

# AIR MONITORING PROGRAMME DESIGN FOR URBAN AND INDUSTRIAL AREAS

Prepared by the Secretariats of the

WORLD  
HEALTH  
ORGANIZATION

and the

WORLD  
METEOROLOGICAL  
ORGANIZATION

following a

WHO/WMO Consultation on Air Quality Monitoring in Urban  
and Industrial Areas, Geneva, 1976



WORLD HEALTH ORGANIZATION  
GENEVA  
1977

WHO offset publications are intended to make generally available material that for economic, technical, or other reasons cannot be included in WHO's regular publications programme and would otherwise receive only limited distribution. They are usually reproduced by photo-offset from typescript, rather than by letterpress, and do not necessarily receive such detailed editorial revision as other WHO publications.

ISBN 92 4 170033 5

© World Health Organization 1977

Publications of the World Health Organization enjoy copyright protection in accordance with the provisions of Protocol 2 of the Universal Copyright Convention. For rights of reproduction or translation of WHO publications, in part or *in toto*, application should be made to the Office of Publications, World Health Organization, Geneva, Switzerland. The World Health Organization welcomes such applications.

The designations employed and the presentation of the material in this publication do not imply the expression of any opinion whatsoever on the part of the Secretariat of the World Health Organization concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

The mention of specific companies or of certain manufacturers' products does not imply that they are endorsed or recommended by the World Health Organization in preference to others of a similar nature that are not mentioned. Errors and omissions excepted, the names of proprietary products are distinguished by initial capital letters.

PRINTED IN SWITZERLAND

# CONTENTS

	<u>Page</u>
Preface . . . . .	4
Introduction . . . . .	5
Chapter 1. Monitoring objectives and approaches . . . . .	9
1.1 Objectives . . . . .	9
1.2 Approaches to monitoring programme development . . . . .	12
Chapter 2. Monitoring network design . . . . .	14
2.1 Background information needed . . . . .	16
2.1.1 Sources and emissions . . . . .	16
2.1.2 Health and demographic information . . . . .	16
2.1.3 Meteorological information . . . . .	17
2.1.4 Topographical information . . . . .	17
2.1.5 Previous air quality information . . . . .	17
2.1.6 Land-use zoning considerations . . . . .	17
2.2 Organization and resource requirements . . . . .	18
2.2.1 Organizational arrangements . . . . .	18
2.2.2 Personnel, equipment and finance . . . . .	18
2.3 Design considerations . . . . .	19
2.3.1 Selection of pollutants . . . . .	19
2.3.2 Selection of the area to be studied . . . . .	20
2.3.3 Number and distribution of sampling sites . . . . .	20
2.3.4 Sampling duration and frequency . . . . .	23
Chapter 3. Station location criteria . . . . .	25
3.1 Representativeness . . . . .	25
3.2 Requirements for comparability . . . . .	26
3.3 Physical requirements . . . . .	27
Chapter 4. Other essential components of the monitoring programme . . . . .	28
4.1 Laboratory requirements . . . . .	28
4.2 Quality assurance . . . . .	28
4.3 Data acquisition and handling procedures . . . . .	28
4.4 Data presentation . . . . .	29
References . . . . .	30
<u>Annex 1.</u> Principal sources and pollutants of possible concern in urban areas . . . . .	33
<u>Annex 2.</u> Examples to illustrate the guidelines for the development of an air pollution monitoring programme . . . . .	35
Example 1. Starting an air pollution monitoring programme based primarily on manually operated instruments . . . . .	35
Example 2. Development of an urban air pollution monitoring programme based primarily on automated equipment . . . . .	38
Example 3. Developing an air quality monitoring programme in the vicinity of a large single source . . . . .	42
<u>Annex 3.</u> List of participants in the WHO/WMO Consultation on Air Quality Monitoring in Urban and Industrial Areas, Geneva, 21-25 June 1976 . . . . .	45

## PREFACE

Both the World Health Organization (WHO) and the World Meteorological Organization (WMO) have for many years been engaged in technical cooperation with Member States in establishing or developing environmental control programmes, and several projects have been undertaken jointly by the two Organizations.<sup>1,2</sup> This collaboration was strengthened when the Global Environmental Monitoring System (GEMS) was established as part of the United Nations Environment Programme (UNEP).

The World Meteorological Organization has organized a global background air pollution monitoring network operated by Member States in rural and remote locations.<sup>3</sup> As air pollution is one of the factors that affect human health, the World Health Organization began to monitor air quality in selected urban and industrial areas in 1972.<sup>4</sup> Both WMO and WHO programmes are part of GEMS and are operated in cooperation with and with the support of UNEP.

