ozone

INTRODUCTION

Ozone (O_3) is the reactive molecular form of oxygen. It is one of the strongest oxidising agents and accounts for approximately 90% of all oxidants. O_3 is formed indirectly during the photochemical process by the action of sunlight on nitrogen dioxide and is therefore a secondary pollutant.

The atmosphere has a natural ozone content and, although there is concern about the loss of ozone in the upper atmosphere, at ground level it is a pollutant which reacts very easily with biological material.

Ozone is also the major component of summertime smog often seen as a brown haze.

HEALTH EFFECTS

As with all photochemical oxidants ozone can cause damage to all parts of the respiratory system dependant on concentration and duration of exposure.

Clinical effects include coughing, shortness of breath, headache and eye, nose and throat irritation. In addition to causing functional changes ozone is capable of inducing increased respiratory sensitivity. Strenuous exercise during high levels of ozone results in an increase in the volume of inhaled ozone and deeper penetration into the lungs.

Although the whole population is equally vulnerable to the effects of ozone, susceptible groups such as asthmatics, smokers and those suffering chronic obstructive lung disease are thought to be at increased risk due to the more serious health consequences.

Exposure to typical urban concentrations normally cause effects which are temporary and reversible.

OTHER EFFECTS

Ozone interferes with plant cell metabolism and injury is indicated by stippling or flecking on leaves. Ozone also readily oxidises paints, elastomers such as rubber, textile fibres and dyes.

SOURCES

There are no significant anthropogenic emissions of ozone into the atmosphere. Ozone removal occurs mainly through reaction with nitrogen oxides and therefore concentrations are expected to be lower in urban areas. Greater use of catalytic converters on vehicles would slow the removal process.

As a result of the complex chemical reactions taking place in the atmosphere O_3 tends to build up down wind of urban centres. The rate at which ozone is produced is dependent on a number of factors including the intensity of sunlight. For this reason ozone episodes occur on hot, sunny days.

Figure 4.1 Until recently there was widespread belief that 'sea air' ozone was healthy

STANDARDS

The current standard for ozone is set by the EU Directive on Air Pollution by Ozone (92/72/EEC) based on WHO recommendations. This has been implemented in the UK by the Ozone Monitoring and Information Regulations 1994 and was not therefore applicable during the period covered by this report. The standard uses thresholds of health risk and is shown in table 4.1.

The World Health Organisation guidelines are shown in table 4.2. Ozone is also included in the DoE Air Quality guidelines and the bands are shown in table 4.3.

Table 4.1 Ozone thresholds

	$\mu g/m^3$	ppb
Health protection; 8 hour mean	110	55
Population information; 1 hour mean	180	90
Population warning; 1 hour mean	360	180

Table 4.2 WHO ozone guidelines

1-hour average	150 - 200$\mu g/m^3$	75-100ppb
8-hour average	100 - 120$\mu g/m^3$	50-60ppb

Table 4.3 DoE Air Quality categories for ozone

Very good	≤49ppb	≤100$\mu g/m^3$
Good	50 - 89ppb	100 - 178$\mu g/m^3$
Poor	90 - 179ppb	180 - 358$\mu g/m^3$
Very poor	≥180ppb	≥360$\mu g/m^3$

MONITORING SITES

Until recently ozone has not been monitored by Southwark directly but had been subject to monitoring by London Scientific Services (LSS), now TBV Science, as part of a London-wide Ozone Monitoring programme sponsored by nine Boroughs including Southwark. The programme comprised hourly measurements at initially two sites. The most relevant, the Central London urban background site, was located at County Hall just outside our borough.

The results as presented by LSS for the relevant period are shown in figure 4.2 and tables 4.4 and 4.5. Although ozone episodes occur about three to four times each year and last between one and four days the actual levels reached are not particularly informative. The results are therefore presented in the form of the number of days and hours when ozone concentrations exceeded particular levels.

COMMENTARY

The graphs clearly indicate that, unlike most primary pollutants, ozone does not display annual trends which can be related to precursor emissions.

Ozone formation is significantly affected by meteorological factors and most exceedences have occurred in those years with the hottest summers particularly in 1976 and 1989 which was the sunniest year in central London since records began in 1929.

The highest ozone level recorded in central London in 1990 was 128ppb on 4 August occurring during an episode lasting four days.

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LEVELS AND TRENDS

The following graph and tables indicate ozone exceedences in Central London.

