The Categorisation of Volatile Organic Compounds

Department of the Environment: HMIP-commissioned research

Report Title: # The Categorisation of Volatile Organic Compounds

DOE Report No: DoE/HMIP/RR/95/009

Contract Title: Categorisation of Volatile Organic Compounds

DOE Reference: HMIP/CPR2/41/1/92 and HMIP/CPR2/41/1/183 **Sector No:** 1.1

Contractor's Reference: AEA/CS/16405545/REMA-137

Author/Affiliations etc:

I T Marlowe, C M Bone, S Byfield, M A Emmott, R Frost, N Gibson, J P Hagan, N F Harman, G D Hayman, M E Jenkin, P H R Lindsell, C L Rose, H Rudd and A Stacey
AEA Technology

Date of submission to DOE:
September 1995

Period covered by report:
August 1994 - September 1995

Abstract (100-200 words as desired):

A regimen is provided to assist HMIP staff to rank the harmfulness of named volatile organic compounds. Using the data provided in annexes to the report, and the simple flow chart given as Figure 1, about 500 substances have been ranked as of high, medium or low harmfulness. The ranking takes account of adverse human health effects and contributions to photochemical oxidant formation, stratospheric ozone depletion and global warming.

The body of the report discusses which parameters of environmental impact should influence the ranking. It also outlines how the methodology and the contributory data should be developed.

The reader's attention is drawn to the separately bound annex detailing adverse physiological effects.

The results of this work will be used in the formulation of Government Policy, but views expressed in this report do not necessarily represent Government Policy.

THIS VERSION: This version has been recreated from the final draft supplied by AEA Technology. Every effort has been made to ensure its accuracy, though this can not be guaranteed. Recreated June 1999. (Edited by Graham Winter, EPNS. Tel: 0117 914 2868)

Contents

Figures

Annexes

1. Introduction

Her Majesty's Inspectorate of Pollution (now the Environment Agency) contracted AEA Technology's National Environmental Technology Centre (NETCEN) to carry out a project entitled 'The Categorisation of Volatile Organic Compounds' (contract number HMIP/CPR2/41/1/92).

The objectives of the project were as follows:

- To define a method of allocating volatile organic compounds (VOCs) to categories according to their harmfulness.

- To use the method to create a list of VOCs likely to be encountered by Environment Agency Inspectors, which gives their categories and an indication of the reasons behind their allocation.

- To provide a method for the regular updating of the list.

The results of the project were reported to HMIP in December 1994 (Marlowe *et al*., 1994), including a proposed categorisation of some 420 VOC species. Subsequently we have been contracted to carry out a complementary study "The categorisation of volatile organic compounds - Part II" (contract number HMIP/CPR2/41/1/183), in which we have categorised a further 110 VOC species and made a number of revisions to our earlier proposed categorisation. This document forms the Final Report of the latter project. It is a consolidated report which combines all the material from the earlier report together with the new or revised categorisation previously reported to HMIP as an interim report (Marlowe *et al.*, 1995).

This report:

- summarises relevant background information;
- describes and justifies the provisional categorisation method;
- presents the provisional categorised listing of VOCs;
- documents sources of input data;
- discusses how the data can be updated in the future.

2. Background To Project

Volatile organic compounds (VOCs) are a large family of carbon-containing compounds which are emitted into the atmosphere from a variety of industrial processes. A number of these processes are prescribed for Integrated Pollution Control (IPC) under Part I of the Environmental Protection Act (1990) and associated Environmental Protection (Prescribed Processes and Substances) Regulations 1991 (SI 472 and updates). Operators of plant subject to IPC must apply for an authorisation which specifies conditions of operation, including emission limits, where appropriate. Under Schedule 4 of SI 472 organic compounds and partial oxidation products are listed as prescribed substances for release into the air, and so Environment Agency Inspectors need to take account of VOC emissions in the determination of IPC authorisations.

The term VOCs covers a range of chemical classes, including aliphatic, aromatic and chlorinated hydrocarbons; aldehydes; ketones; esters; ethers; acids; and alcohols. They contribute directly or indirectly to a number of important environmental issues and concerns, but the nature and extent of their contributions depend on the chemical

structure of each individual compound. Consequently Environment Agency Inspectors require guidance on the relative harmfulness of each VOC likely to be encountered.

Existing guidance for Environment Agency Inspectors is given in a series of Process Guidance Notes which divide VOCs into three categories:

- **Extremely hazardous to health**, such as benzene, vinyl chloride and 1,2-dichloroethane.

- **Class A compounds**: those organic compounds that may cause significant harm to the environment. Examples include acetaldehyde, aniline, benzyl chloride, carbon tetrachloride, CFCs, ethyl acrylate, halons, maleic anhydride, 1,1,1-trichloroethane, trichloroethylene, trichlorotoluene.

- **Class B compounds**: organic compounds of lower environmental impact than Class A compounds.

The categories that the VOC emissions fall into at a given plant are used to give a first indication of appropriate VOC emission levels for that plant. A BPEO/ BATNEEC assessment may follow and emission limits may be set.

The categorisation described above is insufficient as it stands, since it is left to the judgement of individual Inspectors to categorise an unlisted VOC - leaving the Inspectors open to criticism from plant operators for a given judgement. This is a crucial point for the plant operator, since the costs of abatement may increase exponentially as standards are tightened (NETCEN, unpublished results). On the other hand, it would be impossible to set emission limits for every VOC. Some lists of categorised VOCs have been prepared in other countries - Germany (3 categories) and Italy (5 categories) for example. But these lists are by no means agreed by UK companies or necessarily appropriate for UK environmental concerns. At European level an attempt was made to develop a categorisation scheme for solvents for use in the draft solvents directive (Commission of the European Communities, 1993) but this initiative has been abandoned due to lack of agreement on the detailed approach. Therefore it is desirable to establish in the UK a categorisation method so that Inspectors can have information leading to a first indication of appropriate emission levels for listed and unlisted VOCs, and so that plant operators can understand the basis for these emission levels. To meet these objectives, the categorisation method should be transparent, and should draw on agreed and published data concerning the adverse effects of VOCs.

3. Criteria to be Met by the Categorisation Method for VOCs

A variety of methods for categorising VOCs can be envisaged. In developing a suitable method we adopted a number of criteria which the method should meet.

The basic premise was that the method should categorise VOCs according to their harmfulness.

It was necessary to decide on the number of categories to be defined. We proposed that there should continue to be 3 basic categories for VOCs, corresponding approximately to the existing categories. While it is envisaged that in the long term a greater number of categories might be desirable, a simple approach has a number of advantages for the present time.

It was recognised that the method should be transparent, to aid implementation and to ensure that both Inspectors and plant operators can readily understand the basis on which categorisation has been made.

It is desirable that the proposed categorisation method should be accepted as widely as possible. For this reason it was felt that the method should draw on agreed and published data concerning the adverse effects of VOCs.

HMIP further requested that the method should as far as possible be compatible with any preliminary categorisation decisions which HMIP had taken in the past.

In summary, the adopted criteria required that the proposed VOC categorisation method should:

- categorise VOCs according to their harmfulness;
- define 3 categories of VOCs;
- be transparent;
- draw on agreed and published data concerning the adverse effects of VOCs;
- be compatible with previous HMIP practice.

4. VOCs Considered

We aimed to ensure that the initial categorised list of VOCs would be as comprehensive as possible, and would include the most frequently encountered VOCs. Our starting point for the working list was HMIP's Chemical Release Inventory (HMIP, 1994). A preliminary listing of about 300 substances (including non-VOCs) contained in the CRI as of February 1994 is given in Annex A (HMIP, personal communication). This list was supplemented by data given in Rudd (1994) and by a list produced by HMIP Anglia Region to generate the master list of VOCs given in Annex B. For convenience we assigned code numbers to each compound; these are shown in Annex B and allows cross-reference to data in subsequent annexes.

5. Overview of the Environmental Impacts of VOCs

VOCs have a variety of direct and indirect impacts on man and the environment. The main issues of concern are:

- harmful effects on human health and on natural ecosystems through toxicity, carcinogenicity and other adverse physiological effects;
- damage to materials;
- tropospheric photochemical oxidant formation;
- stratospheric ozone depletion;
- global climate change;
- odour.

The following sections briefly describe and comment on each of these issues.

5.1 ADVERSE PHYSIOLOGICAL EFFECTS

Many VOCs are directly harmful to human health on a broad spectrum of acuteness, and include irritation to skin and mucous membranes; various toxic and neurological effects; carcinogenicity, teratogenicity and mutagenicity. Some, such as methane, ethane and ethylene, are simple asphyxiants. There are a number of sources of information on these effects and on classification and categorisation of individual VOCs; key sources include Occupational Exposure Limits (Health & Safety Executive, 1994; 1995) and the risk phrases associated with the Chemicals (Hazard Information and Packaging) Regulations 1993 (CHIP).

In addition, VOCs have an indirect effect on human health via the formation of photochemical oxidants such as ozone (see below). Ozone is an aggressive and reactive pollutant that has a number of damaging and adverse environmental effects on human health, vegetation and materials. Its main effect on humans is to cause a change in lung function, together with eye, nose and throat irritation.

Similarly VOCs have direct and indirect adverse effects on plants and animals, with general implications for the well being of natural ecosystems. With more persistent VOCs, there is potential for impacts on human health following transport via numerous possible environmental pathways, for example via sewer atmospheres or through contamination of the natural water cycle.

5.2 DAMAGE TO MATERIALS

Some VOCs have the potential to cause damage to materials close to their point of discharge, for example as a consequence of oxidising or corrosive properties. VOCs also indirectly contribute to damage to materials through the formation of ozone (see below). Ozone is a highly reactive oxidising agent and can attack natural and synthetic rubber, textiles, and resins such as those used in surface coatings. Through attack of protective coatings ozone damage can lead to accelerated building decay.

5.3 PHOTOCHEMICAL OXIDANT PRODUCTION

Photochemical oxidants result from the reactions that occur between VOCs and oxides of nitrogen (NO_x) in the presence of sunlight. Photochemical oxidants include ozone, peroxyacyl nitrates, peroxides etc. These compounds can affect human health and are harmful to plants and materials; they also increase the environmental harmfulness of NO by oxidising it to NO_2.

The ability of a VOC to contribute to the formation of photochemical oxidants may be expressed by its Photochemical Ozone Creation Potential (POCP) factors. The key references for POCP factors and their derivation and application are United Nations Economic Commission for Europe (1990), Derwent & Jenkin (1991), and Richardson & Woodfield (1992).

5.4 STRATOSPHERIC OZONE DEPLETION

Concern over the effect of CFCs and other man made chemicals on the concentration of ozone in the stratosphere led to the Montreal Protocol and subsequent amendments and the European Council Decision 88/540/EEC. Although attention has focused on CFCs, halons and HCFCs, it is becoming clear that other VOCs have a role to play especially where they are being assessed as potential alternative components. Of particular relevance are the following extracts from Annex 1 to European Council Decision 88/540/EEC:

- Methane - has both natural and anthropogenic sources and affects both tropospheric and stratospheric ozone.

- Non Methane Hydrocarbons - play a direct role in tropospheric chemistry and an indirect role in stratospheric chemistry.

- Chlorine-containing Substances - e.g. CH_3Cl, CHF_2Cl, CH_3CCl_3, - these gases also act as a source of ClO_x. ClO_x is an important intermediate in the breakdown of ozone in the stratosphere.

5.5 GLOBAL WARMING

Almost all VOCs have the potential to contribute directly to global warming by absorbing infra red radiation from the earth's surface. In general the more complex a VOC, the greater its ability to absorb infra red radiation, however most VOCs have a very short atmospheric lifetime and are broken down by atmospheric reactions. Generally speaking the exceptions to this rule are the saturated light hydrocarbons and halogenated compounds. VOCs also contribute indirectly to global warming through the change in concentration of ozone, which is a potent greenhouse gas.

International concern about global warming inspired the United Nations Framework Convention on Climate Change. This was signed by very many nations at the UN Conference on Environment and Development, at Rio de Janeiro in June 1992.

5.6 ODOUR

Many VOCs have an odour. In certain circumstances emissions of VOCs can give rise to localised odour nuisance problems. If subject to complaint such a problem is usually treated as a Statutory Nuisance and becomes subject to Health and Safety Regulations.

