattam Hill, as depicted in Fig. 3 and shown in Table 1. But at Helwan, approximately 20 km south of central Cairo, the mean ozone concentrations are higher both at day-time and in the night (Fig. 3 and Table 1). The average night-time concentration of ozone is significantly higher at Helwan. This is because there are no fast-acting sinks, destroying ozone so that the average night-time concentration of ozone is maintained at 40 ppb at that site. The prevailing wind directions in March 1990 were north-northeast, 87% of the time. Thus, photochemically produced ozone generated in the industrial zone north of, and in central Cairo is transported southward. Generally, the ozone maximum at Helwan occurs with a delay of 1 to 2 h compared to the city of Cairo. On March 13 and 14, the ozone maximum concentrations at Shoubra El-Kheima and Mokattam were 70 ppb at 14:00 h LST; at Helwan they were 85 and 90 ppb, respectively, at 16:00 h LST. On both days strictly northerly winds with wind velocities of 9 and 8.5 km/h, respectively, were blowing so that the transport times for the distance from the city of Cairo to the measuring site in Helwan were 2 h.

Since ozone in urban air is formed as a result of fast photochemical reactions which take some time to occur, its concentration in ambient air is often correlated with solar irradiance [1,3,4]. The ozone volume fraction data was correlated with the intensity of solar irradiance by introducing a

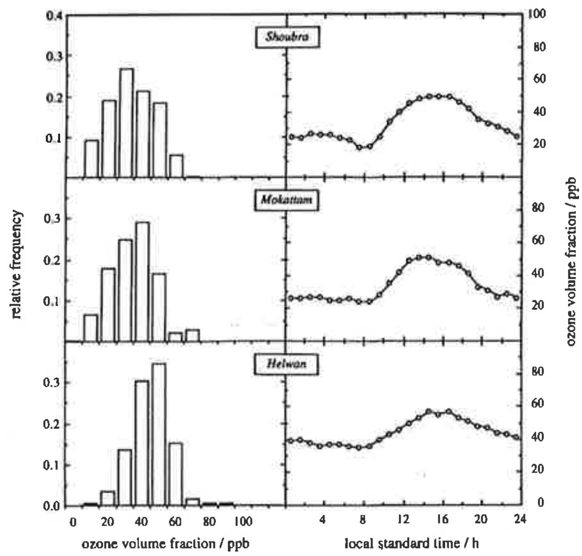

Fig. 3. Probability distribution of hourly average ozone volume fractions (left) and their average diurnal variations (right) at the three measuring sites during March 1990.

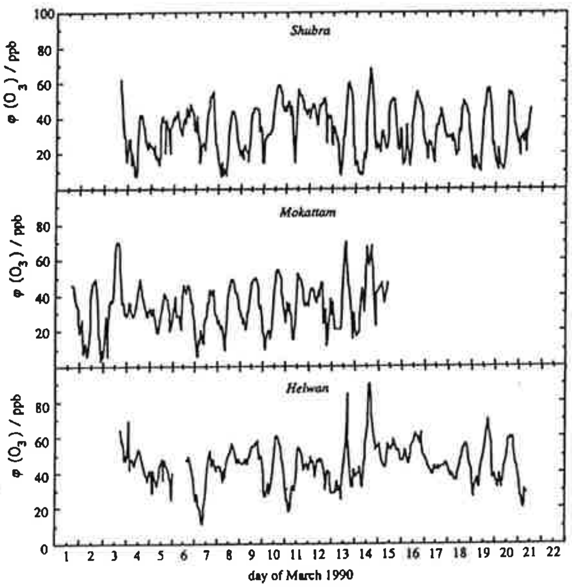

Fig. 2. Hourly average ozone volume fractions at three measuring sites in greater Cairo during March 1990.

