Cairo Air Improvement Project

Air Quality Monitoring Component

Support to the Air Pollution Episode Management Program for Cairo

Chemonics International, Inc.
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A. INTRODUCTION AND SUMMARY

Recent air pollution episodes in the Greater Cairo area have led to an urgent need for senior environmental officials to explain, anticipate, manage, and mitigate these events. During the period of most recent episodes, beginning in late October 1999, staff from EEAA, the Egyptian Meteorological Authority (EMA), other agencies, and donor projects were engaged to respond to requests from senior decision-makers. The Egyptian government has now requested assistance to build a simple, locally-sustainable air quality forecasting system and to support their development of the related episode mitigation program.

The following work plan describes support to be provided, focussing on the forecasting component, and includes the tasks to be implemented, the work schedule, and resource requirements. Forecasting work will target particulate matter and sulfur dioxide. Available data suggest that these pollutants most important for short-term episodes in Cairo.

Tasks and activities have been defined based on initial discussions in the first few months of 2000 and meetings held from April 30 through May 4 involving EEAA, USAID, EMA, several Egyptian specialists, DANIDA's EIMP project, and a US team led by Chemonics International and the USEPA, with specialists from Sonoma Technology Inc. and the Allegheny County Health Department. The plan includes:

1. *Roles for Chemonics and EPA teams.* This work plan includes support activities to be led by a Chemonics team and a USEPA team. The Chemonics team will lead four of the task areas: coordinating the Technical Working Group, forecasting, air quality monitoring refinement recommendations, and communications. USEPA will lead support activities under EEAA's episode management program. Text descriptions of the tasks identify which team will do the work. The level-of-effort matrix in Section E includes labor estimates for both teams. The budget that follows the matrix however is only for the Chemonics portion. A separate budget will be developed for the USEPA component.

2. *Two key elements:*

    - *Forecasting system development.* The first version of a simple forecasting system will be developed on a fast-track basis, to be available to government officials prior to October 2000. The program provides for progressive refinement of the system as additional data become available, possible refinements are made to air quality monitoring networks in Cairo, and forecasters and users gain experience with local air quality forecasting.

    - *Institutional development and training.* The program includes training and use of local Egyptian specialists to ensure that the forecasting system is appropriate for the Egyptian government and is operated with progressively less involvement of US specialists. Ultimately, refinement and operation of the system will be done by trained Egyptian specialists.

The work plan is divided into two phases covering a 20-month period from May 2000 through December 2001. Five tasks are included in the two phases:

- Task 1, Start-up and formation of the Technical Working Group
- Task 2, Development and operation of an air quality forecasting system

- Task 3, Air quality monitoring data transfer and enhancement
- Task 4, EEAA episode management program support
- Task 5, EEAA communications program support

Phase 1 includes support for all tasks but focuses on developing the forecasting system. This system will be installed in September 2000 and operated for approximately two months, through the end of November 2000. Based on the anticipated progress of Phase 1, several possible Phase 2 activities are described in this work plan. However, these activities will need to be more clearly defined at the end of Phase 1 and based on an evaluation of the effectiveness of the systems put in place during Phase 1.

Role of EEAA

The objective of this effort is to support EEAA in their development of an episode management program, with emphasis on developing an air quality forecasting system and transferring it to local specialists. To accomplish this, EEAA will take the lead in establishing and implementing the management program and communications plans, calling on the Chemonics and USEPA teams for support as needed.

For the forecasting component, EEAA will play an integral role in providing access to data and other resources from the EIMP project and the Egyptian Meteorology Authority. In addition, staff from EEAA will be made available for data analysis and forecasting system development and ultimately transfer of the system. Throughout the process, EEAA will make certain critical decisions on the structure and function of the system to ensure it is appropriate for the government's short- and long-term needs. Finally, EEAA will need to establish an "operations center" capable of receiving up to date air quality and meteorology data during the period when the forecasting system becomes operational.

To ensure long-term sustainability, EEAA will identify personnel that can be trained to take over operations of the forecasting and episode management programs as they are developed and refined over time.

Schedule

A schedule for work plan implementation, showing Phase 1 and Phase 2 activities, is presented on the following page.