The strength of a given compound's odour may be expressed by its odour threshold, that is, the concentration at which half the population could not detect an odour. It is difficult to predict the odour threshold of a mixture of VOCs since there are often complex and non-linear synergistic effects that can alter both the strength and quality of the perceived odour. In such cases the odour threshold of the emitted mixture must be determined by practical measurement.

6. VOC Impact Data Used In This Project

The following sections discuss the availability of suitable environmental impact data for each of the impacts introduced in section 5 above. In each case, the section identifies the sources and nature of data, assesses its quality and indicates the extent of availability of the data at the time of writing. Section 6 summarises the sources of data used in this project to compile the categorised list of VOCs.

6.1 ADVERSE PHYSIOLOGICAL EFFECTS

VOCs can be assigned hazard classifications using the Chemicals (Hazard Information and Packaging) Regulations 1993 (CHIP). These classifications are made on the basis of health effects and/or physico-chemical effects.

The health hazards are: Very Toxic, Toxic, Harmful, Corrosive and Irritant, supplemented by Carcinogenic, Mutagenic and Teratogenic (Categories 1, 2 or 3), if information is available. For physico-chemical effects the resulting hazards are: Explosive, Oxidizing, Extremely Flammable, Highly Flammable and Flammable. The latter are not regarded as measures of environmental impact and are considered irrelevant to this project.

The criteria used to define the health hazards to humans are found in the 'Approved guide to the classification and labelling of substances and preparations dangerous for supply' (Health and Safety Commission, 1994b). The data required is taken from animal experiments (rat or rabbit) and the guide lays down the specific values for a given classification as well as defining the route of entry to the body, i.e. by inhalation, swallowing or by contact with skin.

The CHIP classification method is considered to be sufficiently well accepted to be an appropriate measure of the adverse human physiological effects of VOCs for establishing a categorised list for the Environment Agency. The CHIP Regulations already classify a number of VOCs in the 'Approved Supply List - Information approved for the classification and labelling of substances and preparations for supply' (Health and Safety Commission, 1994a), but by no means does this cover all the VOCs in the master list (Annex B), and so other sources of data were required. It was also noted during the project that some VOCs in the Approved Supply List are not given a classification for health effects, but were classified according to their physico-chemical effects only (e.g. Flammable) even though suitable toxicity data is available to derive a health-based classification. Where this is the case, a CHIP health hazard classification for the compound has been assigned.

A number of publications provided data on the human health effects of VOCs. The prime source used was the Registry of Toxic Effects of Chemicals (RTECS) database - supplied as a CD-ROM from the Canadian Centre for Occupational Health & Safety (CCOHS). In addition, Sax's Dangerous Properties of Industrial Materials, Eighth Edition (Lewis, Sr.), was used.

Information on adverse physiological effects of VOCs on other biota (i.e. mammals, insects, birds, fish, plants etc) is sparse. Even where information is available on, for example, LD50 for fish, a wide variety of species have been examined and no one species is common to all such studies. Annex C illustrates this point with example information on eight VOCs taken from Verschueren (1977). The nature and strength of the effects is also diverse and varies between different species of a given taxonomic class. At the present time there appears to be no obvious way to take into account the effects of VOCs on biota other than humans. Some discussion of how this type of information might be used in the future is given in section 9 below.

6.2 DAMAGE TO MATERIALS

Information on corrosiveness or other properties of VOCs which might lead to materials damage can be found in a variety of standard textbooks. However such damage is unlikely to occur at any distance from the point of discharge, due to dilution through dispersion. In the event that a given discharge is thought to have the potential for significant damage the provision that discharges should be rendered harmless should provide sufficient scope for Inspectors to take action; additional consideration through the categorisation of VOCs is considered to be an unnecessary complication. Potential for materials damage is therefore not included in the proposed categorisation method for VOCs, although inclusion of POCP (see following section) takes account of ozone formation that may lead to ozone attack on certain materials.

6.3 PHOTOCHEMICAL OXIDANT PRODUCTION

It is well established that the photochemical degradation of hydrocarbons and other VOCs in the presence of nitrogen oxides leads to the production of ozone (O_3) and other harmful secondary pollutants (Atkinson, 1990; Lightfoot *et al*., 1992). The complete gas-phase oxidation of organic compounds into CO_2 and H_2O occurs predominantly by sunlight-initiated mechanisms, driven by free radical reactions, with O_3 generated as a by-product. However, each VOC can contribute differently to the formation of O_3 and other secondary oxidants in the troposphere, both in terms of quantity and timescale. Those compounds which are degraded rapidly (i.e. on the timescale of up to a few days) may be particularly important for efficient local O_3 production in the boundary layer, whereas those with lifetimes of a week or more are transported into the background troposphere where their slower oxidation has a less dramatic effect, even though they may ultimately be responsible for the production of more O_3 than those compounds which are degraded quickly.

Concern resulting from the generation of elevated levels of O_3 in regions of high population has led to more emphasis being placed on those compounds which are oxidised rapidly. Consequently, the reactivity of an organic compound with the hydroxyl radical (OH), the predominant initiation reaction, is commonly used as an indicator of its ability to contribute to photochemical air pollution. It is also recognised, however, that the nature of the oxidation steps following the initial attack by OH have a (sometimes profound) influence on the resulting production of ozone and other oxidants. Photochemical trajectory models, incorporating detailed degradation mechanisms for VOCs, have long been used to study the time-dependent production of photochemical oxidants in the boundary layer (Derwent & Hov, 1979), and these have been used to investigate the contribution to total O_3 formation made by a range of organic compounds (Derwent & Jenkin, 1991) on three trajectories over Europe. The concept of "Photochemical Ozone Creation Potential" (POCP) has been introduced to allow such contributions to be ranked. Based on trajectory model calculations over periods of up to 5 days from the points of emission, POCP values have been assigned to approaching 100 non-methane VOCs, as indicators of the relative abilities of a unit mass emission of these compounds to produce O_3 on the given timescale.

The POCP scale indicates the **relative** abilities of VOCs to produce O_3 on short timescales (up to 5 days). Ethene (C_2H_4) is the reference compound, for which a POCP value of 100.0 is assigned. A POCP value is defined per unit mass emission. Currently calculated POCP values range from zero, for unreactive fully halogenated compounds such as chlorofluorocarbons, to about 130 for reactive substituted aromatic compounds such as trimethyl benzenes.

In assessing the utility of POCP for ranking harmfulness, the following considerations apply:

- POCP expresses a real difference between organic compounds in their capacity to help create ozone.

- POCP is a calculated quantity which depends on the use of models and their underlying assumptions. When POCP is calculated using different atmospheric models, the ratio of POCPs for any given pair of compounds may differ appreciably.

There is a consensus on the approximate ordering and relative size of POCPs. However, at the current stage of development, workers disagree on the precise POCP values to ascribe to particular substances. So literature values can be confidently used

to approximately rank the harmfulness of substances, provided no subtle differentiation is entertained.

Although the science behind POCP values is still developing, we feel that it is sufficiently developed to assist Environment Agency Inspectors in determining appropriate VOC emission abatement regimes for IPC processes. POCP values are therefore used in the proposed categorisation method, taken from Derwent & Jenkin (1991). Additionally, 8 fully halogenated compounds are assigned a POCP value of 0 (zero) since they are unreactive in the troposphere and therefore are unable to contribute to photochemical air pollution.

6.4 STRATOSPHERIC OZONE DEPLETION

The extent to which VOCs can contribute to depletion of ozone in the stratosphere is usually expressed in terms of Ozone Depletion Potentials (ODPs). An ODP is a calculated quantity. To find the ODP for a particular compound, properties of that compound are put into a mathematical model. The model calculates the rate and height at which the compound interacts with other atmospheric constituents in the presence of sunlight, to initiate chains of reactions which destroy stratospheric ozone. The ozone depletion arising from an instantaneous release of the compound is calculated for the whole of the life of the compound in the atmosphere. The depletion of stratospheric ozone calculated for the compound is then expressed as a fraction of the depletion calculated for CFC-11 (trichlorofluoromethane) which is given an ODP of 1.0. The highest value encountered is for halon-1301 (trifluorobromomethane) with an ODP of 12.

ODP is only associated with compounds containing the halogens fluorine, chlorine, bromine and iodine; consequently the majority of VOCs are ascribed a zero ODP.

ODP values are published by the World Meteorological Organisation 1994). (

6.5 GLOBAL WARMING

The Global Warming Potential (GWP) of a substance is a measure of the extra amount of heat that is trapped in the atmosphere when one kilogram of the substance is released instantaneously into it, relative to the case when 1kg carbon dioxide is released.

GWPs are calculated using computer models which incorporate the radiative heat balance of the atmosphere and the chemical kinetics of all the substances involved. The model is initially in a steady state. If a kilogram of a greenhouse gas is released the temperature will increase until a new steady state is established. If a substance stayed in the atmosphere indefinitely the new steady state would be permanent and the increase in temperature could be used as a measure of the global warming potential. However, organic compounds are removed from the atmosphere by various processes including photochemical reactions and wet and dry deposition. In time the concentration of the emitted substance will decline to zero and the initial state will be restored. Consequently a simple temperature increase cannot be used as a measure of global warming potential because it depends on time. Instead, the time integral of the increase in heat flux is used, normalised so that it equals unity for carbon dioxide. Recently a paper has been published (Derwent, 1994) in which GWPs have been derived using a continuous source instead of an instantaneous one. The GWPs are very similar to those from the references using instantaneous (Ramaswamy *et al.*, 1991 and Shine *et al.,* 1990) sources so we have taken the average of all three references. Where values in the more recent IPCC report, Climate Change 1994, supersede these, the more recent values have been used.

The GWP of a compound includes a direct effect and an indirect effect. The direct effect is the warming due to the absorption of radiation by molecules of the compound in question. The indirect effect is due to the impact that the presence of the compound has on the concentration of other greenhouse gases. The indirect effect can be negative if the molecule causes the removal of other greenhouse gases.

The integration is taken from the time at which the substance is released until a specified time in the future. GWPs are usually calculated for time horizons of 20 years, 100 years and 500 years. Various interest groups have proposed that one set of GWPs should be used over another, but no universal concensus has been reached. We propose to use the GWPs calculated using the 100 year time horizon.

Because powerful computer models are needed, GWPs have only been determined for a handful of compounds, namely carbon dioxide, methane, nitrous oxide, 5 chlorofluorocarbons, 5 HCFCs, 4 halons, carbon tetrachloride, 1,1,1-trichloro-ethane and bromotrifluoromethane.

It is not possible to estimate GWPs on the basis of chemical intuition without using the sophisticated models mentioned above. This is because there exist no simple correlations between chemical structure and GWP. GWPs depend on the lifetime of the molecule in the atmosphere as well as the spectrum of the compound, and these lifetimes can vary greatly even among similar molecules.

6.6 ODOUR

General

Annex D provides a list of odour thresholds, these values mark the point at which a 'population' (in a statistical context) of people can and cannot detect an odour. Due to the small number of people used to derive the threshold values the values may not be very accurate. At the values given in Annex D the odour is not recognisable, similarly the values cannot be directly related to annoyance and/or to odour quality (eg. pleasantness/unpleasantness). To use these values to indicate where a potential odour problem might exist, the odour emission rate must be determined; the odour emission rate is the odour threshold value multiplied by the flow rate.

Data Categories

For guidance, Annex D places VOCs into high, medium and low categories. VOCs in the high category have an odour threshold value of less than 0.001 ppm, while those in the low category have a threshold value of greater than 1 ppm. The medium category includes those compounds which lie between 0.001 and 1 ppm. These limits place compounds such as sulphides in the high category, most alcohols, esters and aldehydes etc. in the medium category and most alkanes, alkenes etc., in the low category. It was felt that the categories selected in this way reflect the types of odour emitting plants which have come to the attention of NETCEN.

Data sources and data quality

The data given in Annex D were generated from three main sources:

Source 1 - Fazzalari (1978)
Source 2 - Amoore & Hautala (1983)
Source 3 - Woodfield & Hall (1994)

Source 1 provides a listing of all detection threshold values reported in the literature between 1910 and 1976. The techniques used to generate threshold values in the early references are unknown and therefore are likely to be subject to very significant uncertainty. It is likely that the degree of uncertainty will be reduced in the later references.

Source 2 provides a listing of a number of chemical species for which threshold data has previously been reported. The authors have calculated and reported averaged values for thresholds reported in the literature. These averaged values are likely to be more accurate than the individual literature values.