Table 1
Maximum, minimum, mean and standard deviations of the ozone volume fractions in greater Cairo during March 1990

Location/Time	N	O_3 max [ppb]	O_3 min [ppb]	O_3 mean [ppb]	σ [ppb]
Shoubra El-Kheima	428	69	8	34	14
08:00–18:00 h LST	194	69	8	41	13
18:00–08:00 h LST	234	55	8	28	11
Mokattam	313	71	3	35	13
08:00–18:00 h LST	139	71	8	43	12
18:00–08:00 h LST	174	47	3	28	10
Helwan	422	90	12	45	11
08:00–18:00 h LST	181	90	16	50	11
18:00–08:00 h LST	234	70	12	41	10

N, number of data (hourly averages).

time shift of 1 to 4-h. In Table 2 the data of such a correlation are given as squared correlation coefficients.

In Fig. 4 the correlation is shown of the hourly average ozone volume fractions, measured at Shoubra El-Kheima, with the solar irradiance. It is interesting to note that the optimum time shift for the correlation at Shoubra El-Kheima and Mokattam is 2 h indicating that the primary photochemical process take place 2 h before ozone reaches the monitoring site. Since the values of the squared correlation coefficients at Helwan are much lower and the maximum is reached after 3 h, it can be concluded that the generally higher ozone concentrations at Helwan are due mainly to the transport of ozone from regions further to the north of greater Cairo and are to a lesser extent due to ozone locally generated by the photochemical smog process. This indicates that the northern parts of greater Cairo, where the main industrial areas are concentrated, are the source of ozone and its precursors.

3.2. Ozone concentrations in Cairo during 1991

In order to gain more insight into the seasonal behaviour of the photochemical activity in the air of greater Cairo, a long-term measurement of ozone and meteorological variables was started on the roof of the Meteorological Observatory in El-Kobba (Fig. 1) in early April and terminated at the end of October 1991. Fig. 5 shows a compilation of the probability distribution of the ozone concentrations measured, represented as histograms, and of the average diurnal variations of the ozone volume fractions during the three measuring terms. The diurnal behaviour of the ozone volume fractions in Fig. 5 are shown in a 'box and whiskers' presentation [15]. The black squares indicate the medians, the box edges the 25th and 75th percentiles, the bars the 10th and 90th percentiles and the dots the minima and maxima values of the ozone volume fractions. The variation of the ozone concentration is largest in the first term when the wind direction varied more than during the other measurement terms. Dur-

Table 2
Squared correlation coefficients (r^2) of ozone volume fractions with the solar irradiance during March 1990

Station	Time shift (h)				
	0	1	2	3	4
Shoubra El-Kheima	0.180	0.372	0.456	0.357	0.165
Mokattam	0.246	0.481	0.581	0.347	0.145
Helwan	0.103	0.201	0.261	0.284	0.233

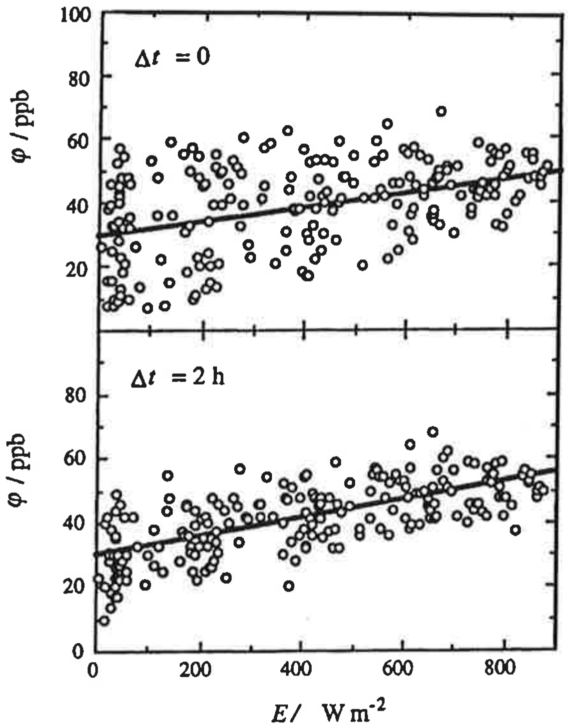

Fig. 4. Correlation of hourly average ozone volume fractions at the Shoubra El-Kheima site with the intensity of solar irradiance, without delay (top) and with a time shift of 2-h (bottom).