[insert MS Project Gantt chart here]

Chart not available in electronic version

B. DETAILED WORK PLAN

Work under this project will both involve and enhance Egyptian expertise, starting with the formation of a Technical Working Group (Task 1). Development of the forecasting system (Task 2) is the highest priority and has been most clearly defined. The plan includes making the initial system operational before October of 2000 and progressive refinement thereafter. Data analysis under the forecasting task will lead to an understanding of the processes that control air pollution in Cairo and help to select appropriate forecasting tools. Results from the data analysis will also support recommendations in Task 3, including procedures for routine transfer of air quality monitoring data to the operational forecasting team and recommendations of potential mid- and long-term refinements to the air quality monitoring program for Cairo. Areas of support under Episode Management (Task 4) and Communications (Task 5) are presented below and focus on sharing US experience that might be useful as EEAA builds and refines its programs.

Phase 1 and Phase 2 activities under the above tasks are presented separately below.

B1. Phase 1: May through November 2000

Task 1. Start-up and Formation of Technical Working Group

Following the initial meetings in April/May 2000, the priority task is to obtain data and other information that will support the development of the forecasting approach. As described below, the data will be analyzed by US specialists in consultation with Egyptian experts to understand data quality and relationships between local air quality and meteorology. Discussions will focus on pooling all knowledge for maximum understanding.

In parallel with this analysis, the Chemonics team intends to help finalize composition of the Technical Working Group in consultation with USAID and EEAA. This group will provide active engagement of relevant specialists to review progress on technical issues, validate approaches, and resolve impediments to progress on technical analyses. Initial discussions suggest involvement by the following organizations or individuals: USAID, EEAA, EMA, Dr. Nasralla, Dr. El Shahawy, CAIP—Air Quality Monitoring component, DANIDA EIMP, and the Chemonics team forecasting specialist.

The first meeting of the working group will be held approximately July 31, following analyses of data quality and historical trends (Tasks 2.1 and 2.2).

- Present data analysis results for discussion
- Discuss the approach to developing the forecasting system and software specifications
- Solicit input from Egyptian experts

In conjunction with this meeting and based on conclusions of the working group, the team will meet with USAID and EEAA to reach final agreement on the approach for developing the initial forecasting system and software. The effects of any data limitations on next steps will be discussed.

Subsequent working group meetings will be held on a regular schedule based on needs identified by the group. The Chemonics team will also explore the need to share information and analytical results on an interim basis (e.g., internet-based data exchanges).

USAID and EEAA have also discussed the formation of an Egyptian management review committee for the episode management program. The Chemonics team will support this committee as requested.

Outputs: Meeting notes and recommendations from working group

Task 2. Development and operation of a forecasting program

The short-term need to begin forecasting before by October 2000 requires a plan to rapidly develop a simple and flexible forecasting program (see schedule above). This program will have all of the basic elements of forecasting programs currently running in other parts of the world and will incorporate Egyptian input to ensure that it meets both immediate and longer-term requirements.

Egyptian involvement is essential to completion of many of these tasks. To facilitate this process, program status meetings would be periodically held in Cairo to seek input from the working group. In addition, the reports, databases, and software (including source code) from this project would be transferred to the EEAA to ensure a sustainable and flexible program for future development.

Task 2.1 Acquire data and evaluate data quality and completeness

Air quality and meteorological data are necessary to set up this forecasting program. These historical data serve as a link for understanding what has happened in the past to help predict what will happen in the future. Based on meetings with EEAA, CAIP, EIMP, and EMA, it appears that sufficient monitoring data exist to begin development of a forecasting program. Table 1 shows the data available from various monitoring programs in Egypt.
To complete this task the Chemonics team will:

- Work with EEAA, EMA, CAIP, and EIMP to acquire all of the air quality and meteorological data as well as other information (QA/QC reports and logs, site information).
- Decode the data and make a database in Microsoft Access that contains the data values and quality indicators. This comprehensive database will contain the air quality and meteorological data and information about time standards, units, site locations, etc.
- Evaluate the quality of the data by plotting time series and spatial plots of the air quality and meteorological data as well as reviewing QA/QC reports. Team members familiar with these data types will review the plots for inconsistencies, outliers, etc. In addition, the Chemonics team will identify problem data and monitoring gaps and suggest changes to monitoring network. Since the data serves as a foundation for the forecasting program, the Chemonics team will quickly determine if enough data exists to develop a forecasting system. This initial review will be completed approximately 40 days after receiving the data.

Outputs:

- *A Microsoft Access database containing all of the air quality and meteorological data.*

- *A report that summarizes the quality and completeness of the data, identifies problems with the data, and makes initial suggestions for changes in the monitoring network. This report will contain output from analyses.*

Table 1. List of the meteorological and air quality data needed to develop and operate an air quality forecasting system.