Source 3 provides a short list of thresholds which were either determined using the latest olfactometric methodology by Warren Spring laboratory or were recently supplied by other olfactometry laboratory groups in Europe. The data quality of this list is considered to be good, with low uncertainties. Low uncertainties are considered to be +/- 40%; this range stems from the pseudo-subjective nature of the olfactometric methodology.

6.7 SUMMARY OF DATA USED IN THE PROPOSED METHODOLOGY

The following table summarises the nature and reference sources of data on VOC impacts used in the proposed methodology. The table also refers to annexes which list the values of POCP, ODP and GWP used, and in the case of human health effects records various information on pro forma.

Impact	Factor Used	Reference Source	Annex of Data
Human health effects	CHIP classification	Approved Supply List - Information approved for the classification and labelling of substances and preparations dangerous for supply.	G
	IARC group	Registry of Toxic Effects of Chemicals (RTECS) database	
Photochemical oxidant formation	POCP	Derwent, Jenkin & Sanders (in press)	E
Stratospheric ozone depletion	ODP	World Meteorological Organisation (1994)	
Global warming	GWP	World Meteorological Organisation (1995) Derwent (1994) Ramaswamy et al (1991) Shine et al (1990)	

7. A Proposed Categorisation Method For VOCs

This section describes the proposed categorisation method for VOCs, and assesses the method against the criteria presented in section 3 above.

The method uses a decision tree approach to judge VOCs against a number of selection criteria which determine the category. Three categories are used which, for the purposes of this report, are termed 'high', 'medium' and 'low' in descending impact. The decision tree approach proposed is summarised in Figure 1.

VOCs are first judged according to criteria based on human health effects, then on the other factors discussed above, ie POCP, ODP and GWP. The three categories may be summarised as follows:

- **High:** HIP category 1 or 2 carcinogens, mutagens or teratogens; *or* IARC Groups 1 & 2A; *or* CHIP class 'very toxic'; or risk phrase R42.

- **Medium:** CHIP category 3 carcinogens, mutagens or teratogens; *or* IARC Group 2B; *or* CHIP class 'toxic by inhalation' *and* LC50 (inhalation, rat) is less than 0.8 mg/l/4h and greater than 0.5 mg/l/4h; *or* POCP value greater than 85; *or* ODP value greater than 0.2; *or* GWP value greater than 10.

- **Low:** All other VOCs, ie: not CHIP category 1, 2 or 3 carcinogens, mutagens or teratogens; *and* not IARC Group 1 or 2A or 2B; *and* not CHIP class 'very toxic'; *and* not CHIP class 'toxic by inhalation' with LC50 (inhalation, rat) less than 0.8 mg/l/4h and greater than 0.5 mg/l/4h; *and* not risk phrase R42; *and* POCP less than or equal to 85; *and* ODP less than or equal to 0.2; *and* GWP less than or equal to 10; *or* any combination of some of the preceding factors, plus no data for the remainder.

The method may be assessed against the criteria given in section 3 as follows:

***The method should categorise VOCs according to their harmfulness**:*

The proposed method takes into account adverse human health effects, contributions to photochemical oxidant formation, contributions to stratospheric ozone depletion, and contributions to global warming. It does not take into account adverse physiological effects on biota other than humans, damage to materials, or odour. The proposed method therefore only partially meets this criterion. With suitable minor modifications, the proposed method is capable of taking these factors into account - this is discussed in section 9 below. An additional factor which has not been discussed above is 'persistence'; this is an ill-defined 'impact' which in itself does not imply damage to the environment but rather is an indicator of how a substance survives transportation through and between the various environmental media. This issue is also discussed in section 9 below.

***The method should define 3 categories of VOCs**:*

The proposed method meets this criterion.

***The method should be transparent**:*

The authors consider that the proposed method meets this criterion in as much as it can be readily summarised in Figure 1 as a simple decision tree.

***The method should draw on agreed and published data concerning the adverse effects of VOCs**:*

The authors consider this criterion to be met as far as is practicable, but nevertheless anticipate that this report will lead to lively debate. Few of the data used by the method are free from scientific critique, nevertheless all have been subjected to public debate and various degrees of consensus are emerging. The proposed method draws on what are state-of-the-art data at the time of writing, but developments in the respective branches of science should be taken into account, see section 9 below.

***The method should be compatible with previous HMIP practice**:*

We have attempted to address this criterion through regular discussions with HMIP throughout the course of the project.

8. A Proposed Categorised Listing of VOCs

The method presented in the previous section has been applied to the compounds given in Annex B using the data given in Annexes E and G to derive the proposed categorised list of VOCs presented in Annex F. This categorises VOCs into the three categories 'high', 'medium' and 'low', corresponding with the Environment Agency's current categories 'extremely hazardous to health', 'class A' and 'class B' respectively.

Figure 2 illustrates the distribution of VOCs between the three categories. It should be noted that a number of compounds are categorised as 'low' on the basis of lack of data, some of these may require re-categorisation as suitable data becomes available.

9. Future Updating of the Categorised List

As new or revised data becomes available concerning the toxicity, POCP, ODP or GWP of VOCs, the list as it is presented in Section 8 can easily be updated following the method described in Section 7. It is recommended that the Environment Agency maintain an up-to-date master list so that they can issue controlled copies to Inspectors: use of an effective QA/QC regime is recommended for this purpose.

As indicated in Sections 5 & 6, some information is available on other environmental impacts of VOCs but the authors consider that the state of development of the information is insufficient to include these impacts in the categorisation methodology at this time. These impacts are: adverse physiological effects on biota other than humans, odour and persistence.

Adverse physiological effects on biota other than humans:

This is clearly an important impact to take into account in future developments of the categorisation method. The potential receptors and effects are too diverse to adequately discuss in this report, but a number of issues can be identified as follows.

- A problem which has been highlighted earlier in this report is that such data as does exist refers to a wide variety of species. Ideally comparisons would only be made on the basis of common parameters measured on the same species.

- Account needs to be taken of the environmental pathways by which VOCs emitted from industrial facilities into the atmosphere can reach receptor organisms. For example, a VOC which does not readily deposit and is rapidly destroyed in the atmosphere is not likely to affect many organisms.

- The mode of impact is also important. For example, a compound which can give adverse physiological effects by inhalation is perhaps a higher priority than a compound that is only harmful by ingestion in aqueous solution since, in the latter case, more dispersion and dilution is likely to have occurred. It also follows that some receptor organisms are more susceptible than others, depending on their local environment and the VOC in question. Birds nesting in trees close to and at the same height as an emitting stack may be at risk from VOCs which cause harm by inhalation; fish living in local water bodies may at some risk from other VOCs.

For the future, it is recommended that the Environment Agency initiate a data base to collate data which might be suitable for future inclusion in a revised categorisation method. For simplicity it is suggested that the database limits records to a small number of potential receptor species, chosen to represent various groups of organisms and habitats. For example, the salmon or rainbow trout are studied fairly frequently and might serve to represent fish. When it is deemed that data has been collected for a sufficient number of VOCs (say, 10% of the compounds on our initial list), then this impact can be included into the categorisation method.

Adverse effects on biota other than humans could be incorporated in a similar manner to the toxicological data for humans. Suitable risk phrases are given in the CHIP Regulations which relate to given species. The collation of data for VOCs will entail extra work because it is more varied, and less well defined, than human data.

***Odour**:*

As discussed in Section 6.6, the odour strength of VOCs can be measured and expressed as odour threshold values. Potentially, then, odour can be incorporated into the categorisation method. However, there is considerable variability in reported odour threshold values for a given compound because of systematic differences in the measurement methods used. This situation should be rectifiable in the long term, since CEN committee TC264 /WG2 'ODOURS' is developing a standard for odour measurements of stack gases. Over the next few years odour threshold values should be established for a number of VOCs. This impact could then be included into the categorisation method in parallel with POCPs, ODPs and GWPs, with a simple cut-off between 'medium' and 'low'. It is recommended that the Environment Agency compile a central data base of such values once the standard has been promulgated.

Persistence:

Persistence in the environment is a particular concern in Germany, but little work has been carried out in the UK. During the study we have contacted two European bodies requesting information on persistence of VOCs in the environment. The data received was sparse and its application dubious at this time. Nevertheless it is recommended that the Environment Agency maintain dialogue with researchers in this field, against a time when this branch of science has more fully developed.

10. References

Amoore J.E. & Hautala, E., 'Odour as an aid to chemical safety: Odour threshold compared with thresholds, limits values and volatilities for 214 industrial chemicals in air- and water- dilution', Journal of Applied Toxicology, Vol. 3, No. 6, 1983.

Atkinson, R., 'Gas phase tropospheric chemistry of organic compounds: A review', *Atmospheric Environment*, **24A**, 1-41, 1990.

Canadian Centre for Occupational Health and Safety, 'Registry of toxic effects of chemical substances' (CD ROM database).

Commission of the European Communities, 'Proposal for a Council Directive (EEC) on the limitation of the emissions of organic compounds due to the use of organic solvents in certain processes and industrial installations', working draft dated March 1993.

Derwent R.G. & Hov, O. (1979) 'Computer modelling studies of photochemical air pollution in north-west Europe'. AERE Report R-9434, HMSO, London.

Derwent, R.G. & Jenkin, M.E., 'Hydrocarbons and the long-range transport of ozone and PAN across Europe', *Atmospheric Environment*, **25A**, 1661-1678, 1991.

Derwent, R.G. (1994). The Estimation of Global Warming Potentials for a Range of Radiatively Active Gases. Proceedings of International Conference on Non-CO_2 Greenhouse Gases, 1994

Fazzalari F.A., 'Compilation Of Odor And Taste Threshold Values Data', American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pa 19103, 1978.

Health and Safety Commission, 'Chemicals (Hazard Information and Packaging for Supply) Regulations 1994. Approved supply list. Information approved for the classification and labelling of substances and preparations dangerous for supply', HMSO, London, 1994(a).

Health and Safety Commission, 'Chemicals (Hazard Information and Packaging for Supply) Regulations 1994. Approved guide to the classification and labelling of substances and preparations dangerous for supply', HMSO, London, 1994(b).

Health and Safety Executive, 'Occupational exposure limits 1994', report EH40/94, HMSO, London, 1994.

Health and Safety Executive, 'Occupational exposure limits 1995', report EH40/95, HMSO, London, 1995.

HMIP, 'Chemical Release Inventory Annual Report 1992 & 1993', Department of the Environment, 1994.

R.J. Lewis Snr. (ed.), 'Sax's dangerous properties of industrial materials', van Nostrand Reinhold, 8th. edition.

Lightfoot, P.D., Cox, R.A., Crowley, J.N., Destriau, M., Hayman, G.D., Jenkin, M.E., Moortgat G.K. & Zabel, F., 'Organic peroxy radicals: kinetics, spectroscopy and tropospheric chemistry', *Atmospheric Environment* **26A**, 1805-1964, 1992.

I.T. Marlowe, C.M. Bone, S. Byfield, M.A. Emmott, R. Frost, N. Gibson, J.P. Hagan, N.F. Harman, G.D. Hayman, M.E. Jenkin, P.H.R. Lindsell, C.L. Rose, H. Rudd & A. Stacey, 'The categorisation of volatile organic compounds. Final report', AEA Technology report AEA/CS/16405508/REMA-066/ISSUE 1, December 1994.

I.T. Marlowe, P.H.R. Lindsell, S. Byfield & C. Jones, 'The categorisation of volatile organic compounds - Part II. Interim report', AEA Technology report AEA/CS/16405545/REMA-124/ISSUE 1, May 1995.

Ramaswamy V., Leovy, C., Rodhe, H., Shine, K., Wang, W.C., Weubbles, D. (1991). 'Radiative Forcing of Climate'. Chapter 7 of "Scientific assessment of Ozone Depletion: 1991". World Meteorological Organisation Global Ozone Research and Monitoring Project - Report No 25

Richardson, S.J. & Woodfield, M.J., 'The science behind POCPs', *Spray Technology & Marketing*, October 1992, pp. 10-83.

Rudd, H.J., 'Emissions of volatile organic compounds from stationary sources in the United Kingdom: speciation', AEA Technology report AEA/CS/16419033/REMA-029, October 1994.