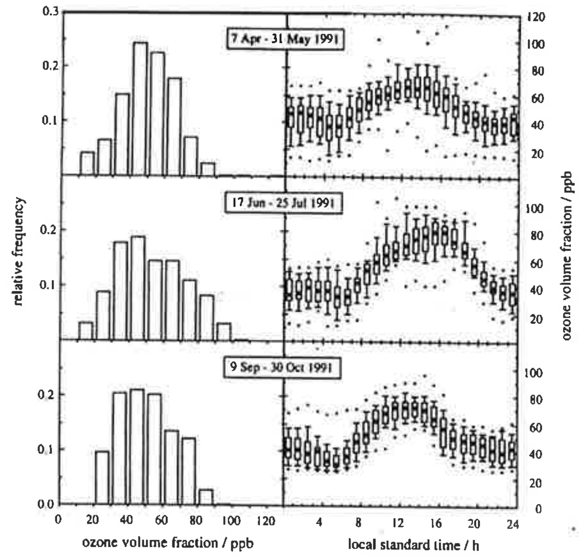

Fig. 5. Probability distribution of hourly averaged ozone volume fractions (left) and their average diurnal variations (right) at El-Kobba during the three measuring periods in 1991. The diurnal behaviour of the ozone volume fractions are given in a 'box and whiskers' presentation [15]. For explanation consult the text.

ing the summer term the ozone concentration was higher than during the spring and autumn. During the summer between 08:00 and 18:00-h the WHO air quality standard of 60 ppb was exceeded 90% of the time despite the fact that no extremely high ozone concentrations above 120 ppb were measured. During the three measurement terms a total of 3144-hourly average ozone volume fractions were obtained. In Table 3 the maximum, minimum, mean and standard deviations of the ozone volume fractions in Cairo, at El-Kobba, during 1991 have been entered.

In Table 3 the day-time and night-time values of the ozone concentrations are separately indi-

Table 3
Maximum, minimum, mean and standard deviations of the ozone volume fractions in greater Cairo in 1991

Term	N	O_3 max [ppb]	O_3 min [ppb]	O_3 mean [ppb]	σ [ppb]
I (Apr. 7–May 31)	1234	121	12	50	16
08:00–18:00 h LST	576	121	16	60	14
18:00–08:00 h LST	658	76	12	41	12
II (June 17–July 25)	812	105	11	52	20
08:00–18:00 h LST	365	105	16	67	16
18:00–08:00 h LST	447	95	11	41	14
III (Sept. 9–Oct. 31)	1098	96	14	50	16
08:00–18:00 h LST	488	96	14	62	13
18:00–08:00 h LST	610	74	25	41	10

N, number of data (hourly averages).

cated. As shown in Fig. 5 and in Table 3, the mean ozone concentration over 6 months, from April until the end of October, was constant, with values of about 50 ppb. Also the day-time and night-time concentrations of ozone are fairly constant throughout the year. These constant average ozone concentrations throughout spring and summer are associated with very uniform meteorological conditions such as high solar insolation and prevailing northerly winds. From April until October, the maximum of the average diurnal ozone concentrations increases from term I, 67 ppb, to only 78 ppb in term II (June–July). Term II is the time when the longest days occur with most intense sunlight for photochemical smog production. From June/July until the end of October, the maximum of average diurnal variations in the early afternoon decreases only slightly to 72 ppb of ozone. The highest ozone concentration of 121 ppb in 1991 was measured on April 23. The constant mean ozone concentrations in greater Cairo from the beginning of April until the end of October indicate that, unlike the photochemical smog potential in central Europe the spring and summer ozone dosages in Cairo are surprisingly constant. This may mean that health hazards and crop damage are higher in and around greater Cairo than in central Europe during the fairly short period of intense photochemical smog formation from June until the end of August; in other words, the annual integrated ozone exposure is higher in greater Cairo than in central Europe.