					Use in Program	
Data Type	**Variables [1]**	**Observed Forecasted**	**Frequency**	**Agency/ Program**	**Development**	**Operations**
Meteorology						
Surface	WS, WD, T, RH, SR, VIS, P	Observed	Hourly	EMA	X	X
Upper-air	WS, WD, T, RH, P	Observed	Twice daily	EMA	X	X
Weather charts (surface)	WS, WD, T, RH, P	Observed	Four times daily	EMA	X	X
Weather charts (upper-air) [2]	WS, WD, T, RH, HGT	Observed	Twice daily	EMA	X	X
Satellite	Visible and IR images	Observed	Hourly	EMA		X
3-D Prognostic Model [3]	WS, WD, T, RH, HGT, VV	Forecasted	Twice daily	EMA		X
Weather forecasts	Discussions	Forecasted	Four times daily	EMA		X
Air Quality						
PM 10 & 2.5	PM 10 & 2.5 mass	Observed	Every 6th day	CAIP	X	
	PM 10 & 2.5 speciated	Observed	Two periods	CAIP	X	
	PM 10 mass continuous	Observed	Hourly	EIMP	X	X
Primary	CO	Observed	Hourly	EIMP	X	X
	SO2	Observed	Hourly	EIMP	X	X
	NOx	Observed	Hourly	EIMP	X	X
Secondary	Ozone	Observed	Hourly	EIMP	X	X

[1] WS=Wind speed; WD=Wind direction; T=Temperature; RH=Relative humidity; SR=Solar radiation; VIS=Visibility; P=Pressure; HGT=Pressure height; VV=Vertical velocity

[2] Upper-air levels at 700, 850, and 500 hectopascals

[3] Variables available for many levels

Task 2.2 Perform historical data analysis

Air quality concentrations are strongly affected by weather, emissions, and local topography. Developing a basic understanding of how weather affects pollutant formation, dispersion, and transport in Cairo is critical to developing an accurate forecasting system. This will be accomplished through various data analyses. Since local involvement from the EEAA, EMA, and other Egyptian authorities is important to completing this task, the Chemonics team will conduct some preliminary scoping analyses and solicit input from local experts on the working group before conducting more extensive analyses. Subsequent analyses will include the following:

- Examine papers, reports, and journal articles that discuss meteorology and air quality in the Cairo region.
- Examine the temporal distributions of air pollution in Cairo, including daily, weekly, day-of-week, and seasonal distributions.
- Examine the spatial distribution of air pollution in Cairo to identify where peak pollutant concentrations occur relative to regional emissions and local sources.
- Perform statistical analyses to relate meteorological and air quality data.
- Perform weather typing to identify what types of synoptic weather patterns are associated with high pollutions episodes.
- Examine the role of surface and aloft transport of pollutants by examining wind data. Determine the role of transport from the Nile Delta as well as the role of recirculation of pollutants from one day to the next.
- Examine how the aloft temperature structure influences pollutant concentrations.
- Select key episodes to perform detailed case studies to understand the full interaction of meteorology and air quality.

This work will incorporate the findings of any similar analyses by the CAIP or EIMP teams and full results will be discussed at the first formal working group meeting described in Task 1.

The major outcome of this task is a conceptual understanding of the atmospheric and chemical processes that affect air pollution in Cairo. This conceptual model is used to select predictor variables, which are used as input into the forecasting tools.

Outputs:

- *Presentation on the analyses and short report to accompany these analyses.*
- *Report that summarizes the results of the data analyses and a description of the conceptual model of the atmospheric and chemical processes that produce high pollution episodes.*

Task 2.3 Develop initial forecasting program

With the knowledge gained in Task 2.2 and the database produced in Task 2.1, the Chemonics team will develop tools for forecasting the major pollutants (PM10 and SO2). The proposed forecast will include a quantitative 24-hr (next day) forecast of pollutant concentrations; and 48 to 72 hour outlook, which provides a qualitative description of the expected pollution levels.

The development of the forecast tools will include both subjective and objective methods (i.e., statistical). The exact approach will depend on the quality and completeness of the data and results from the data analysis, with input from the working group. Based on currently available information, the Chemonics team will explore the following forecasting tools:

- "Rules of thumb" use meteorological or air quality variables to forecast pollution concentrations. This subjective method serves as a fundamental tool with which to start a forecasting program. This method is based on the fact that specific values of certain meteorological and air quality variables are associated with high pollutant concentrations. For example, high PM and SO2 concentrations are often associated with light winds and a strong, shallow temperature inversion. Historical data analysis conducted as part of Task 2.2 may show that wind speeds less than 2 m/s and an inversion below 500 m is required to have PM concentrations greater than 800 ug/m3. Given predictions of these meteorological variables, a forecaster can estimate future PM concentrations.

