

# **AIR QUALITY MONITORING IN SINGAPORE**

*By Koh Chin Yong*  
**National Environment Agency**  
**Singapore**

## **ABSTRACT**

Ambient air quality monitoring in Singapore was initiated in 1972 and is undertaken by the National Environment Agency (NEA), Singapore. Air quality monitoring was fully automated with the commissioning of the telemetric air quality monitoring and management system (TAQMMS) in 1994. The Pollutant Standards Index (PSI), intended as a public information tool to advise the public about the general health effects associated with different pollution levels, is used to report daily air pollutant concentrations in Singapore since 1991.

## **1 AIR MONITORING NETWORK OF SINGAPORE**

1.1 Ambient air quality monitoring in Singapore was initiated in 1972 and is undertaken by the Strategic Planning & Research Department (SPRD) of the National Environment Agency, Singapore. The objectives of the monitoring programme are as follows:

- ?? To assess the nature and magnitude of any air pollution problems
- ?? To monitor trends in the air quality so that timely policy decisions can be made to prevent air pollution episodes
- ?? To assess the adequacy and effectiveness of pollution control programmes

1.2 Air quality monitoring which initially involved manual collection and laboratory analysis of air samples, was fully automated with the commissioning of the telemetric air quality monitoring and management system (TAQMMS) in Jan 1994. The network has 16 air quality monitoring stations on the mainland. The stations are linked via public telephone lines to a Central Control Station (CCS) located at the Environment Building. **Chart 1** shows the locations of the 16 air monitoring stations.

- 1.3 The 16 air monitoring stations are strategically located to capture the air quality of different parts of the island accurately. Of the 16 stations, 13 monitor general ambient air quality while 3 monitor roadside air pollution levels. The ambient stations are classified as urban, industrial and sub-urban stations depending on the activities in the area where they are located. The 3 roadside stations are located near busy roads or expressway and are used to assess the adequacy and effectiveness of NEA's vehicular emission programme.
- 1.4 At the air monitoring stations, automatic analysers continuously monitor the classical air pollutants like sulphur dioxide, nitrogen oxides, ozone, carbon monoxide, particulate matter (PM10) and hydrocarbon. At selected stations, meteorological parameters like wind speed and direction, temperature and relative humidity are also monitored.
- 1.5 The data collected at the air monitoring stations in the network are transmitted via the public telephone network to the CCS at regular intervals. At the CCS, the data is automatically processed to give an update on air quality. The system provides NEA with a continuous and efficient means of monitoring air quality, with immediate access to air quality data collected at the monitoring stations. It also provides numerical models for simulation of various air pollution scenarios.

## **2 METHOD OF MEASUREMENT**

- 2.1 The air quality monitoring methods used in Singapore are based on the United States Environmental Protection Agency (USEPA) reference methods.

<b>Pollutants</b>	<b>Method of Measurement</b>
Sulphur Dioxide	Pulsed Fluorescence
Nitrogen Oxides	Chemiluminescence
Ozone	Ultraviolet Photometry
Carbon Monoxide	Non-Dispersive Infrared Spectroscopy
Particulate Matter	1) Continuous Filter-Based Mass Measurement 2) Beta Attenuation
Hydrocarbon	Flame Ionisation Detection
Lead	Hi-Volume Sampling followed by Atomic Absorption Spectroscopy

### 3 AMBIENT AIR QUALITY STANDARDS

3.1 USEPA Primary Air Quality Standards and the WHO Long Term Goals are used as guidelines in the evaluation of the ambient air quality in Singapore. The standards are summarised as follows:

Pollutants	Averaging Time	USEPA Primary Air Quality Standard	WHO Long Term Goals
Sulphur Dioxide	Annual Mean 24 Hours	80 $\mu\text{g}/\text{m}^3$	50 $\mu\text{g}/\text{m}^3$
		365 $\mu\text{g}/\text{m}^3$	125 $\mu\text{g}/\text{m}^3$
Nitrogen Dioxide	Annual Mean	100 $\mu\text{g}/\text{m}^3$	40 $\mu\text{g}/\text{m}^3$
Carbon Monoxide	1 Hour	40 $\text{mg}/\text{m}^3$	30 $\text{mg}/\text{m}^3$
	8 Hours	10 $\text{mg}/\text{m}^3$	10 $\text{mg}/\text{m}^3$
Ozone	1 Hour	235 $\mu\text{g}/\text{m}^3$	–
	8 Hours	–	120 $\mu\text{g}/\text{m}^3$
Particulate Matter (PM10)	Annual Mean 24 Hours	50 $\mu\text{g}/\text{m}^3$	–
		150 $\mu\text{g}/\text{m}^3$	–

### 4 POLLUTANT STANDARDS INDEX

4.1 The Pollutant Standards Index (PSI) developed by the USEPA has been used to report daily air pollutant concentrations in Singapore since 1991. PSI is intended as a public information tool to advise the public about the general health effects associated with different pollution levels and on the precautions to take when the air pollution levels escalate to the unhealthy or hazardous range.