In spite of the evidently high emission rates of primary pollutants in greater Cairo and the strong solar irradiance throughout spring and summer, ozone does not reach extremely high concentrations in the ambient urban air of Cairo as might be anticipated. Higher ozone concentrations in the eastern Mediterranean were measured in Athens, Tel-Aviv and Jerusalem [9,16,17]. One explanation for the lower maximum ozone concentration in greater Cairo might be the steady wind blowing almost exclusively from the north to northeast throughout the year (Fig. 6). When we examine more closely the wind on the day of 22 April when the ozone volume fraction exceeded

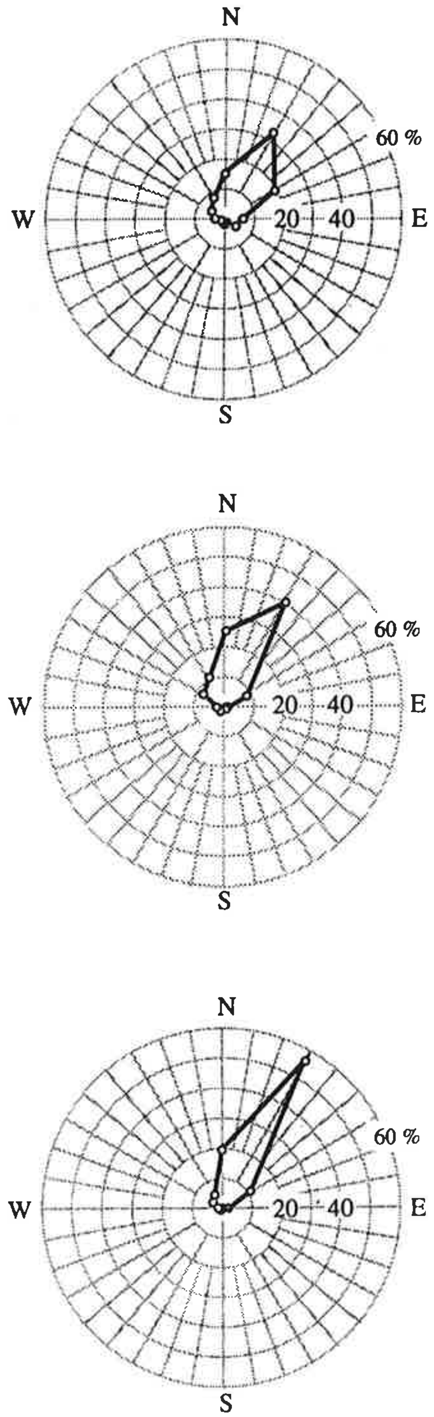

Fig. 6. Wind roses for the three monitoring terms in Cairo during 1991 at El Kobba: top, 7 Apr.–31 May; centre, 17 June–25 July; bottom, 9 Sept.–30 Oct.

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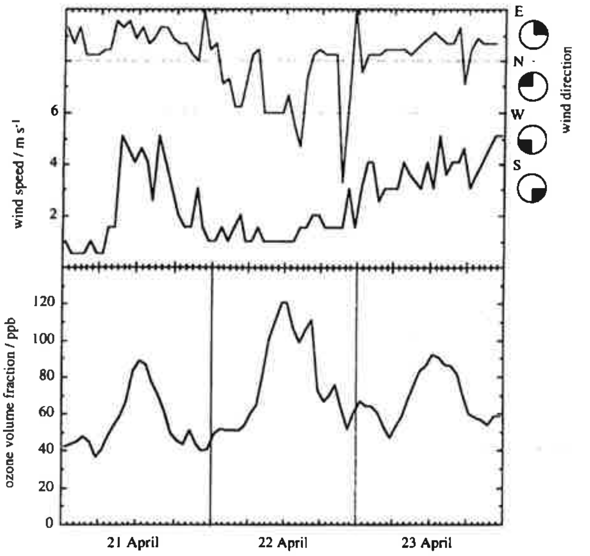

Fig. 7. Diurnal variations of the wind data and ozone volume fractions for 21–23 April 1991. In the top diagram the upper curve gives the wind direction as indicated on the right and the lower curve the wind speed on the left scale.

