

Environmental Protection Policy for Sulfur Dioxide and Particulate Matter at Kwinana

Introduction

Kwinana is a major heavy industrial area 30 km south of Perth, Western Australia. Most industry is concentrated in a strip of land about eight kilometres long bordering the Indian Ocean, as shown in Figure 1.

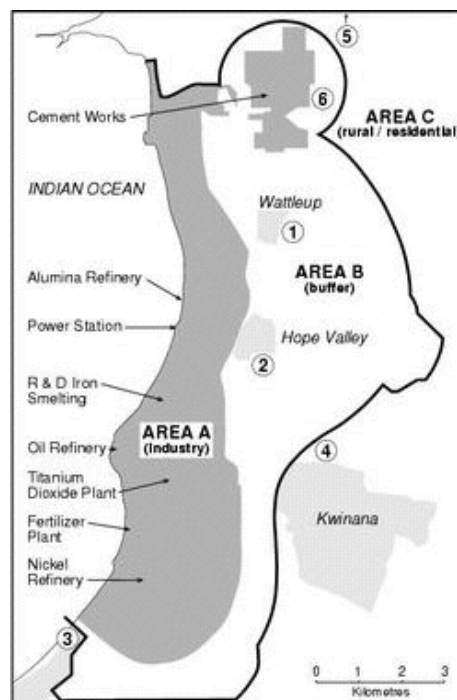
In the late 1970s emissions of sulfur dioxide from Kwinana industries caused significant pollution in nearby residential areas. The almost universal conversion to natural gas in 1984 virtually eliminated sulfur dioxide emissions associated with fuel combustion. However, with growth in demand and the cost of natural gas, plus the increase in sulfur dioxide emissions from other sources, the Environmental Protection Authority recognised the potential for the air quality around Kwinana to again become degraded and therefore established an Environmental Protection Policy (EPP) in 1992 to maintain acceptable air quality.

This paper explains the Policy and the control strategy underpinning it.

Features of the Sulfur Dioxide Control Policy

Ambient Standards and Limits

The Policy defines three areas (Areas A, B and C) as shown in Figure 1, where:



- Area A is the area of land on which heavy industry is located;

- Area B is a buffer area surrounding industry;
- Area C is beyond Areas A and B, predominantly rural and residential.

Sulfur dioxide standards and limits were set for the three areas, increasing in stringency from Area A to Area C, as seen in Table 1. The most important of these with respect to controlling air quality are the standards and limits averaged over 1-hour.

Similarly, ambient standards and limits were established for total suspended particulates.

A Strategy to Achieve the Ambient Standards and Limits

The relationship between the cumulative concentration of sulfur dioxide at some point in the region and the emissions from several independent industries is highly complex, particularly in a coastal environment. This complexity renders simplistic control strategies unsuitable. Simply demanding that each individual industry conduct its operations so as not to cause or contribute to an exceedance of the ambient standards and limits is not a sensible option. On the other hand, prescriptive "command and control" which does not offer a reasonable basis for confidence that the standards and limits will be achieved, or that arbitrary conservatism will be avoided, is also unacceptable.

Table 1 - Sulfur dioxide standards and limits (micrograms per cubic metre) for the Kwinana Policy Areas for specified averaging periods.

| REGION | 1-HOUR | 24-HOUR | ANNUAL |
|-----------------|--------|---------|--------|
| Area A standard | 700 | 200 | 60 |
| Area A limit | 1400 | 365 | 80 |
| Area B standard | 500 | 150 | 50 |
| Area B limit | 1000 | 200 | 60 |
| Area C standard | 350 | 125 | 50 |
| Area C limit | 700 | 200 | 60 |

- Concentrations are at zero degrees Celsius and one Atmosphere pressure (1013.25 hPa).
 - "standard" is the concentration of atmospheric waste which it is desirable not to exceed.
 - "limit" is the concentration of atmospheric waste which shall not be exceeded.