- Pattern recognition is a way to associated surface and aloft weather patterns over Egypt with air quality conditions. Developing this tool involves an understanding the physical atmospheric processes that produce air pollution (completed under Task 2.2) and relating surface and aloft weather patterns to pollutant concentrations.

- Classification and Regression Tree (CART) is an objective statistical procedure designed to classify data into distinct (or dissimilar) groups. For pollution forecasting, CART predicts the PM and SO2 concentrations based on the values of meteorological and air quality predictor variables that are associated with pollutant concentrations.

Although several forecasting tools will be produced, the combination of the predictions from these tools with a forecaster's experience yields the most accurate prediction of pollution.

To help guide personnel through the forecasting process, the Chemonics team will produce a forecasting protocol that describes the key steps for producing an air quality forecast. It ensures that all activities are performed on time without the need for last minute decisions and helps maintain consistency from one forecaster to the next. The protocol document will include:

- Descriptions of the meteorological conditions that produce high PM and SO2 concentrations in Cairo (i.e., the conceptual model).
- Instructions on how to operate each forecasting tool.
- Forms and worksheets for documenting data and forecast information.
- Forecast verification procedures to help evaluate the quality of a forecast by comparing the predicted PM and SO2 levels to the observed data. Statistical metrics will help evaluate the forecast, and will include: accuracy (average "closeness" between the forecast and observed values), bias (indicates, on average, if the forecasts are under- or over- predicted), skill score (forecast improvement with respect to a reference forecast), false alarm rate (forecast of high pollution that does not actually occur), and probability of detection (ability to predict pollution events).

Arabic forecasting and operator software will be developed that allows EEAA staff to input meteorological and air quality data and then compute the forecast. The forecast software will transfer the forecasting tools developed above to a user-friendly format for generating

forecasts. It will store data, run the forecast methods, compute verification statistics, and print reports. Since the EEAA is already using MS Access to archive the EIMP data, the Chemonics team will use MS Access to store the data, combined with MS Visual Basic to develop the program. To develop this software, the Chemonics team will:

- Produce a software specifications document that describes all of the requirements and functions as well a draft user interface. The team will review the specifications document with EEAA staff to ensure that it meets the agency's needs. Preliminary software specifications will be discussed at the first working group meeting.

- Develop the software and supporting database. A possible option for this work is to have the lead Egyptian programmer working temporarily in the Sonoma Technology Inc. offices in California.

- Install the software and train EEAA and EMA staff. See Task 2.4.

Outputs:

- *Several forecasting tools and short report that describes each tool.*
- *Forecasting protocol document.*
- *Software specifications document.*
- *Software to operate the forecasting tools.*

Task 2.4 Begin operational forecasting and training

Once the forecasting methods and software are in place, the next step is to start forecasting. At this time the Chemonics team will transfer the initial forecasting system to EEAA staff. To help get the forecasting started, the Chemonics team will:

- Support EEAA and EMA staff by providing a list of key data inputs (both meteorological and air quality) as well as infrastructure needs for the "operations center." Getting routine and reliable data in the "operations center" is critical to issuing an accurate forecast.

- Install the software and train the EEAA staff on its use beginning in mid September. The US-based team will be available in Cairo for 3 weeks starting in September to assist in forecasting and answer questions. Training will include sample exercises and "dry runs" to ensure that all staff have comprehensive knowledge of the system under the conditions anticipated. It will also begin developing experience and knowledge in other factors contributing to effective forecasting. The target group for training will be operators; managers will also be exposed to forecasting concepts and additional understanding of factors contributing to air pollution episodes. One key issue to address during this period is what can be done in the case of missed forecasts.

- Review operational performance during the Fall with EEAA staff to help ensure that staff are comfortable with the forecasting system.

Outputs:

- *Report on operations center recommendations*
- *System performance summary*

Task 3. Air Quality Monitoring Data

This task is closely tied to the forecasting activities listed above. Work will be executed in parallel with the initial forecasting method development.