A group of experts was convened in Geneva in June 1976, cosponsored by both Organizations, to consider the principles for the design of urban air monitoring networks, including meteorological aspects. The participants (see Annex 3) reviewed a document that had been drafted prior to the meeting on the basis of working papers prepared by Mr G. Akland, Dr D. Szepesi and Mr R. Waller. The document was subsequently edited for this publication by a small panel in collaboration with WMO and WHO staff. The members of the panel were Dr J. Mahoney and Mr R. Waller, who had both also participated in the consultation, and Dr D. Shearer, WHO Collaborating Centre on Environmental Pollution Control, United States Environmental Protection Agency, Washington, DC, USA.

---

## INTRODUCTION

The main purpose of this publication is to provide guidance on the design of air quality monitoring programmes for urban and industrial areas. Such programmes are needed for almost all the actions taken to prevent or abate air pollution, from the initial assessment of existing conditions, to the enforcement of current control regulations, to the evaluation of the effectiveness of abatement programmes, and finally to the development of new control measures. It is also hoped that this publication will contribute to more effective harmonization of air monitoring procedures, permitting the comparison of data obtained throughout the world.

The information contained in this publication attempts to provide general guidance on when the institution of monitoring programmes should be considered, what should be monitored, where monitoring should be carried out and how it should be conducted.

Air pollution control procedures are not discussed, although they are definitely interrelated with those of air quality monitoring. Methods of analysis of air pollutants have been presented elsewhere.<sup>5-10</sup>

The information given should also serve to guide the further development of the Global Environmental Monitoring System (GEMS) activities<sup>11</sup> in urban areas. In addition, emphasis is placed on the need for a full and continuing cooperation between air pollution control agencies which are involved in air quality monitoring and the local and national meteorological services.

Air quality monitoring proposals should always be viewed in the broad context of environmental management. The decision-maker must often assign priorities amongst a multitude of environmental concerns and he must decide whether an air quality monitoring programme is justified, and if so, what level of technical support it should receive. It is important to beware of establishing too ambitious a programme unless there is a clear understanding of how the air quality data will be used.

This publication is primarily directed at administrative and technical personnel in those countries that are becoming concerned about air pollution aspects of an increasingly developing industrial economy. The guidance provided should also be useful to those countries that have already established a monitoring programme and are making decisions for further development of their monitoring network. In this connexion it

should also be noted that industry should be encouraged to monitor not only their plant emissions, but also the ambient air in and around their establishments. The guidelines presented will also aid them in this.

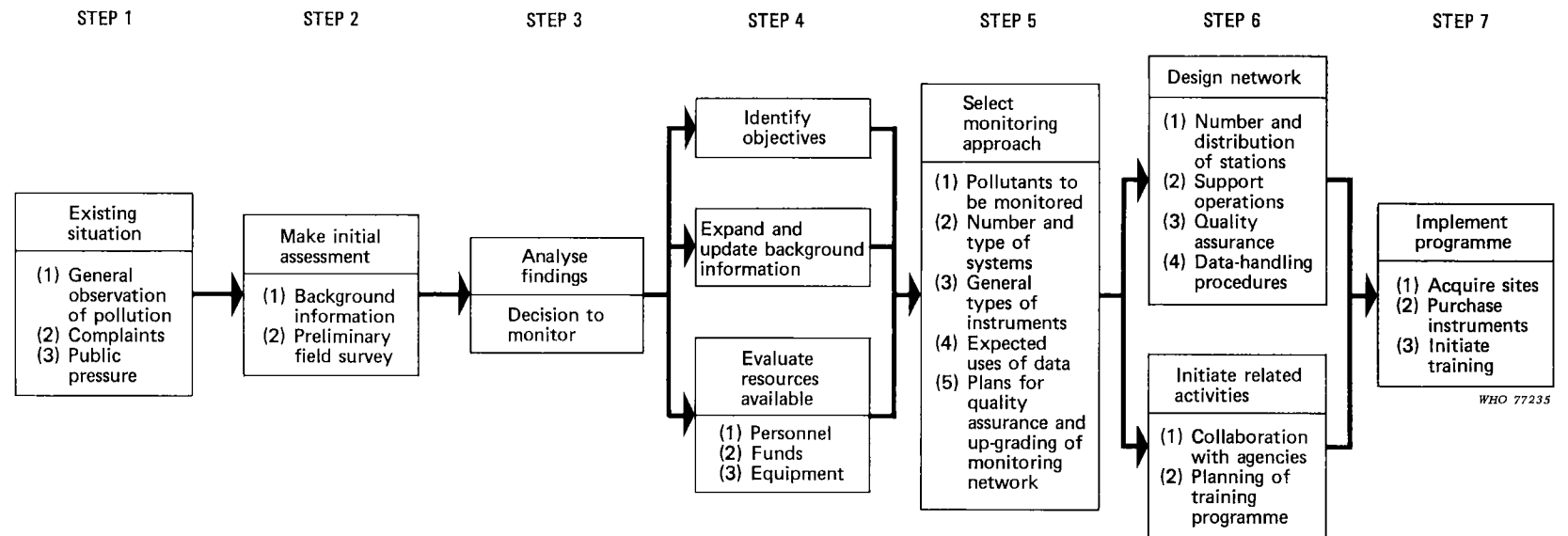
An overall picture of the major steps for the development of an air monitoring programme is presented in Fig. 1. The various developmental stages are shown in chronological sequence; some steps include a number of activities that can be carried out simultaneously.