4.2 The PSI converts the measured sulphur dioxide, nitrogen dioxide, carbon monoxide, ozone and respirable suspended particulate (PM10) concentration to a number on a scale of 0 to 500. Intervals on the PSI scale are related to the potential health effects of the daily measured concentrations of five major pollutants. The index value of 100 corresponds to the short-term (24 hours or less) National Ambient Air Quality Standard set by the USEPA to represent the concentration for each pollutant below which adverse health effects have not been observed. A PSI level in excess of 100 means that a pollutant is in the unhealthy range on a given day while a PSI level less than 100 means that the pollutant reading is in the satisfactory range.

4.3 The PSI intervals and the terms describing the air quality levels are as follows:

PSI			Air Quality Descriptor
0	to	50	Good
51	to	100	Moderate
101	to	200	Unhealthy
201	to	300	Very Unhealthy
301	and	above	Hazardous

## 5 AIR QUALITY IN SINGAPORE

- 5.1 Except for the levels of PM10 in 1994 and 1997 when Singapore was affected by transboundary smoke haze, the rest of the air pollutants (sulphur dioxide, carbon monoxide, ozone and nitrogen oxides) are well within the standards prescribed by WHO and USEPA.
- 5.2 The air quality in terms of PSI is summarised in **Chart 2**.

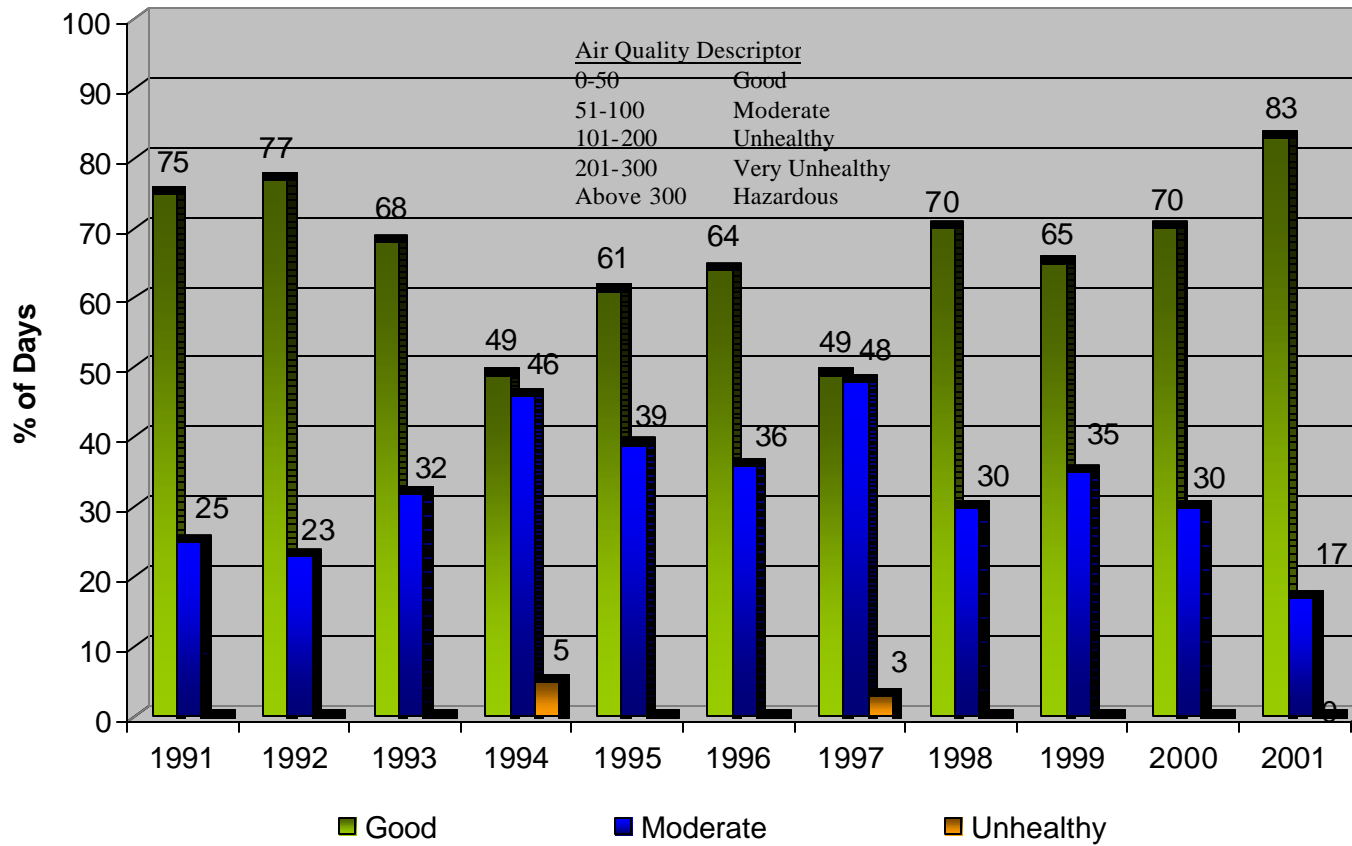
Chart 1

# LOCATION OF AIR QUALITY MONITORING STATIONS



Chart 2

**AIR QUALITY IN TERMS OF PSI  
1991 TO 2001**



(Note: Air quality in 1994 and 1997 was affected by the transboundary smoke haze from the land and forest fires in Indonesia)