Task 3.1 Routine data transfer procedures

Additional data transfers (beyond the initial transfer of EIMP and EMA data) will be required on an operational basis as input to the forecasting tools/software. The exact data variables are not yet known, but will be identified during Task 2.2 and 2.3 and communicated to EEAA via a data transfer protocol document. By mid-August 2000, EEAA should have hardware/software and communication links to receive these data. Based on data needs of other forecasting programs, we expect the following types of data will be necessary:

- Real-time air quality data updated at least several times per day (preferably hourly) from the EIMP stations located in Cairo and the Nile Delta.
- Yesterday's maximum pollutant concentrations from the EIMP network.
- Surface weather observations from Cairo and surrounding areas.
- Upper-air observations from Helwan.
- Forecasts for surface and aloft meteorological data (0 to 72 hour predictions) from EMA's Eta model.
- Weather forecast discussions.

Output: data transfer protocol document

Task 3.2 Enhancements to monitoring system

The review of monitoring data quality and representativeness may reveal shortcomings in the data for the medium- to long-term monitoring program. The team's evaluation will look for any limitations in and recommendations for:

- Monitoring sites
- Monitoring technology
- Analytical parameters
- QA/QC procedures

The Chemonics team will coordinate with any similar CAIP and EIMP efforts to review and optimize their respective monitoring efforts for the future.

Outputs:

- *Plan for monitoring program enhancements, including specifications and budgets for any recommended procurement actions*

Task 4 EEAA Episode Management Program Support

EEAA has begun developing its episode management program based on past and anticipated future events. Creation of the full program may include the agency's current draft of an environmental disaster action plan and a separate document recently prepared on mitigation measures to be undertaken over different time frames.

Support under this task will be led by the USEPA and will be based on EEAA's needs and schedule in developing its air pollution episode management program. Proposed support below is based on an example program concept provided as Attachment 1 to this document and example episode mitigation measures provided in Attachment 2.

The Chemonics team is available to provide support under this task although no effort has been budgeted in this work plan.

Task 4.1 Support to management plan development

In the United States, episodes with elevated levels of pollutants have occurred with some frequency. As a result, state and local government agencies have a great deal of experience developing detailed plans and procedures for managing episodes. These plans have helped reduce the severity and duration of the episodes, and helped the agencies communicate an understanding and appreciation of their causes and consequences.

A written Episode Management Plan could provide EEAA with a comprehensive, functional guide for reliably responding to periodic high levels of pollutants. Assuming EEAA favors this approach, USEPA can provide support and assistance to EEAA for plan development.

Work may include:

- reviewing and providing recommendations on draft documents
- sharing experiences and examples from the United States (e.g., case studies, "what if" scenarios, potential consequences of certain actions)

The USEPA team could arrange for a workshop to help EEAA develop their episode management program. The objectives of this event would be to support EEAA to:

- establish roles and responsibilities and coordination mechanisms within EEAA and with other government agencies and the private sector
- developing operational procedures for episodes themselves and day-to-day program operations
- further defining mitigation measures and their implementation
- strategies for addressing episodes of different severities

Outputs:

- *written recommendations and materials from US and other country episode experiences*

- *workshop materials*

Task 4.2 Training and practice exercises for implementers

Specialists provided by the USEPA with experience in managing episodes can help develop training programs to improve the level of preparedness of the episode teams and leaders in Egypt. Specific activities could include assisting in development and presentation of training programs for those involved in managing an episode, ie., the episode team and other personnel from EEAA and other agencies.

Episodes will occur only a few times per year on occasions that cannot be predicted more than three days in advance. A system that is used infrequently and unpredictably needs to be tested in advance to assure it is functional at the time when it is needed. USEPA specialists could assist in conducting practice exercises or drills, and reviewing results with EEAA. These exercises could have varying levels of difficulty and decision making requirements, incorporating scenarios likely to be encountered in actual episodes. Practice exercises could be conducted first in-house at EEAA and then incorporate other agencies. Results could be used to make changes to the Episode Management Plan.

Outputs: training program(s), including syllabus and training materials; materials for practice exercises

Task 5. Support to EEAA Communications Program

This task will be led by Chemonics and recognizes that specific support is based on requests from EEAA as the agency develops its communications program, both internally and ultimately for the general public.

Task 5.1 Support plan to communicate current air quality

Communication of air quality data to decision-makers and the public is an important element of environmental management programs. A full communications plan addresses different audiences (e.g., government policy-makers, health and environmental professionals, academia, the general public) and should embody an understanding of the baseline knowledge, attitudes, and practices of these audiences (derived from previous assessments) to ensure communications are effective. The plan must define responsible individuals and their roles and responsibilities; communication techniques, messages, and mechanisms; and follow up procedures. It must provide for training on all relevant topics.