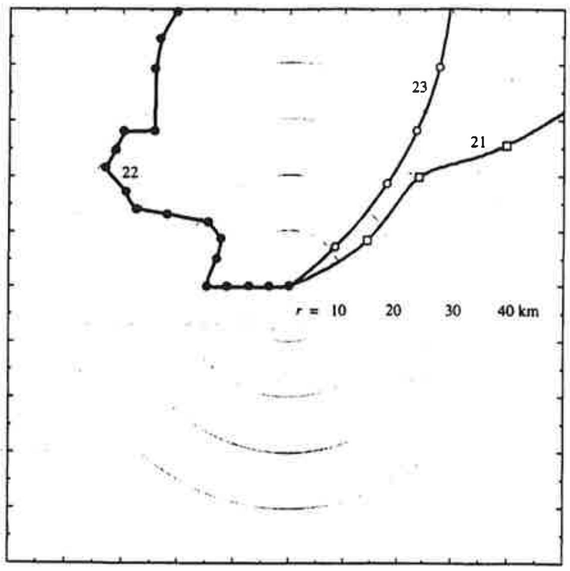

Fig. 8. Air mass trajectories calculated backwards from the peak ozone values of 21, 22 and 23 April 1991 in greater Cairo at El-Kobba. The distances between adjacent points correspond to 1-h intervals.

120 ppb (Fig. 7), we see that on that day the wind speed was unusually low and in addition, the prevailing wind direction was from the west and northwest. Assuming that the wind monitored at the Meteorological Observatory at El-Kobba is representative for the neighbouring region for a 20–30 km radius, we can calculate the back-trajectories for the time preceding the daily peak ozone concentration. They show the probable routes the air travelled before reaching the monitoring site at El-Kobba. These trajectories are shown in Fig. 8 for the 3 days illustrated in Fig. 7. While the trajectories for the 21st and 23rd April represent the typical situation in Cairo, the one for the 22nd April is markedly different, showing that the air reaching the monitoring site spent about 7 h within a radius of 20 km, while typically it spends significantly less than 2 h within that distance. This steady flow of air in one direction might also explain the relatively high nocturnal ozone concentrations observed in Cairo. They might be representative of the background air to the northeast of the city. On the other hand this also means that the urban plume of Cairo will have the largest effect in the area to the south west in the agricultural region of El Faiyoum.

Egypt has fixed ambient-air quality standards for many gaseous and particulate components. They have been laid down as 24-h mean values with a maximum permissible level which should not be exceeded. Surprisingly, the ambient-air quality standard for ozone of 30 ppb is much lower than the usual international air-quality standards, similar to the value of 30 ppb for an 8-h period or 60 ppb for a 1-h period of the WHO, or the German recommendation of 90 ppb for 1 h. If we accept the stringent WHO long-term target value of 60 ppb of ozone/h, this ozone level had been exceeded in measuring term I for 6 h per day, in term II for 9 h per day, and in term III for 7 h per day (Fig. 5). For the greater Cairo area we have to conclude that the Egyptian air-quality standard for ozone is too low and should be reviewed and reformulated taking international standards into account.

Contrary to many urban areas in Europe and the USA, the average night-time concentrations of ozone are above 30 ppb (Figs. 3 and 5) in greater Cairo. In general, in urban areas high NO concentrations caused by traffic destroy the high ozone levels of the afternoon [3]. In greater Cairo wind speeds during the night throughout 1991

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were high, generally between 4 and 7 m s^{-1}, blowing predominantly from the north. Thus at night all NO from the evening rush hour could be swept away from the urban centre followed by air from the desert with average ozone concentrations recorded at night of 30 ppb, at the El-Kobba site. The fairly high night-time ozone concentrations could also be explained by the particular location of greater Cairo. Cairo is surrounded by deserts. Very stable atmospheric conditions with the formation of a shallow nocturnal inversion level occur regularly every day, causing a strong increase in the relative humidity from about 30% to about 80% at night. Thus, it is likely that our measuring sites in greater Cairo were located above the nocturnal inversion layer. Above the nocturnal inversion layer, the ozone formed during the day is effectively cut off at night from all sinks below the inversion which gives rise to generally higher average night-time concentrations of ozone. The measurement of vertical profiles of ozone, temperature and humidity in Cairo at night using a captive tethered balloon will clarify this assumption.