Shine K.P., Derwent, R.G., Weubbles, D.J. & Morcrette, J.J. (1990). 'Radiative Forcing of Climate'. Chapter 2 of "Climate Change - the IPCC Scientific assessment". Cambridge University Press 1990

United Nations Economic Commission for Europe, 'Hydrocarbons and ozone formation; An approach to their control based on likely environmental benefits', Document EB.AIR/WG.4/R.11, 14 May 1990.

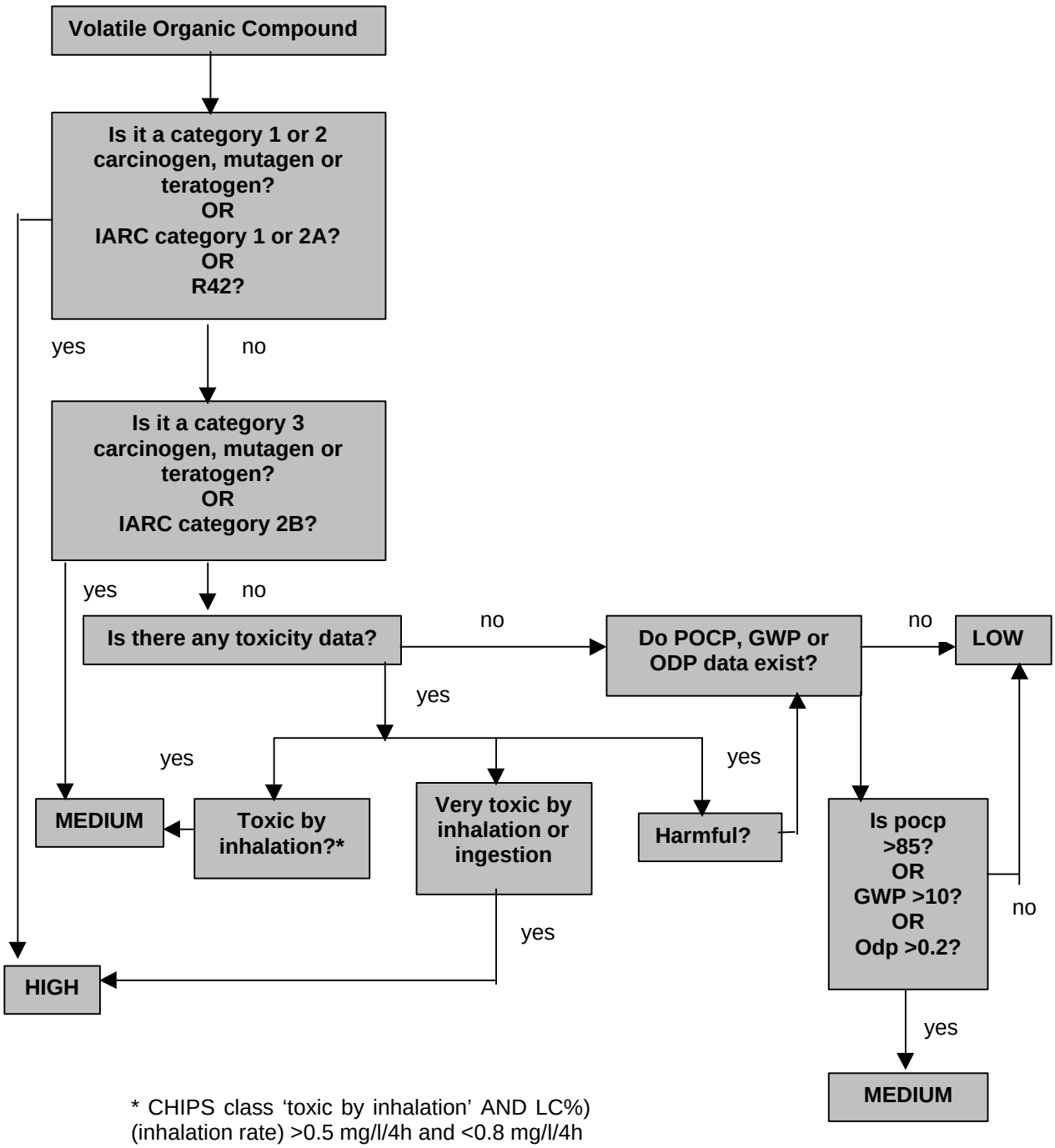
Verschueren, K., 'Handbook of environmental data on organic chemicals', Van Nostrand Reinhold Co., New York, 659 pp., 1977.

Woodfield, M. and Hall, D., 'Odour Measurement and Control - An Update' AEA Technology, National Environmental Technology Centre, Culham, Abingdon, Oxon. OX14 3DB, 1994.

World Meteorological Organisation, 'Scientific assessment of ozone depletion: 1994', Global Ozone Research & Monitoring Project Report number 37, WMO, Geneva, 1995.

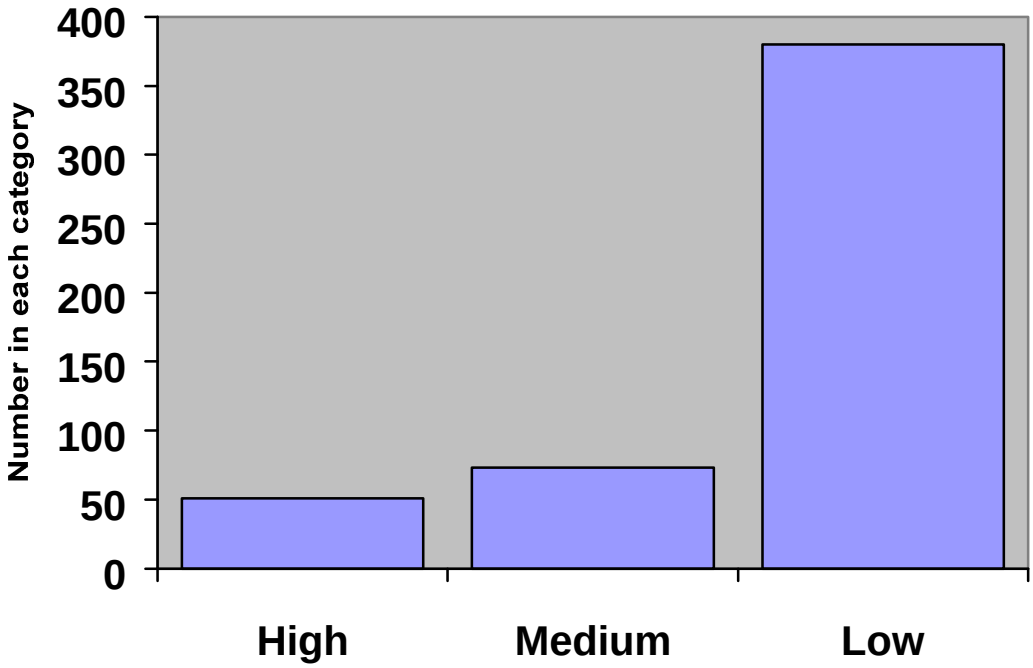
World Meteorological Organisation/United Nations Environment Programme, 'Climate Change 1994, Radioactive Forcing of Climate Change, IPCC Report', Cambridge, 1995.

FIGURE 1: The proposed categorisation decision tree for VOCs.



* CHIPS class 'toxic by inhalation' AND LC%) (inhalation rate) >0.5 mg/l/4h and <0.8 mg/l/4h

FIGURE 2: The distribution of VOCs between the three categories.



ANNEX A

Preliminary List of VOCs Contained In HMIP's Chemical Release Inventory as at February 1994

SUBSTANCES IN THE UK's CHEMICAL RELEASE INVENTORY (with CAS Numbers Where Appropriate)

Substance Name	CAS Number		
1 -CHLORO-2,3-EXPOXYPROPANE (EPICHLOROHYDRIN)	106	89	8
1 -CHLORO-4-NITROBENZENE (P-CHLORONITROBENZENE)	100	00	5
1,1-DIBROMOETHANE	557	91	5
1,1-DICHLOROETHANE (VINYLIDENE CHLORIDE)	75	35	4
1,1'-DIMETHYL-4,4'-BIPYRIDINIUM (PARAQUAT)	4685	14	7
1,1,1-TRICHLOROETHANE	71	55	6
1,1,2,2-TETRACHLOROETHANE (TETRACHLOROETHANE)	79	34	5
1,2-BENZISOTHIAZOL-3(2H)-ONE	2634	33	5
1,2-DIAMINOETHANE (ETHYLENEDIAMINE)	107	15	3
1,2-DICHLOROBENZENE	95	50	1
1,2-DICHLOROETHANE (ETHYLENE DICHLORIDE)	107	06	2
1,3-BUTADIENE	106	99	0
1,6-DICHLOROHEXANE (DICHLOROHEXANE)	2163	00	0
1,6-DICYAN0HEXANE (DICYAN0HEXANE)	629	40	3
2-(2-AMINOETHYLAMINO)ETHANOL	111	41	1
2-AMINOETHANOL (MONOETHANOLAMINE)	141	43	5
2-ETHOXYETHANOL	110	80	5
2-METHYLBUT-2-ENE (2-METHYL 2-BUTENE, AMYLENE)	513	35	9
2-METHYLBUTYRALDEHYDE (2-METHYLBUTANAL)	96	17	3
2-METHYLPROPAN-1 -OL (ISOBUTYL ALCOHOL)	78	83	1
2-PHENYLPROPENE (METHYL STYRENE)	98	83	9
2-PROPEN-1-OL (ALLYL ALCOHOL)	107	18	6
2,2'-IMINODI(ETHYLAMINE) (DIETHYLENE TRIAMINE)	111	40	0
2,2'-IMINODIETHANOL (DIETHANOLAMINE)	111	42	22
2,4-DIBROMOPHENYL ACETATE	36914	79	1
2,4,6-TRICHLORO-1,3,5-TRIAZINE (CYANURIC CHLORIDE)	108	77	0
3-BROMOPROPENE	106	95	6
3-METHYLBUTAN-1-0L (ISOAMYL ALCOHOL)	123	51	3
3A, 4,7,7A-TETRAHYDRO-4,7-METHANOINDENE	77	73	6
4-4'-METHYLENEDIPHENYL DIISOCYANATE	101	68	8
4-BROMOPHENYL ACETATE	1927	95	3
4-METHYLPENTAN-2-ONE (METHYL ISOBUTYL KETONE)	108	10	1
4,4'-METHYLENEBIS (2-CHLOROANILINE)	101	14	4
4,4'-METHYLENEDIANILINE (METHYLENE DIANILINE)	101	77	9
ACETALDEHYDE	75	07	0
ACETATE ESTERS - TOTAL Not Otherwise Specified			
ACETIC ACID		19	7
ACETIC ANHYDRIDE		24	7
ACETONE (PROPANONE)	67	64	1
ACETONITRILE	75	05	8
ACETYLENE	74	86	2
ACRYLAMIDE	79	06	1
ACRYLATES - TOTAL Not Otherwise Specified			
ACRYLIC ACID	79	10	7
ACRYLONITRILE	107	13	1
ALCOHOLS - TOTAL Not Otherwise Specified			
ALDEHYDES - TOTAL Not Otherwise Specified			
ALDRIN	309	00	2
ALUMINIUM	7429	90	5
ALUMINIUM CHLORIDE	7446	70	0
AMINES - TOTAL Not Otherwise Specified			