The air quality index (AQI) is a common communications technique, based on potential health effects, that has been used in the US and elsewhere for conveying air quality information. It could be useful for conveying both current and forecasted information in Egypt. This could be combined with other information on pollutant sources (e.g., results of the CAIP source apportionment study).

An initial step in communicating air quality information internally could be the presentation of same-day air quality data from the EIMP network in AQI format. This could start with using the US methodology and refining it as necessary based on local conditions (e.g., the effect of high particulate background). The process will:

1) Identify health effects and population groups potentially affected by pollutant levels
2) Provide cautionary messages intended for the affected groups
3) Provide simple descriptors and color coding for ease of interpretation of pollutant levels by non-technical audiences

4) Use an internationally recognized tool to communicate information to decision-makers that will eventually be conveyed to the public
5) Begin reporting in a format anticipated for forecasted air quality

Chemonics will support the EEAA development of a communications plan as requested. This could result in EEAA producing written procedures. The exact type of Chemonics support is yet to be determined but generally would provide perspective from US experience in communications efforts. Examples of specific support include:

- Provide example strategies and lessons learned from the US
- Provide example communications tools (brochures, videos)
- Review draft approaches and plans and "brainstorm" new strategies
- Help develop training programs

This work plan assumes a total of two weeks of Chemonics team support to EEAA in preparing their plan or approaches. As requested, USEPA can work in partnership with Chemonics to provide additional support to be determined.

Outputs: written material, videos, training programs and other information to be determined

Task 5.2 Support plan to communicate forecasted air quality

This activity is tightly linked to the previous task and could follow from or be combined with efforts to communicate current air quality. Similar types of support can be provided in advance of the initial forecasting system start-up in September 2000. EEAA would likely continue developing this initial program after forecasting begins.

Chemonics will lead the support effort, similar to that proposed in Task 5.1 above. Two weeks of Chemonics team assistance is assumed under this component. Specific inputs from the USEPA team may also be appropriate.

Outputs: as above in Task 5.1

Task 5.3 Support plan for episode communication and mitigation measures

Communications activities for episodes themselves and related to specific mitigation measures are integral to overall episode management and tied with previous tasks. Chemonics will provide similar support under this task as for previous tasks. It would be especially relevant for Chemonics to provide experience from the US and other countries where episode management programs are operated. Specific inputs from USEPA may also be appropriate.

Work under this task can help EEAA modify its current draft of an environmental disaster action plan to address air pollution episode communications. Four weeks of support are included in the budget estimate.

Outputs: as above in Task 5.1

B2. Phase 2: December 2000 through December 2001

Activities that could be implemented starting in December 2000 are described below under:

- Task 2, Forecasting
- Task 4**,** Episode Management Support
- Task 5, Communications Program Support

The task numbers for Phase 2 follow the sequence from Phase 1.

The scope of Phase 2 tasks is tentative and will need to reassessed at the completion of Phase 1 and based on review of the performance of the forecasting, episode management, and communications programs during that period.

Task 2 Forecasting

During Phase 2, the experience gained during the Fall of 2000 will be used as a basis for expanding the longer-term forecasting program by addressing whether or not additional data analyses or more accurate forecasting tools are needed. In addition, the mid-to long-term activities would include a sustainability plan along with training on how the EEAA could continue future development of the program.

Task 2.5 Evaluate forecasting program and transfer full capability

This task begins with a review and evaluation of the Year 2000 forecasting season. Forecast verification statistics will serve as a basis for evaluating the performance of the forecasting system. Based on the results of the verification, several addition tasks will be needed to improve the forecasting system. A joint Egyptian and US team will conduct these additional analyses and develop new forecasting tools to improve the accuracy of the program. During this revision to the program, the Chemonics team will transfer all aspects of the program to EEAA including: data, database, guidelines for future data analysis, etc. Complete transfer of the program so that Egyptian counterparts can perform activities such as data analysis and forecasting method enhancement on new air monitoring data will be completed by the end of 2001.

To complete this task, the Chemonics team will:

- Compute verification statistics from the Year 2000 forecasting season. These statistical metrics will be reviewed with the working group.
- Conduct additional analyses on the Year 2000 data. By the end of 2000, two years of air quality data will be available for analyses. Many of the analyses performed during Task 2.2 in Phase 1 would be repeated to update the conceptual model. An Egyptian-US team will perform analysis of the Year 2000 data and results will be presented to the working group.
- Based on the forecast performance results and additional data analyses, some revisions to the forecasting methods may be needed. In addition, developing other forecasting methods may be necessary to improve forecast accuracy. The forecasting plan and software may require updating as well. The level of effort required for this activity is difficult to determine. Preliminary estimates presented later in this work plan for the joint Egyptian-US team may need to be modified as time progresses.