The DEP's approach has been to accept responsibility for developing and maintaining a computer model to provide the link between ambient concentrations and industrial emissions, and employing this model to calculate chimney emissions limits which will ensure that the ambient standards and limits are met. Individual industries are held responsible, via licence conditions, for complying with limits on the discharges from their chimneys, not for complying with the air quality standards and limits. Industries are also required to undertake ambient monitoring of sulfur dioxide at key locations in the region, and to undertake monitoring of their source emissions to demonstrate compliance with licence conditions. The DEP is then able to investigate any exceedance of air quality standards and limits which appears in the monitoring data to see whether industries were complying with emissions limits at the time and:

- if they were, review the adequacy of emissions limits;
- if they were not, take appropriate action.

The DEP is also able to use the combined monitoring results to improve the predictive capability of the model and to assess the need for a redetermination of emissions limits, either upward or downward.

All of the foregoing is enabled by the provisions of the EPP.

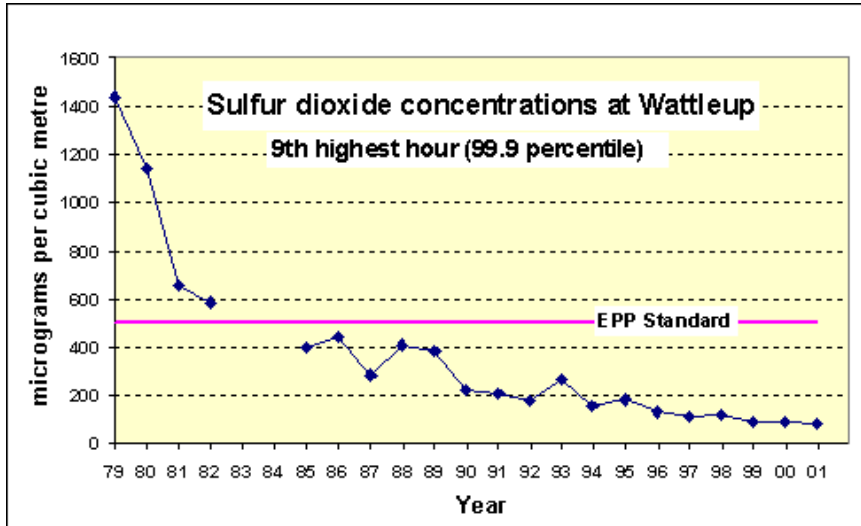
For an airshed like that at Kwinana, the task of allocating emissions limits to the various industries, and to individual sources within each industry, is not simply an exercise of dividing up a fixed total amount. A kilogram of pollutant emitted from a tall chimney with a very buoyant plume causes a much lower concentration at ground level than a kilogram from a short stack with a weakly buoyant plume, so emissions rates cannot be redistributed between industries in a simple fashion (i.e. the simple "bubble model"). Rather, any estimate of allocations must be tested via the model and modified, step by step, to achieve a set of emissions limits which the model confirms will result in the Policy standards and limits being met.

Early in the development of the Policy, the Department of Environmental Protection explained to the Kwinana industries the options for allocating emissions limits. Industries could propose a set of emissions limits (as verified by the model). The obvious advantage of this approach was allowing industries to grapple with the commercial implications and to optimise the set of limits from their viewpoint, hopefully resulting in a sense of ownership of the final result.

Alternatively, DEP would develop a set of criteria defining how the emissions could be equitably allocated to the various industries, and would apply these criteria in calculating the limits. The draft criteria presented for discussion allocated emissions on the basis of ground level impacts rather than mass of emissions at source, thereby giving credit for investment in tall chimneys.

Kwinana industries chose the first option and subsequently, with the assistance of consultant modellers, provided a set of emissions limits for all significant sources together with model results which predicted compliance with the Policy standards and limits. As is allowed under the Policy, some of the proposed emissions limits were formulae describing the relationship between sources within an industry, while other sources had start-up allowances with associated conditions.

The Kwinana Industries Council (KIC) was established in the course of the Policy development to provide a forum for negotiations between industries and to form a single body to represent industry's viewpoint. The KIC also undertakes ambient sulfur dioxide monitoring on behalf of all participating industries. The DEP and KIC monitoring systems (six stations in total) have combined to demonstrate the successful achievement of Policy standards and limits. This is shown in the graph below by the trend of sulfur dioxide concentrations at the Wattleup monitoring station.



The Kwinana EPP was formally reviewed in 1999 and re-issued unchanged. The EPP provides for a redetermination of industrial emissions limits as and when required, e.g. to accommodate new industries or variations to existing industry emissions.