3.3. Khamasin season

Khamasin weather most frequently occurs in April and May when strong winds occasionally transport desert sand and dust from the Sahara and the Eastern desert to the greater Cairo area [18]. Khamasin in Arabic language means fifty referring to a period of fifty days in spring when these winds appear, as known from ancient times. The Khamasin weather brings hot dry air with a relative humidity below 50%. High wind velocity and gustiness produce a turbulent air flow capable of lifting soil particulate matter to greater heights in the atmosphere where it may stay for longer periods. Sand and dust reduce the visibility to less than 1000 m. Besides the dust of natural origin, high mean monthly values of total suspended particulate matter (TSP) of anthropogenic origin have been measured in greater Cairo which exceed by up to 12 times the US ambient-air quality standard of TSP [19]. It has been argued that atmospheric aerosols and particulates could exert an influence on the ozone level [20,21]. It is conceivable that in urban air a heterogeneous degradation of ozone occurs at the particle surface [22,23]. In Fig. 9 the diurnal variation of the total dust collected for 24 h at the El-Kobba site is shown for the period of April 14 until May 31. The figure indicates that the US ambient-air quality standard for 24-h TSB of 0.26 mg m^{-3} which should not be exceeded more than once per year, was exceeded 13 times during that period of 48 days in 1991. Like the ozone standards, the Egyptian air quality standard for TSP of 60 $\mu g/m^3$ for a 24-h period is definitely too low. No correlation between the diurnal TSP and the diurnal cumulative ozone concentration was observed for the period indicated. An analysis of the diurnal dust concentrations with the corresponding wind directions indicates that during Khamasin days, when the wind was blowing from southwest to southeast in April and May 1991, lower dust concentrations were measured at the El-Kobba site, in general. Thus, it can be said with some caution that we did not observe during the Khamasin season in 1991 lower ambient ozone concentrations on days with large values of TSP. Since, contrary to our expectations, the peak TSP concentrations in Fig. 9 were measured during periods with prevailing northerly winds, the dust sampled at El-Kobba might well be predominantly of anthropogenic origin from the industrial area of Shoubra El-Kheima (Fig. 1). Further chemical analyses and an analysis of the particle-size distribution of the dust sampled at El-Kobba

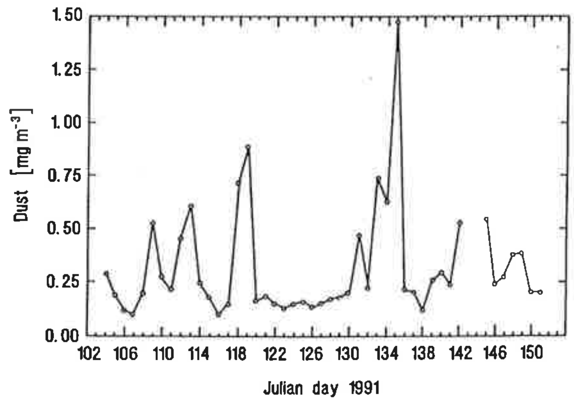

Fig. 9. Diurnal variation of the total suspended particulate matter at El-Kobba during the Khamasin season from April 14 (Julian day 104) until May 31 (Julian day 151), 1991.

may give an explanation of the origin of the TSP [24].

4. Conclusions

From the analysis of the ozone concentrations measured in the greater Cairo area in 1990 and 1991 the following conclusions are drawn:

- The regular diurnal variations of the ozone concentration with peak values of up to 120 ppb in the afternoon indicate a strong contribution of photochemical smog and are similar to those reported from other urban centres in Europe and North America.
- Ozone is formed predominantly over the industrial area and in the centre of Cairo and transported southward by the prevailing northerly winds.
- The daily maximum values of the ozone concentration in the greater Cairo area have approached, but not yet exceeded, critical levels. However, unlike many urban centres in Europe, the daily mean ozone concentration of 50 ppb throughout the year is higher in greater Cairo.
- Unlike many urban centres in Europe and North America, fairly high average ozone concentrations of 40 ppb are observed during the night, throughout the year.
- The very low Egyptian air-quality standard for ozone should be reconsidered.

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ABSTRACT
Summaries of the fourth mission to Egypt including planning of the second phase meetings and site visits. Additional air quality sites in Cairo have been described.

A project group meeting and a visit to the Egypt Meteorological Service have been reported.

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