Outputs:

- *Verification statistics and other performance analyses*
- *Enhanced forecasting plan and/or software, including data analysis guidelines*

Task 2.6 Develop plan for long-term forecasting

One of the major objectives of this effort is to produce a fully sustainable program so that the Egyptian government can operate and improve its own forecasting system. As noted above, this process involves transfer of information, databases, and software, as well as training. Tasks 2.1-2.5 in Phase 1 all include training and transferring of information to EEAA, EMA, and other Egyptian authorities. This task will lay out longer-term directions for further improvements of the forecasting system. It will likely include suggestions for:

- Monitoring additional pollutants and meteorology (beyond recommendations from Task 3).
- Additional data analysis techniques to further understand the air quality-meteorology interaction in Cairo.
- Descriptions of new forecasting techniques that may have emerged.

Outputs: recommendations report(s) for forecasting program enhancements

Task 4 Episode Management Support

Task 4.3 Support Episode Management System refinement

This activity will follow the initial experience with forecasting and episode management through November 2000. Based on the findings of Phase 1, USEPA will assist EEAA in refining the management system following experience the agency gains during operations. The Chemonics team may also provide support as requested. Specific activities will be defined at a later date.

Task 5 Communications Program Support

Task 5.4 Revise communications plans based on initial experience

EEAA communications strategies and plans will evolve over time. The Chemonics team will be available to provide inputs to these revisions as requested. A small level of effort is included in the budget to support EEAA but specific activities will need to be defined.

Outputs: to be determined

C. CRITICAL ASSUMPTIONS FOR WORK PLAN

Assumptions for timely and effective implementation of this work are as follows:

- Air quality and meteorological data will be received no later than May 15, 2000. Receipt of data past May 15, 2000 may affect the schedule of deliverables, including the forecasting system and software.
- Data quality and completeness reviews under Task 2.1 will determine how much data are available for analysis and forecast tool development. Lack of (or poor quality) data may result in changes to the scope of work and/or budget.
- Forecasting methods will focus on PM10 and SO2.
- EEAA will set up an operations center that has real-time access to air quality and meteorological data. Exact data needs would be specified in Task 3.1. This forecasting system would need to be operational by August 20, 2000.

D. MANAGEMENT AND RESOURCE REQUIREMENTS

A level-of-effort matrix is provided below which separates estimated involvement of the Chemonics team and the USEPA in each of the tasks described above. A cost estimate for the Chemonics-led effort follows the labor matrix. The Chemonics team will include US and local staff, including Sonoma Technology Inc. and the Egyptian Meteorology Authority as subcontractors.

USEPA costs are not included in this document.

Budget assumptions are as follows:

- No equipment is budgeted in either Phase 1 or Phase 2
- Phase 1 will use only existing data; no additional monitoring or data collection will be undertaken
- One Egyptian programmer will be sent to Sonoma Technology for one month to develop the forecasting software
- No communications campaigns are included in the budget for the communications task
- Rough estimates are provided for Phase 2 costs; evaluation of the needs during Fall 2000 may require revised budget estimates
- USEPA will perform all activities under episode management in Phase 1 and no budget is included in this document; a small level of effort is included for the Chemonics team for Phase 2

ATTACHMENT 1

Air Pollution Episode Management

Below is an overview of a possible configuration for the EEAA episode management program based on similar programs in the US. This is offered for illustrative purposes only.

The System

The objective of an Air Pollution Episode Management System is to decrease the duration and severity of high air pollution episodes. Air pollution episodes are short periods of time during which high air pollution concentrations are brought about by emissions during meteorological conditions unfavorable to dispersion. Such periods can be avoided by staged reductions in emissions in conjunction with forecasts and air quality measurements. The goal of the system in Egypt should be the avoidance of air quality levels deemed to be unacceptable on a short-term, periodic basis.

To achieve the objectives of the system, routine activities, as well as preparatory and special activities during episodes, must be performed. The routine activities should be performed by an episode team leader with assistance from other team members. The routine duties include daily or twice-daily review and evaluation of air quality data and meteorology, maintenance of communication lists and written communication forms, maintenance of lists of sources and source categories with significant emissions and those with mitigation plans, maintenance of logs and files, providing training, and conducting practice exercises.