Substance Name	CAS Number		
AMITROLE (AMINOTRIAZOLE)	61	82	5
AMMONIA	7664	41	7
AMMONIUM CHLORIDE	12125	02	9
AMMONIUM NITRATE	6484	52	2
AMMONIUM PENTADECAFLUOROCTANOATE	3825	26	1
AMMONIUM SULPHATE	7783	20	2
AMMONIUM TRIOXOVANADATE	7803	55	6
ANILINE	62	53	3
ANTHRACENE	120	12	7
ANTHRAQUINONE	84	65	1
ANTIMONY	7440	36	0
ANTIMONY COMPOUNDS - TOTAL			
ARSENIC	7440	38	2
ARSENIC COMPOUNDS - TOTAL			
ASBESTOS (SUSPENDED PARTICLES & FIBRES)			
ATRAZINE	1912	24	9
AZININPHOS-METHYL	86	50	0
BARIUM	7440	39	3
BARIUM COMPOUNDS (NOT SULPHATE) TOTAL			
BARIUM OXIDE	1304	28	5
BARIUM SULPHATE	7727	43	7
BENZAMIDE	55	21	0
BENZENE	71	43	2
BENZENE- 1,2,4-TRICARBOXYLIC ACID 1,2-ANDHYDRIDE	552	30	7
BENZYL ALCOHOL	100	51	6
BERYLLIUM	7440	41	7
BERYLLIUM COMPOUNDS-TOTAL			
BIOCIDES - TOTAL Not Otherwise Specified			
BIS(TRIBUTYLTIN) OXIDE (TRIBUTYL TIN OXIDE)	56	35	9
BISMUTH	7440	69	9
BORON	7440	42	8
BROMINE	7726	95	6
BUTANONE (METHYL ETHYL KETONE)	78	93	3
CADMIUM	7440	43	9
CADMIUM COMPOUNDS - TOTAL			
CALCIUM	7440	70	2
CARBON DIOXIDE	124	38	9
CARBON DISULPHIDE	75	15	0
CARBON MONOXIDE	630	08	0
CARBON TETRACHLORIDE	56	23	5
CHLORIDES - TOTAL Not Otherwise Specified (AS SODIUM CHLORIDE)			
CHLORINE	7782	50	5
CHLORINE DIOXIDE	10049	04	4
CHLOROBENZENE (MONOCHLOROBENZENE)	108	90	7
CHLORODIFLUOROMETHANE	75	45	6
CHLOROETHANE (ETHYL CHLORIDE)	75	00	3
CHLOROETHYLENE (VINYL CHLORIDE)	75	01	4
CHLOROFLUOROCARBONS - TOTAL Not Otherwise Specified			
CHLOROFORM	67	66	3
CHLOROMETHANE	74	87	3
(CHLOROMETHYL) ETHYLBENZENE	26968	58	1
CHLOROPHENOLS - TOTAL Not Otherwise Specified			
CHLOROTOLUENE (BENZYL CHLORIDE)	100	44	7
CHROMIUM	7440	47	3

Substance Name	CAS Number		
CHROMIUM COMPOUNDS -TOTAL			
COBALT	7440	48	4
COBALT COMPOUNDS - TOTAL			
COPPER	7440	50	8
COPPER COMPOUNDS - TOTAL			
CRESOL - ALL ISOMERS - TOTAL			
CYANIDES - TOTAL Not Otherwise Specified (AS CN)			
CYCLOHEXANE	110	82	7
DDT - ALL ISOMERS			
DIAMINOTOLUENE	25376	45	8
DIBORANE (BORON HYDRIDE)	19287	45	7
DICHLOROMETHANE (METHYLENE CHLORIDE OR DICHLORIDE)	75	09	2
DICHLORVOS	62	73	7
DIELDRIN	60	57	1
DIETHYL OXALATE	95	92	1
DIETHYL SULPHATE	64	67	5
DIFLUOROMETHANE			
DIISOPROPYL ETHER	108	20	3
DIMETHYL ETHER	115	10	6
DIMETHYL SULPHATE	77	78	1
DIMETHYLAMINE	124	40	3
DINITROGEN OXIDE (NITROUS OXIDE)	10024	97	2
DINOSEB	88	85	7
DIPHOSPHORUS PENTAOXIDE (PHOSPHORUS PENTOXIDE)	1314	56	3
DIPHOSPHORUS PENTASULPHIDE (P PENTASULPHIDE)	1314	80	
DIPROPYL ETHER	111	43	
DIQUAT DIBROMIDE (DIQUAT)	85	00	7
DISODIUM OXIDE (SODIUM OXIDE)	1313	59	3
DITHIOCARBAMATES - TOTAL Not Otherwise Specified			
DIVANADIUM PENTAOXIDE (VANADIUM PENTOXIDE)	1314	62	1
ENDOSUFAN	115	29	7
ENDRIN	72	20	8
ESTERS - TOTAL not Otherwise Specified			
ETHANE	74	84	0
ETHANE-1,2-DIOL (ETHYLENE GLYCOL)	107	21	1
ETHANOL (ETHYL ALCOHOL)	64	17	5
ETHOFUMESATE	26225	79	6
ETHYL ACETATE		78	6
ETHYL ACRYLATE	140	88	5
ETHYL FORMATE	109	94	4
ETHYL MERCAPTAN (ETHANETHIOL)	75	08	1
ETHYLAMINE	75	04	7
ETHYLBENZENE	00	41	4
ETHYLENE	74	85	1
ETHYLENE OXIDE	75	21	8
FENITROTHION	122	14	5
FENTIN HYDROXIDE (TRIPHENYL TIN OXIDE)	76	87	9
FINASTERIDE (“PROSCAR”) - (Prescription Drug)	98319	26	7
FLUORIDES - TOTAL Not Otherwise Specified			
FLUORINE	7782	41	4
FORMALDEHYDE	50	00	0
FORMANILIDE	103	70	8

Substance Name	CAS Number		
FORMIC ACID	64	18	6
FREON R502			
FUMARIC ACID	110	17	8
GALAXOLIDE	1222	05	5
GALLIUM	7440	55	3
GERMANIUM	7440	56	4
GLASS FIBRES			
GLYCEROL	56	81	5
GOLD	7440	57	5
HALOGENS - FREE - TOTAL Not Otherwise Specified			
HALONS - TOTAL Not Otherwise Specified			
HEPTANES - TOTAL Not Otherwise Specified			
HEXACHLOROBENZENE	118	74	1
HEXACHLOROBUTA-1,3-DIENE (HEXACHLOROBUTADIENE)	87	68	3
HEXACHLOROCYCLOHEXANE	58	889	9
HEXACHLOROCYCLOHEXANE - GAMMA ISOMER	319	86	8
HEXAFLUOROPROPENE	116	15	4
HEXAMETHYIDISILANE	1450	14	2
HEXAMETHYLENEDIAMINE	124	09	4
HEXANES - TOTAL Not Otherwise Specified	110	54	3
HYDROCARBON VAPOUR UNSPEC TOTAL			
HYDROCHLORIC ACID			
HYDROGEN	1333	74	0
HYDROGEN BROMIDE	10035	10	6
HYDROGEN CHLORIDE	7647		0
HYDROGEN CYANIDE	74	90	88
HYDROGEN FLUORIDE	7664	39	3
HYDROGEN IODIDE	10034	85	2
HYDROGEN PEROXIDE	7722	84	1
HYDROGEN SULPHIDE	7783	06	4
HYDROQUINONE	123	31	9
INDIUM	7440	74	6
IODINE	7553	56	2
IODOMETHANE	74	88	4
IRON	7439	89	6
ISOBUTYRALDEHYDE (2-METHYLPROPANOL)	78	84	2
ISOPENTYL ACETATE (ISOAMYL ACETATE)	123	92	2
ISOPROPYLAMINE	75	31	0
ISOVALERALDEHYDE (3-METHYLBUTANAL)	590	86	3
L-ASPARTIC ACID (INCLUDING Z-BLOCKED)	56	84	8
LEAD	7439	92	1
LEAD COMPOUNDS (PARTICULATE) - TOTAL (AS PB)			
LEAD COMPOUNDS - TOTAL			
LEAD - PARTICULATE (+ ITS COMPOUNDS) - TOTAL (AS PB)			
LITHIUM	7439	93	2
MAGNESIUM	7439	95	4
MAGNESIUM OXIDE	1309	48	4
MALATHION	121	75	5
MALEIC ANHYDIDE	108	31	6
MANGANESE	7439	96	5
MANGANESE COMPOUNDS -TOTAL			
MERCAPTANS - TOTAL (Not Otherwise Specified).			

Substance Name	CAS Number		
MERCURY	7439	97	6
MERCURY COMPOUNDS - TOTAL			
METAL FUME - TOTAL (PARTICLE SIZE < 3 MICRON)			
METALS -GROUP 1 (CD + TL)			
METALS - GROUP 2 (SB+AS+CR+CO+CU++PB+MN+NI+SN+V)			
METALS - GROUP 3 (AS+CR+CU+PB+MN+NI+SN)			
METALS - GROUP 4 (SB+AS+CD+CR+CO+CU+PB+MN+NI+TL+SN+V)			
METALS - GROUP 5 (CR+CU+PB+MN)			
METALS - GROUP 6 (NI+AS)			
METALS - GROUP 7 (CD+HG)			
METALS - GROUP 8 (PB+CD)			
METALS - GROUP 9 (SB+AS+CR+CU+NI+SE)			
METALS - GROUP 10 (MN+SN+V)			
METALS - HEAVY - TOTAL Not Otherwise Specified (EXCLUDING CD & HG)			
METHACRYLIC ACID (METHYL METHACRYLATE)	79	41	4
METHANE	74	82	8
METHANOL	67	56	1
METHYL ACETATE	79	20	9
METHYL ACRYLATE	96	33	3
METHYL BROMIDE	74	83	9
METHYLOXIRANE (PROPYLENE OXIDE)	75	56	9
MINERAL FIBRES - NOT ASBESTOS/GLASS			
MOLYBDENUM	7439	98	7
MOLYBDENUM TRIOXIDE	1313	27	5
MONOHYDRIC PHENOLS - TOTAL Not Otherwise Specified			
MORPHOLINE	110	91	8
n-BUTANOL	71	36	3
n-BUTYL ACETATE	123	86	4
n-BUTYL ACRYLATE	141	32	2
n-METHYL -2-PYRROLIDONE	872	50	4
n-[3-CHLOR0~4-METHOXYLPHENYL]-n, n-DIMETHYLUREA	19937	59	8
NAPHTHALENE	91	20	3
NEDOCROMIL SODIUM (PD)			
NICKEL	7440	02	0
NICKEL COMPOUNDS -TOTAL			
NITRATES - TOTAL Not Otherwise Specified			
NITRIC ACID	7697	37	2
NITROBENZENE	98	95	3
NITROGEN COMPOUNDS - TOTAL Not Otherwise Specified (AS AMMONIA)			
NITROGEN COMPOUNDS - TOTAL Not Otherwise Specified (AS TRIMETHYLAMINE)			
NITROGEN OXIDES (AS N02)	10102	44	0
NITROMETHANE	75	52	5
NITROPHENOLS –TOTAL Not Otherwise Specified			
n,n-DIMETHYLPYRIDIN-4-AMINE	1122	58	3
Non Prescribed – AQUEOUS RESIDUES Not Otherwise Specified -TO LAND			
Non Prescribed - COD - CHEMICAL OXYGEN DEMAND			
Non Prescribed - OIL & OIL/SOLID MIXTURES Not Otherwise Specified - TO WATER			
Non Prescribed - OIL & OIL/SOLID MIXTURES Not Otherwise Specified - TO LAND			
Non Prescribed – ORGANIC RESIDUES Not Otherwise Specified - TO LAND			
Non Prescribed – OZONE	10028	15	6
Non Prescribed – SOLIDS Not Otherwise Specified - TO LAND			
Non Prescribed – SULPHITES - TOTAL Not Otherwise Specified – TO WATER			