The text is organized into four chapters as follows: (1) monitoring objectives and approaches, (2) monitoring network design, (3) station location criteria, and (4) other essential components of the monitoring programme. The principal information is contained in Chapters 2 and 3, where specific guidance is provided on the design of air quality monitoring networks. Chapter 1 serves primarily as an introduction to these chapters and Chapter 4 gives some additional helpful information.

In addition, three examples are given in Annex 2 to illustrate the development of different types of air quality monitoring programmes. The first example shows the development of a programme based primarily on the use of manually operated instruments; the second is based on the use of automatic monitoring instrumentation; and the third deals with the development of a monitoring programme in the vicinity of a large single source of air pollution. It should be stressed that these examples should only be taken as general guidance to illustrate some of the types of programmes that could be developed for a particular need. Specific suggestions about numbers of samples and costs are included; however, all such decisions and calculations must be made locally in any real situation, following the guidelines set out in the main part of the text.

---

FIG. 1 STEPS IN THE DEVELOPMENT OF AN AIR QUALITY MONITORING PROGRAMME



### 1.1 Objectives

Before considering the establishment or expansion of an air quality monitoring programme, it is essential to examine the objectives carefully if the appropriate data are to be collected with a minimum of effort and cost. Although it may be tempting to design a system that could serve a multitude of different objectives and associated data needs, in practice it appears that only certain combinations of objectives are realizable with a given network. For example, it is generally not possible to use a network designed to monitor long-term trends of air pollution levels to investigate a specific complaint. Of course, it is possible to modify a network designed primarily for one purpose so that it will serve another as well.

Monitoring objectives have been divided into two groups. The first group (a and b below and in Table 1) includes the objectives for a monitoring programme for an average industrialized city with an actual or potential air pollution problem. They cover the basic monitoring requirements and most of the remaining chapters deal with further information on these. The second group (c-i below and in Table 1) includes more specialized monitoring objectives, which are generally more optional in nature (and also technically somewhat more complex) and, according to the local situation, may or may not form part of the basic programme.

The basic monitoring programme will provide the essential data required to develop air quality standards and will in general permit the development of a viable air pollution control programme. Normally the major air pollutants (see Annex 1), such as suspended particulate matter, sulfur dioxide, carbon monoxide, nitrogen oxides and oxidants, would be considered for inclusion in this type of monitoring operation. Depending on the type of industries active in the general area, other pollutants, for example, hydrogen sulfide, may be added.<sup>12</sup> The meteorological parameters to be measured would be wind speed and direction. If possible, the frequency of inversions should also be recorded.

The objectives in the first group are as follows:

(a) To observe long-term trends

This is to detect any deterioration in air quality arising from residential or industrial development. For this purpose alone a network using manually operated equipment would be sufficient; 24-hour samples could be collected intermittently over relatively long periods and measurements might be made at only three or four sites within a given urban area (with the important proviso that these should remain in operation at the same places for many years). The siting must, however, be considered very carefully to avoid undue influence from nearby sources.

Much additional information can be gained, and the network can be made more versatile, if uninterrupted observations are made over 24-hour periods. Statistical analyses can then be done to provide not only the yearly averages, but the frequency distributions of the daily values. Trends can be studied separately for weekdays versus weekends, and interrelationships with meteorological factors can be examined.

预览已结束，完整报告链接和二维码如下：

[https://www.yunbaogao.cn/report/index/report?reportId=5\\_30843](https://www.yunbaogao.cn/report/index/report?reportId=5_30843)