Preparatory activities include development of mitigation plans assuring proper coordination with other agencies, arranging for special air quality monitoring as needed for episodes, and report preparation as needed. Special activities during episodes include:

- declaration of the episode
- checks to verify proper operation of the monitoring system
- notification of all affected parties using established lists
- facilitation of communications with special entities, initiating more frequent air quality reporting and special monitoring
- coordination of the selection and implementation of mitigation measures
- recording of all activities on communication lists and/or in log books
- termination of the episode

Episode Management Plan

Listed below are some potential steps that could be taken by EEAA to develop an Episode Management Plan which could include a framework for episode operations, assignment of roles and responsibilities, interagency coordination, air quality criteria for action, mitigation measures and implementation procedures, and communication procedures and protocols.

1. *Establish Roles and Responsibilities.* Determine the episode leadership and teams as appropriate. Decide who will evaluate the meteorology and air quality on a routine daily

basis; who will develop and coordinate mitigation plans; and who will plan for interagency and external communications.

2. *Select Criteria for Episode Actions.* Determine what levels of air pollution are unacceptable for short episodic periods and therefore are to be avoided. Base this determination on a review of historical air quality data, the anticipated frequency of reoccurrence and the acceptable frequency of taking action to mitigate the reoccurrence.

3. *Coordination with Other Agencies.* Meet with all entities with a potential role to determine their capabilities and their needs, establish lines of communication and coordinate activities. Begin with an initial roundtable of all entities, then using assigned responsibilities meet individually with each entity to develop detailed plans and establish lines of communication. Determine the capabilities of each entity and their needs in order for them to participate in and support episode actions.

4. *Develop Mitigation Plans.* Develop listings of preferred measures. Develop plans and strategies for implementing mitigation measures. Decide on the criteria, if any, for selecting larger industries or industry sectors for development of mitigation plans in advance and the mechanism for implementing them. Establish a methodology for revising, modifying, and adding mitigation plans.

5. *Training.* Develop a training program for episode leaders and team members.

6. *Practice Exercises.* Assure proper preparedness for episodes by conducting practice exercises within EEAA and then with other agencies.

7. *Management Review Committee.* Establish an advisory board to recommend to EEAA and the Minister of Environment additions and changes to the Episode Management Plan.

ATTACHMENT 2

EPISODE CONTINGENCY PLANNING

Example mitigation measures are presented below based on experience in the US and elsewhere. Note that these measures will apply to mitigation of episodes attributable to particulate matter and certain other pollutants (e.g., ozone).

Mitigation measures

Industry

1. Switch fuels-e.g., low ash, low sulfur
2. Cease, limit, or postpone manufacturing activities and other polluting industries (extent depends on lead time for shut-down and other factors)
3. Curtail specific activities leading to particular pollutant reductions of X%
4. Alter manufacturing processes to have releases during periods of maximum atmospheric turbulence (e.g., afternoon, medium/high ventilation periods)
5. Divert power generation or manufacturing to other locations
6. Cease or limit mining/quarrying
7. Cease or limit certain construction

Transportation and Traffic

1. Increase car pools
2. Increase use of mass transit (discounted fares)
3. No-drive days—by vehicle type, class, age, technology/level of pollution
4. No-drive days—by area
5. Eliminate unnecessary vehicle trips or operations
6. Reduce fleet vehicle miles traveled
8. Cease or limit roadwork, including pothole repair, paving, and landscaping, which impairs traffic flow

Open Burning

1. Cease or limit open burning of refuse
2. Cease or limit open burning of vegetation

Commerce

1. Reduce schedules of (e.g., “Sunday schedule”) or close offices, banks, and retail locations
2. Limit or close gas stations without vapor recovery
3. Curtail activities of natural gas distribution

Public actions/Exposure reduction

1. Reduce outdoor work activities
2. Reduce operation or close public places—schools/child care, recreation establishments (especially involving physical exertion)
3. Other exposure and activity curtailment activities (outdoor activity, exertion), including specific medical recommendations for people with special health problems
4. Access to lower risk environments for sensitive individuals (e.g., buildings with air conditioning, more tightly closed)

Other components required to implement individual measures

1. concurrence of designated officials (e.g., governor)
2. public announcement
3. communication with health and safety officials, law enforcement and emergency officials, other public officials, social/religious institutions, industries, schools, news media, etc.
4. emissions reduction plan development and implementation by industry (e.g., “major sources”)—identify sources, releases, mitigation measures, timetables for reductions, magnitude of reductions, adverse impacts to supply and output chains
5. inspection/enforcement of sources and their reduction plans
6. exemption program: threat to public health and safety, damaging equipment or production, essential service