Substance Name	CAS Number		
Non Prescribed – SUSPENDED SOLIDS - TOTAL Not Otherwise Specified - TO WATER			
Non Prescribed – TOC - TOTAL ORGANIC CARBON (AS C)			
Non Prescribed – WATER INSOLUBLE LIQUIDS TO WATER - Not Otherwise Specified			
ORGANIC SULPHIDES & MERCAPTANS (AS METHYL MERCAPTAN)			
ORGANIC - TIN COMPOUNDS - TOTAL Not Otherwise Specified			
ORGANICS – BROMINATED - TOTAL Not Otherwise Specified			
ORGANICS - CHLORINATED - TOTAL Not Otherwise Specified			
ORGANICS - FLUORINATED - TOTAL Not Otherwise Specified			
ORTHOPHOSPHORIC ACID (PHOSPHORIC ACID)	7664	38	2
P-BENZOQUINONE (QUINONE, BENZOQUINONE)	106	51	4
PALLADIUM	7440	05	3
PARTICULATES			
PENTACHLOROPHENOL	87	86	5
PENTACHLOROPHENOL COMPOUNDS – TOTAL			
PENTAN-1 -OL (n-AMYL ALCOHOL)	71	41	0
PENTANE	109	66	0
PHENOL	108	95	2
PHENOLS - TOTAL Not Otherwise Specified			
PHENOXYZCETIC ACID (PHENOXY ACID)	122	59	8
PHENYLACETIC ACID	103	82	2
PHORATE	298	02	2.
PHOSGENE	75	44	5
PHOSPHATES - TOTAL Not Otherwise Specified (AS PHOSPHORUS)			
PHOSPHINE	7803.	51	2
PHOSPHORUS	7723	14	0
PHOSPHORUS TRICHLORIDE	7719	12	2
PHOSPHORYL TRICHLORIDE (PHOSPHORUS OXYCHLORIDE)	10025	87	3
PHTHALIC ANHYDRIDE	85	44	9
PICRIC ACID	88	89	1
POLYBROMINATED BIPHENYLS – TOTAL			
POLYBROMINATED NAPHTHALENES –TOTAL			
POLYBROMINATED TERPHENYLS – TOTAL			
POLYCHLORINATED BIPHENYLS – TOTAL			
POLYCHLORINATED DIBENZO-P-DIOXIN - ALL CONGENERS			
POLYCHLORINATED DIBENZOFURAN - ALL CONGENERS			
POLYCHLORINATED NAPHTHALENES – TOTAL			
POLYCHLORINATED TERPHENYLS – TOTAL			
PROPAN-2-OL (ISOPROPYL ALCOHOL OR ISOPROPANOL)	67	63	0
PROPANE	74	98	6
PROPENE (PROPYLENE)	115	07	1
PROPENE – POLYMER	9003	07	0
PYRIDINE	110	86	1
SALICYCLIC ACID	69	72	7
SELENIUM	7782	49	2
SELENIUM COMPOUNDS – TOTAL			
SILVER	7440	22	4
SILVER COMPOUNDS – TOTAL			
SIMAZINE	122	34	9
SODIUM 2-ETHYLHEXANOATE	19766	89	3
SODIUM ACETATE	127	09	3
SODIUM ACRYLATE	7446	81	3
SODIUM BENZOATE	532	32	1

Substance Name	CAS Number.		
SODIUM CARBONATE	497	65	2
SODIUM CHLORIDE	7647	14	5
SODIUM FLUORIDE	7681	49	4
SODIUM HYDROXIDE	1310	73	2
SODIUM HYPOCHLORITE	7681	52	9
SODIUM METHACRYLATE	5536	61	8
SODIUM PHENOXIDE	139	02	6
SODIUM SULPHATE	7757	82	6
SODIUM TOLUENE-4-SULPHONATE	657	84	1
STYRENE	100	42	5
SULPHANILAMIDE	63	74	1
SULPHIDES - TOTAL Not Otherwise Specified			
SULPHUR	7704	34	9
SULPHUR DIOXIDE	7446	09	5
SULPHUR OXIDES (AS $S0_2$)			
SULPHUR TRIOXIDE	7446	11	9
SULPHURIC ACID	7664	93	9
SURFACTANTS - TOTAL Not Otherwise Specified			
TELLURIUM	13494	80	9
TELLURIUM COMPOUNDS - TOTAL			
TEQ (TOXIC EQUIVALENT OF PCDD + PCDF)			
TERT-BUTYLAMINE	75	64	9
TETRACHLORETHYLENE (PERCHLOROETHYLENE)	127	18	4
TETRAFLUOROETHYLENE	116	14	3
TETRAHYDROFURAN	109	99	9
THIOCYANATES - TOTAL Not Otherwise Specified			
TIN	7440	31	5
TIN COMPOUNDS NOT ORGANIC - TOTAL			
TITANIUM	7440	32	6
TITANIUM TETRACHLORIDE	7550	45	0
TOLUENE	108	88	3
TOLUENE DIISOCYANATE - ALL ISOMERS			
TRICHLOROBENZENE - ALL ISOMERS			
TRICHLOROETHYLENE	79	01	6
TRICHLOROTOLUENE	98	07	7
TRIETHYLAMINE HYDROCHLORIDE	554	68	7
TRIFLUOROMETHANE	75	46	7
TRIFLURALIN	1582	09	8
TRIZINC BIS(ORTHOPHOSPHATE)	7779	90	0
UREA	57	13	6
VANADIUM	7440	62	2
VINYL ACETATE	108	05	4
VOC - VOLATILE ORGANIC COMPOUNDS (AS C)			
VOC - VOLATILE ORGANIC COMPOUNDS (AS TOLUENE)			
VOC - VOLATILE ORGANIC COMPOUNDS - CLASS A			
VOC - VOLATILE ORGANIC COMPOUNDS - CLASS B			
VOC - VOLATILE ORGANIC COMPOUNDS - CLASSES A & B			
XYLENE	1330	20	7
ZINC	7440	66	6
ZINC COMPOUNDS - TOTAL			

1 "Substances" which are in fact groups of substances will not have CAS Numbers ie.' VOCs

ANNEX B

Master List of VOCs Considered in this Project

Reference Number	Compound	CAS No.
1	(chloromethyl) ethylbenzene	30030-25-2
2	(e)-2-butene	624-64-6
3	(e)-2-hexene	4050-45-7
4	(e)-2-pentene	646-04-8
5	(e)-3-methyl-2-pentene	922-62-3
6	(z)-2-butene	590-18-1
7	(z)-2-hexene	7688-21-3
8	(z)-2-pentene	627-20-3
9	1,1'-dimethyl-4,4'-bipyridinium (paraquat)	4685-14-7
10	*	
11	1,1,1-trichlorotrifluoroethane	359-28-4
12	1,1,2,2-tetrachloroethane (tetrachlorethane)	79-34-6
13	*	
14	1,1-dibromoethane	74-95-3
15	*	
16	1,1-dichlorotetrafluoroethane	374-07-2
17	1,2,3-trimethylbenzene	526-73-8
18	1,2,4-trimethylbenzene	95-63-6
19	1,2-benzisothiazol-3(2h)-one	2634-33-5
20	1,2-diaminoethane (ethylenediamine)	107-15-3
21	*	
22	1,2-dichloroethane (ethylene dichloride)	107-06-2
23	*	
23A	1,2-dichloroethene (cis)	540-59-0
23B	1,2-dichloroethene (trans)	156-60-5
24	1,2-dichlorotetrafluoroethane	76-14-2
25	*	
26	1,2-ethanediol diacetate	111-55-7
27	1,3-dioxolane	646-06-0
28	1,3-propanediol	504-63-2
29	1,6-dichlorohexane (dichlorohexane)	2163-00-0
30	1,6-dicyanohexane (dicyanohexane)	629-40-3
31	1,8-p-menthadiene	138-86-3
32	*	
32A	1-nitropropane	108-03-2/
32B	2-nitropropane	79-46-9
33	1-butene	106-98-9
34	1-chloro-2,3-epoxypropane (epichlorohydrin)	106-89-8
35	1-chloro-4-nitrobenzene (p-chloronitrobenzene)	100-0-5
35A	1-chloro-2-nitrobenzene (o-chloronitrobenzene	88-73-3
35B	1-chloro-3-nitrobenzene (m-chloronitrobenzene	121-73-3
36	1-decene	872-05-9
37	1-ethoxy-2-propanol	1569-02-4
38	1-ethoxy-2-propyl acetate	
39	1-heptene	592-76-7
40	1-hexene	592-41-6

41	1-methoxy-2-propanol	107-98-2
42	1-methoxy-2-propyl acetate	70657-70-4
43	*	
44	1-nonene	124-11-8
45	1-pentene	109-67-1
46	1-propanol	71-23-8
47	2-methyl-1-propene	9003-27-4
48	2,2'-iminodi(ethylamine) (diethylene triamine)	111-40-0
49	2,2'-iminodiethanol (diethanolamine)	111-42-2
50	2,2,4-trimethylhexane	16747-26-5
51	2,2,4-trimethylpentane-1,3-diol mono(2-methyl)propanoate	540-84-1
52	2,2,5-trimethylhexane	3522-94-9
53	2,2-dimethyl-3-methylbutane	
54	2,2-dimethylbutane	79-29-8
55	2,2-dimethylpropane	463-82-1
56	2,4,6-trichloro-1,3,5-triazine (cyanuric chloride)	108-77-0
57	2,4-dibromophenyl acetate	
58	2,5-dimethylhexane	
59	2-(1-hexoxy)ethanol	
60	2-(2-aminoethylamino)ethanol	
61	2-(2-butoxyethoxy)ethyl acetate	124-17-4
62	2-(2-ethoxyethoxy)ethanol	111-90-0
63	2-(2-ethoxyethoxy)ethyl acetate	112-15-2
64	2-aminoethanol (monoethanolamine)	141-43-5
65	*	
66	2-butanone	78-93-3
67	*	
68	2-butanone oxime	96-29-7
69	2-butoxyethyl acetate	112-07-2
70	2-butylthiophene	
71	2-decanone	693-54-9
72	2-ethoxyethanol	110-80-5
73	*	
74	2-ethoxyethyl acetate	115-15-9
75	2-hexylthiophene	
76	2-methyl-1-butene	563-46-2
77	2-methyl-1-pentene	763-29-1
78	2-methyl-1-propanol (isobutyl alcohol)	78-83-1
79	2-methyl-2,4-pentanediol	107-41-5
80	2-methyl-2-butene (amylene)	513-35-9
81	2-methyl-2-pentene	625-27-4
82	2-methylbutane	78-78-4
83	*	
84	2-methylbutanal (2-methylbutyraldehyde)	96-17-3
85	2-methylhexane	591-76-4
86	2-methylpentane	107-83-5
87	2-pentanone	107-87-9
88	2-pentylpyridine	2294-76-0
89	2-pentylthiophene	4861-58-9

90	*	
91	2-propanol (propan-2-ol, isopropyl alcohol)	67-63-0
92	2-propen-1-ol (allyl alcohol)	107-18-6
93	2-propylthiophene	
94	3,3-dimethylpentane	
95	*	
96	3-bromopropene	106-95-6
97	3-heptene	14686-14-7
98	3-methyl-1-butene	563-45-1
99	3-methylbutan-1-ol (isoamyl alcohol)	123-51-3
100	3-methylbutanal	590-86-3
101	3-methylheptane	589-81-1
102	3-methylhexane	589-34-4
103	3-methylpentane	96-14-0
104	3a,4,7,7a-tetrahydro-4,7-methanoindene	77-73-6
105	4,4'-methylenebis[2-chloroanaline]	101-14-4
106	4,4'-methylenedianiline (methylene dianaline)	101-77-9
107	4,8-dioxa-1-dodecanol	112-59-4
108	4-4'-methylenediphenyl diisocyanate	101-68-8
109	4-bromophenyl acetate	
110	4-methyl-1,3-dioxol-2-one	108-32-7
111	4-methyl-2-pentanol	108-11-2
112	*	
113	4-methyl-4-hydroxy-2-pentanone	123-42-2
114	5-methyl-2-hexanone	110-12-3
115	8-methyl-1-nonanol	
116	a tridecene	2437-56-1
117	acetaldehyde	75-07-0
118	acetate esters	
119	acetic acid	64-19-7
120	acetic anhydride	108-24-7
121	acetone (propanone)	67-64-1
122	acetonitrile	75-05-8
123	acetylene	74-86-2
124	acrylamide	79-06-1
125	acrylates - total not otherwise specified	
126	acrylic acid	79-10-7
127	acrylonitrile	107-13-1
128	alcohols	
129	aldehydes	
130	aldrin	309-00-2
131	*	
132	amines	
133	amitrole (aminotriazole)	61-82-5
134	ammonium pentadecafluorooctanoate	3825-26-1
135	undecene	
136	aniline	62-53-3
137	*	
138	anthraquinone	84-65-1