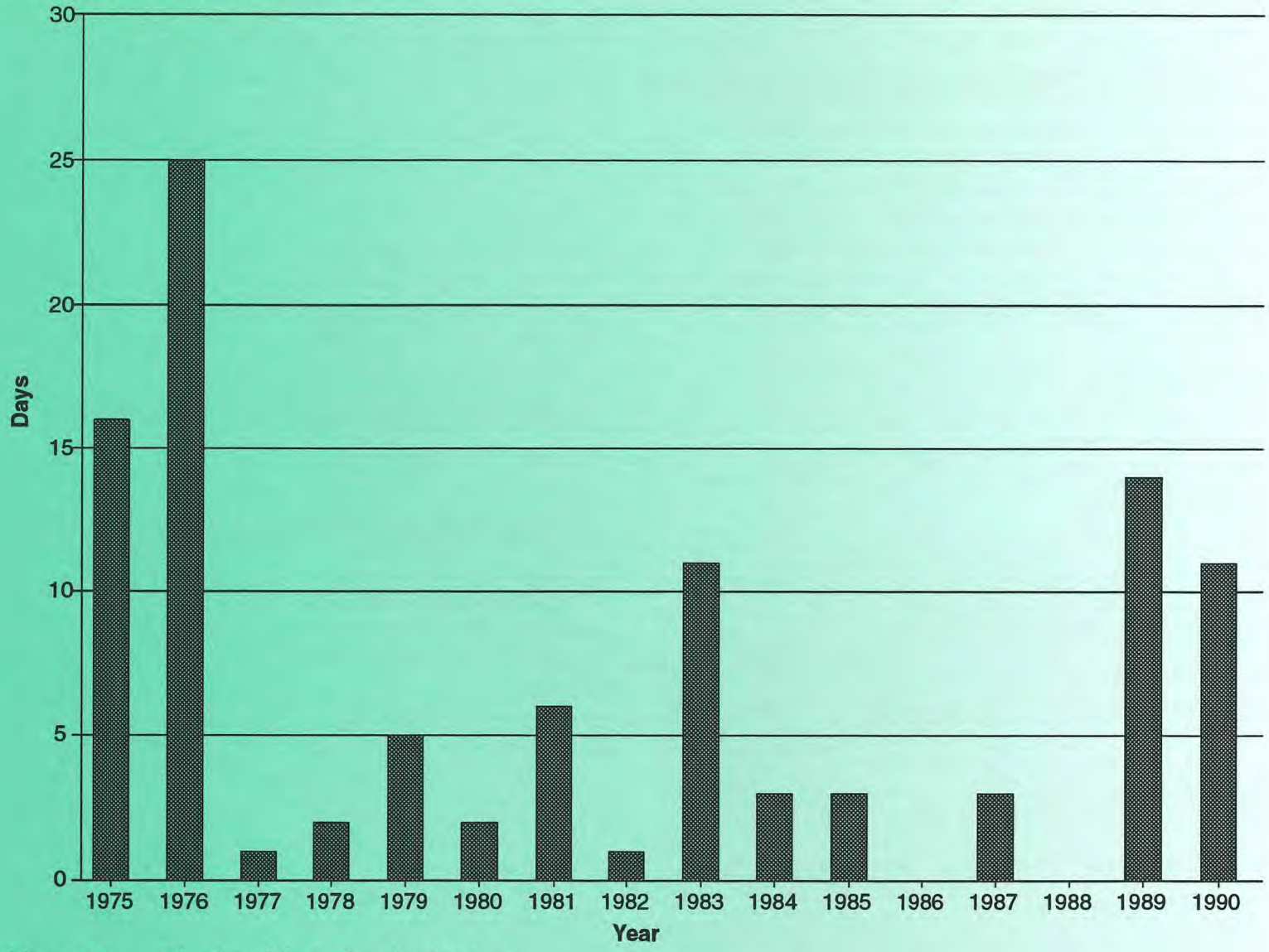

Figure 4.2 Number of days when hourly ozone concentrations exceeded 80ppb at the Central London site 1975 to 1990

Table 4.4 Number of hours when hourly mean value of 60ppb was equalled or exceeded from 1987 to 1989

April	1987	-
	1988	0
	1989	-
May	1987	6
	1988	0
	1989	9
June	1987	0
	1988	3
	1989	40
July	1987	24
	1988	0
	1989	48
August	1987	7
	1988	3
	1989	29
September	1987	-
	1988	0
	1989	4

- no data

Table 4.5 Number of hours when hourly mean value of 100ppb was equalled or exceeded from 1987 to 1989

April	1987	-
	1988	0
	1989	-
May	1987	0
	1988	0
	1989	0
June	1987	0
	1988	0
	1989	4
July	1987	1
	1988	0
	1989	7
August	1987	0
	1988	0
	1989	0
September	1987	-
	1988	0
	1989	0

- no data