139	aromatic hydrocarbon c10h14	
140	aromatic hydrocarbon c8h10	
141	aromatic hydrocarbon c9h12	
142	aromatic hydrocarbon c9h12	
143	atrazine	1912-24-9
144	azinphos-methyl	86-50-0
145	benzamide	55-21-0
146	benzene	71-43-2
147	benzene-1,2,4-tricarboxylic acid 1,2-anhydride	552-30-7
148	benzyl alcohol	100-51-6
149	biocides - total not otherwise specified	
150	bis(2-hydroxyethyl)ether	111-46-6
151	bisol k	
152	bromoethane	74-96-4
153	butadiene	106-99-0
154	butane	106-97-8
155	*	
156	butanethiols	109-79-5
157	*	
158	2-butene	107-01-7
159	butyl acetate	123-86-4
160	butyl acetate (i-)	540-88-5
161	butyl glycolate	
162	butyl lactate	138-22-7
163	butylcyclohexanes	1678-93-9/3178-22-1
164	butyrolactone(gamma)	96-48-0
165	c10 aromatic	
166	c12h26 branched hydrocarbon	
167	c13 hydrocarbons	
168	c2 & up substituted benzene	
169	c3,c4 & c5 alkylbenzenes	
170	c3alkylbenzenes	
171	c6 alkenes	
172	c7 alkenes	
173	c7 cycloparafins	
174	c8 alkenes	
175	c8 cycloparafins	
176	c9 alkenes	
177	c9+alkanes	
178	camphor/fenchone	464-49-3/76-22-2
179	carbon disulphide	75-15-0
180	carbon tetrachloride	56-23-5
181	carbonyl sulphide	463-58-1
182	carboxylic acids	68937-68-8/68603-84-9
183	chlorobenzene (monochlorobenzene)	108-90-7
184	chlorodifluoromethane	75-45-6

185	chloroethane (ethyl chloride)	75-00-3
186	choroethene (chloroethylene, vinyl chloride)	75-01-4
187	chlorofluorocarbons	
188	chlorofluoromethane	593-70-4
189	chloroform	67-66-3
190	chloromethane	74-87-3
191	*	
191A	o-chlorophenol	95-57-8
191B	p-chlorophenol	106-48-9
191C	m-chlorophenol	108-43-0
192	*	
192A	1-chloropropane	540-54-5
193	*	
193A	o-chlorotoluene (benzyl chloride)	95-49-8
193B	m-chlorotoluene	108-41-8
193C	p-chlorotoluene	106-43-4
194	*	
194A	m-cresol	108-39-4
194B	o-cresol	95-48-7
194C	p-cresol	106-44-5
195	cumene	98-82-8
196	cyclohexane	110-82-7
197	cyclohexanol	108-93-0
198	cyclopentane	287-92-3
199	cyclopentene	142-29-0
200	ddt - all isomers	50-29-3
201	decane	124-18-5
202	decenes	-
203	p-toluene diamine	95-7-5
203a	toluene-3,4-diamine	496-72-0
203b	toluene-2,6-diamine	823-40-5
204	*	
204A	o-dichlorobenzene	95-50-1
204B	m-dichlorobenzene	541-73-1
204C	p-dichlorobenzene	106-46-7
205	*	
205A	1,1-dichlorobutene	
206	dichlorodifluoromethane	75-71-8
207	dichlorofluoromethane	75-43-4
208	dichloromethane (methylene chloride or dichloride)	75-09-2
209	dichlorvos	62-73-7
210	dieldrin	60-57-1
211	diethyl disulphide	110-81-6
212	diethyl ether	60-29-7
213	diethyl oxalate	95-92-1
214	diethyl sulphate	64-67-5
215	difluoromethane	75-10-5
216	diisopropyl ether	108-20-3
217	dimethyl disulphide	624-92-0

218	dimethyl esters	
219	dimethyl ether	115-10-6
220	dimethyl sulphate	77-78-1
221	dimethyl sulphide	75-18-3
222	dimethyl trisulphide	3658-80-8
223	dimethylamine	124-40-3
224	dimethylformamide	68-12-2
225	dinoseb	88-85-7
226	*	
227	dipropyl ethers	
228	diquat dibromide (diquat)	2764-72-9
229	dithiocarbamates - total not otherwise specified	
230	dodecane	112-40-3
231	endosulfan	115-29-7
232	endrin	72-20-8
233	esters	
234	ethane	74-84-0
235	ethane-1,2-diol (ethylene glycol)	107-21-1
236	ethanethiol	75-08-1
237	ethanol	64-17-5
238	ethofumesate	26225-79-6
239	ethyl acetate	141-78-6
240	ethyl acrylate	140-88-5
241	ethyl formate	109-94-4
242	*	
243	ethylamine	75-04-7
244	ethylbenzene	100-41-4
245	ethylene	74-85-1
246	ethylene oxide	75-21-8
247	fenitrothion	122-14-5
248	fentin hydroxide (triphenyl tin oxide)	76-87-9
249	finasteride ("proscar") - (prescription drug)	
250	formaldehyde	50-00-0
251	formanilide	103-70-8
252	formic acid	64-18-6
253	freon r502	39432-81-0
254	fumaric acid	110-17-8
255	galaxolide	
256	glycerol	56-81-5
257	halons - total not otherwise specified	
258	heptadienes	
259	heptanal	111-71-7
260	heptane	142-82-5
261	heptane (other isomers)	
262	heptenes	
263	hexachlorobenzene	118-74-1
264	hexachlorobuta-1,3-diene (hexachlorobutadiene)	87-68-3
265	hexachlorocyclohexane	608-73-1
266	hexachlorocyclohexane - gamma isomer	58-89-9

267	hexafluoropropene	116-15-4
268	hexamethyldisilane	999-97-3
269	hexamethylenediamine	124-09-4
270	hexanal	66-25-1
271	hexane	110-54-3
272	hexane (other isomers)	
273	hexenes	
274	hexylbenzene	1077-16-3
275	hydrocarbon vapour unspec	
276	hydroquinone	123-31-9
277	indane	496-11-7
278	iodomethane	74-88-4
279	isobutane	75-28-5
280	isobutyraldehyde (2-methylpropanol)	78-84-2
281	isomers of decane	
282	isopentyl acetate (isoamyl acetate)	123-92-2
283	isopropylamine	75-31-0
284	*	
285	l-aspartic acid (including z-blocked)	86-84-4
286	*	
287	m-xylene	108-38-3
288	malathion	121-75-5
289	maleic anhydide	108-31-6
290	*	
291	menthene	1124-27-2
292	mercaptans total - not otherwise specified	
293	mesitylene	108-67-8
294	*	
295	methacrylic acid (methyl methacrylate)	79-41-4
296	methane	74-82-8
297	*	
298	methanol	67-56-1
299	methyl acetate	79-20-9
300	methyl acrylate	96-33-3
301	methyl bromide	74-83-9
302	methyl butanoate	623-42-7
303	methyl ethyl ether	540-67-0
304	methyl furans	920-27-8/534-22-5
305	methyl pentanoate	624-24-8
306	a-methyl styrene	98-83-9
306A	o-methly styrene	611-15-4
307	methylcyclohexane	108-87-2
308	methylcyclopentane	90-37-7
309	monohydric phenols	
310	morpholine	110-91-8
311	n,n-dimethylpyridin-4-amine	1558-17-4
312	n-[3-chloro-4-methoxyphenyl]-n, n-dimethylurea	96-31-1
313	n-butanol	

314	*	
315	n-butyl acrylate	141-32-2
316	n-methyl pyrrolidone	872-50-4
317	naphthalene	91-17-8
318	nitrobenzene	98-95-3
319	nitromethane	75-52-5
320	*	
320A	o-nitrophenol	88-75-5
320B	m-nitrophenol	554-84-7
320C	p-nitrophenol	100-02-7
321	nonadienes	
322	nonane	111-84-2
323	nonenes	
324	octanal	124-13-0
325	octane	111-65-9
326	octane (other isomers)	
327	organic - tin compounds	
328	organic sulphides & mercaptan(as methyl mercaptan)	
329	organics - brominated	
330	organics - chlorinated	
331	organics - fluorinated	
332	p-benzoquinone (quinone, benzoquinone)	106-51-4
333	p-xylene	106-42-3
334	pentachlorophenol	87-86-5
335	pentachlorophenol compounds	
336	pentadienes	
337	*	
338	pentanal	110-62-3
339	pentane	109-66-0
340	pentane (other isomers)	
341	pentanethiols	110-66-7
342	pentenes	
343	pentyl benzene	538-68-1/29316-05-1/2049-95-8
344	*	
345	phenol	108-95-2
346	phenols - not otherwise specified	
347	phenoxyacetic acid (phenoxy acid)	122-59-8
348	phenylacetic acid	103-82-2
349	phorate	295-02-2
350	phosgene	75-44-5
351	phthalic anhydride	85-44-9
352	picric acid	88-89-1
353	pine oil	
354	polybrominated biphenyls	
355	polybrominated naphthalenes	
356	polybrominated terphenyls	
357	polychlorinated biphenyls	

358	polychlorinated dibenzo-p-dioxin - all congeners	
359	polychlorinated dibenzofuran - all congeners	
360	polychlorinated naphthalenes	
361	polychlorinated terphenyls	61788-33-8/17760-93-9
362	polyether alcohol acetates	
363	polyether alcohols	
364	propanal	123-38-6
365	propane	74-98-6
366	propene (propylene)	115-07-1
367	propylbenzene	103-65-1
368	propylcyclohexanes	
369	pyridine	110-86-1
370	salicylic acid	69-72-7/99-06-9/99-96-7
371	simazine	122-34-9
372	sodium 2-ethylhexanoate	19766-89-3
373	sodium acetate	
374	sodium acrylate	
375	sodium benzoate	532-32-1
376	sodium methacrylate	5536-61-8
377	sodium phenoxide	139-02-6
378	sodium toluene-4-sulphonate	824-79-3
379	styrene	100-42-5
380	sulphanilamide	63-74-1
381	*	
382	*	
383	tert-butylamine	
384	tetrachloroethene (tetrachlorethylene, perchloroethylene)	127-18-4
385	tetradecane	629-59-4
386	tetrafluoroethylene	116-14-3
387	tetrahydrofuran	109-99-9
388	thiocyanates - total not otherwise specified	
389	toluene	108-88-3
390	*	
391	*	
391A	toluene-2,4-diisocyanate	584-84-9
391B	toluene-2,6-diisocyanate	91-08-7
391C	toluene-1,3-diisocyanate	26471-62-5
392	*	
392A	1,2,4-trichlorobenzene	120-82-1
392B	1,3,5-trichlorobenzene	108-70-3
393	1,1,2-trichloroethane	79-00-5
393A	1,1,1-trichloroethane	71-55-6
394	trichloroethylene	79-01-6
395	trichlorofluoromethane	75-69-4
396	trichlorotoluene	98-07-7
397	tridecane	629-50-5
398	triethylamine hydrochloride	554-68-7

399	trifluoromethane	75-46-7
400	trifluralin	1582-09-8
401	trimethylcyclohexanes	
402	trimethylfluorosilane	420-56-4
403	trimetrhylamine	75-50-3
404	undecane	1120-21-4
405	urea	57-13-6
406	vinyl acetate	108-05-4
407	white spirit	64742-88-7
408	xylene	1330-20-7
409	anthracene	120-12-7
410	phenanthrene	85-01-8
411	fluoranthrene	206-44-0
412	pyrene	129-00-0
413	benzo (a) fluorene	238-84-6
414	benzo (b) fluorene	30777-19-6
415	benzo (a) anthracene	56-55-3
416	chrysene	218-01-9
417	benzo (b) fluoranthene	205-99-2
418	benzo (k) fluoranthene	207-08-9
419	benzo (j) fluoranthene	205-82-3
420	benzo (a) pyrene	50-32-8
421	benzo (e) pyrene	192-97-2
422	dibenzo (a,h) anthracene	53-70-3
423	benzo (g,h,i) perylene	191-24-2
424	indeno (1,2,3-cd) pyrene	193-39-5
425	dibenzo (a,e) pyrene	192-65-4
426	dibenzo (a,h) pyrene	189-64-0
427	dibenzo (a,i) pyrene	189-55-9
428	acetyl acetone	123-54-6
429	acetyl chloride	75-36-5
430	adipic acid	124-04-9
431	*	
431A	propyl formate	110-74-7
432	2-amino-2-methyl propanol	124-68-5
433	amyl alcohol	71-41-0
434	benzaldehyde	100-52-7
435	benzyl chloride	100-44-7
436	benzyl-dimethylamine	103-83-3
437	1-bromopropane	106-94-5
437a	2-bromopropane	75-26-3
438	*	
439	sec-butyl alcohol	78-92-2
440	*	
441	butylamine	109-73-9
442	butyl glycol	111-76-2
443	*	
444	butyl propionate	590-01-2
445	1,3-butylene glycol	107-88-0

446	1,3 butylene glycol diacrylate	19485-03-1
447	chlorobromo propane	109-70-6
448	cyanamide	156-62-7
449	cyclohexanone (ACGIH, OSHA)	108-94-1
449a	1,3 cyclohexanone	504-02-9
450	diallate	2303-16-4
451	diallyl maleate	999-21-3
452	dibutyl maleate	105-76-0
453	dibutyl phthalate	84-74-2
454	1,1-dichloroethane	75-34-3
455	*	
456	dicyandiamide	461-58-5
457	diethylamine	109-89-7
458	diethylaniline	91-66-7
458a	2,6-diethylinaline	579-66-8
458b	3,4-diethylaniline	54675-14-8
459	*	
460	di-iso-amylene	
461	di-iso-butylene	107-40-4
462	dimethyl isobutyl ketone	
463	dimethyl-p-toluidine	99-97-8
463a	dimethyl-o-toluidine	609-72-3
464	1,4 dioxane	123-91-1
465	dipropylene glycol	110-98-5
466	*	
467	ethoxy ethyl acetate	111-15-9
468	ethoxy propyl acetate	54839-24-6
469	*	
470	*	
471	2-ethyl hexane-1,3-diol	94-96-2
472	2-ethyl hexanol	104-76-7
473	2-ethyl hexyl acrylate	103-11-7
474	*	
475	2-ethyl toluene or o-ethyl toluene	611-14-3
475a	3-ethyl toluene	620-14-4
475b	4-ethyl toluene or p-ethyl toluene	622-96-8
476	glycidyl acrylate	106-90-1
477	*	
478	glyoxal	107-22-2
479	*	
480	n-hexanol	111-27-3
480A	2-hexanol	626-93-7
481	hydrobromofluorocarbons	
482	hydrochlorofluorocarbons (1 chloro-1,1-difluoroethane)	75-68-3
483	2 hydroxyethyl acrylate	818-61-1
484	hydroxypropyl acrylate	999-61-1
485	hydroxypropyl methacrylate	27813-02-1
485A	2-hydroxypropyl methacrylate	923-26-2
486	industrial methylated spirits	

487	isobutyric acid	79-31-2
488	isophorone	78-59-1
489	isophorone di-isocyanate	4098-71-9
490	iso phthalic acid	121-91-5
491	*	
492	*	
493	lauryl methacrylate	142-90-5
494	*	
495	methacrylamide	79-39-0
496	*	
497	2 methoxy-1-propanol	1589-47-5
498	methylamine	74-89-5
499	methyl-t-butyl ether	1634-04-4
500	*	
501	methyl diphenyl di-isocyanate	
502	*	
503	methyl formate	107-31-3
504	methyl hexahydro phthalic anhydride	25550-51-0
505	methyl isobutyl ketone	108-10-1
506	methyl isocyanate	624-83-9
507	methyl mercaptan	74-93-1
508	methyl methacrylate	80-62-6
509	methyl pyrrolidine	120-94-5
509a	2-methyl pyrrolidine	765-38-8
510	*	
511	petrol	8002-05-9
512	petroleum ether - "ligroline"	8032-32-4
513	*	
514	*	
515	*	
516	propionic acid	75-98-9
517	*	
518	propylene oxide	75-56-9
519	terephthalic acid	100-21-0
520	tetrahydro furfuryl alcohol	97-99-4
521	tetrahydro phthalic anhydride	85-43-8
522	tetramethylene diamine	110-60-1
523	*	
524	*	
525	triethanolamine	102-71-6
526	triethylamine	121-44-8
527	triethylene glycol	112-27-6
528	trimellitic anhydride	5520-30-7
529	trimethylbenzene (mixed isomers)	25551-13-7
530	*	
531	vinylcyclohexane	695-12-5
532	vinylidene chloride	75-35-4
533	vinyl toluene	25013-15-4
534	o-xylene	95-47-6

ANNEX C

Information Concerning the Adverse Physiological Effects of Eight Example VOCs on a Variety of Biota

Table C1 Data on physiological effects of VOCs on various organisms

Compound	Organism		LD50 ppm	TLm ppm	Other
Xylene	algae	Chlorella			55 mg l-1 50% reduction of cell numbers after 1 day incubation, 20oC
	fish	goldfish	13-18		
		fathead minnow, bluegill, guppies		20-35	
Benzene	bacteria	Pseudomonas			92 mg l-1 inhibition of cell multiplication
	algae	Chlorella			525 mg l-1 50% reduction of cell numbers after 1 day incubation, 20oC
		Microcystis			>1400 mg l-1 inhibition of cell multiplication
	fish	goldfish	46		
		fathead minnow, bluegill, guppies		20-40	
	rat		5600-5700*		*mg kg-1 body weight
Methylene chloride	mouse		15000		
Acetone	bacteria	Pseudomonas			1700 mg l-1 inhibition of cell multplication
	algae	Microcystis			530 mg l-1 inhibition of cell multiplication
	arthropoda	Daphnia		10	
	fish	goldfish	5000		
		mosquito fish		13000	
Compound	Organism		LD50 ppm	TLm ppm	Other
Methanol	bacteria	Pseudomonas			6600 mg l-1 inhibition of cell multiplication
	algae	Microcystis			530 mg l-1 inhibition of cell multiplication
	anthropoda	brine shrimp		10000	
	fish	trout		8000	
	mouse		61100		
MEK	bacteria	Pseudomonas			1150 mg l-1 inhibition of cell multiplication
	algae	Microcystis			110 mg l-1 inhibition of cell multiplication
	fish	goldfish	5000		
		mosquitofish		5600	
Formaldehyde	bacteria	Pseudomonas			14 mg l-1 inhibition of cell multiplication
	algae	Microcystis			0.4 mg l-1 inhibition of cell multiplication
	fish	guppy		50-200	
Methyl mercaptan	fish	Salmonides		0.6-0.9	

Notes:

LD50 Median Lethal Dose. Dose of a substance estimated to be lethal to 50% of the test organisms.

TLm Median Tolerance Limit. Concentration of a substance in water at which 50% of the test organisms survive after a specified time of exposure.

ANNEX D

Odour Threshold Values for VOCs

Table D1Odour Threshold Values

Reference No	Compound	Value
2	(e)-2-butene	810
6	(z)-2-butene	810
11	1,1,1-trichlorotrifluoroethane	45
12	1,1,2,2-tetrachloroethane (tetrachloroethane)	0.21
17	1,2,3-trimethylbenzene	0.55
18	1,2,4-trimethylbenzene	0.55
20	1,2-diaminoethane (ethylenediamine)	1
22	1,2-dichloroethane (ethylene dichloride)	0.0033
23	1,2-dichloroethenes	0.0033
25	1,2-epoxypropane (propylene oxide, methyloxirane)	9.9
32	1- or 2-nitropropane	11
34	1-chloro-2,3-epoxypropane (epichlorohydrin)	0.93
37	1-ethoxy-2-propanol	0.035
38	1-ethoxy-2-propyl acetate	0.0008
41	1-methoxy-2-propanol	0.003
42	1-methoxy-2-propyl acetate	0.0014
43	1-methylcyclohexene	630
44	1-nonene	5
46	1-propanol	36.6
49	2,2'-iminodiethanol (diethanolamine)	0.27
61	2-(2-butoxyethoxy)ethyl acetate	0.016
64	2-aminoethanol (monoethanolamine)	2.6
65	2-butanol	1
66	2-butanone	0.27
67	2-butanone	0.27
69	2-butoxyethyl acetate	0.0063
72	2-ethoxyethanol	2.7
73	2-ethoxyethanol	2.7
74	2-ethoxyethyl acetate	0.056
78	2-methyl-1-propanol (isobutyl alcohol)	0.041
84	2-methylbutanal (2-methylbutyraldehyde)	0.0004
90	2-phenylpropene (methyl styrene)	0.003
91	2-propanol (propan-2-ol, isopropyl alcohol)	0.442
92	2-propen-1-ol (allyl alcohol)	0.000066
99	3-methylbutan-1-ol (isoamyl alcohol)	0.041
100	3-methylbutanal	0.0004
112	4-methyl-2-pentanone (methyl isobutyl ketone)	0.121
117	acetaldehyde	0.066
119	acetic acid	0.016
120	acetic anhydride	0.00029
121	acetone (propanone)	4.58
122	acetonitrile	1.96
123	acetylene	620
126	acrylic acid	0.0004
127	acrylonitrile	1.96
136	aniline	0.2
146	benzene	8.65
153	butadiene	0.45
154	butane	2100
155	butane	2100

156	butanethiols	0.000348
159	butyl acetate	0.0066
160	butyl acetate (i-)	0.0066
162	butyl lactate	7
178	camphor/fenchone	0.27
179	carbon disulphide	0.11
180	carbon tetrachloride	40.73
181	carbonyl sulphide	0.012
183	chlorobenzene (monochlorobenzene)	0.042
185	chloroethane (ethyl chloride)	4.2
186	choroethene (chloroethylene, vinyl chloride)	190
189	chloroform	85
191	chlorophenols	0.3
193	chlorotoluene (benzyl chloride)	0.04
194	cresol - all isomers	0.00047
195	cumene	0.008
196	cyclohexane	83.8
197	cyclohexanol	0.15
202	decenes	7
204	dichlorobenzenes	0.18
204A	1,2-dichlorobenzene	0.64
208	dichloromethane (methylene chloride or dichloride)	0.912
219	dimethyl ether	2
221	dimethyl sulphide	0.00033
223	dimethylamine	0.047
224	dimethylformamide	2.2
234	ethane	120000
236	ethanethiol	0.000238
237	ethanol	0.136
239	ethyl acetate	0.61
240	ethyl acrylate	0.0002
241	ethyl formate	31
242	ethyl mercaptan (ethanethiol)	0.00003
243	ethylamine	0.27
244	ethylbenzene	2.3
245	ethylene	260
246	ethylene oxide	260
250	formaldehyde	0.2
252	formic acid	49
258	heptadienes	9
259	heptanal	0.003
260	heptane	150
270	hexanal	0.0045
271	hexane	130
272	hexane (other isomers)	130
278	iodomethane	0.005
282	isopentyl acetate (isoamyl acetate)	0.025
283	isopropylamine	1.2
284	isovaleraldehyde (3-methylbutanal)	0.028
287	m-xylene	0.016
289	maleic anhydide	0.32
294	meta & para xylene	0.016
295	methacrylic acid (methyl methacrylate)	0.083
297	methanethiol	0.0000014

298	methanol	4
299	methyl acetate	0.21
300	methyl acrylate	0.0048
306	methyl styrene	0.003
307	methylcyclohexane	630
310	morpholine	0.01
313	n-butanol	0.04
314	n-butyl acetate	0.35
315	n-butyl acrylate	0.000026
317	naphthalene	0.03
318	nitrobenzene	0.018
321	nonadienes	11.5
322	nonane	65
323	nonenes	9
324	octanal	0.00136
325	octane	0.1
326	octane (other isomers)	0.1
333	p-xylene	0.016
337	pentan-1-ol (n-amyl alcohol)	0.0051
338	pentanal	0.0054
339	pentane	400
345	phenol	0.01
350	phosgene	0.9
351	phthalic anhydride	0.053
364	propanal	0.009
365	propane	16000
366	propene (propylene)	22.5
367	propylbenzene	0.009
369	pyridine	0.001
379	styrene	0.0344
383	tert-butylamine	0.08
384	tetrachloroethene (tetrachlorethylene, perchloroethylene)	4.68
389	toluene	0.16
390	toluene	0.16
392	trichlorobenzene - all isomers	1.4
393	1,1,2-trichloroethane	16
393A	1,1,1-trichloroethane	400
394	trichloroethylene	1.36
406	vinyl acetate	0.09
408	xylene	0.16
434	benzaldehyde	0.000002 to 0.00003
435	benzyl chloride	0.045 to 1.5
439	sec-butyl alcohol	7.8
441	butylamine	0.24 to 219
449	cyclohexanone	3.53
449a	1,3-cyclohexanone	0.083
457	diethylamine	5.16
464	1,4-dioxane	3.0
467	ethoxy ethyl actetate	0.3
473	2-ethyl hexyl acrylate	0.6
480	n-hexanol	0.00004
488	isophorone	1.3 to 23
492	isopropyl ether	0.07

498	methylamine	0.0012 to 0.065
503	methyl formate	840 to 4916
505	methyl isobutyl ketone	0.24 to 0.81
506	methyl isocyanate	0.0069 to 0.0127
507	methyl mercaptan	0.004
508	methyl methacrylate	21.03
516	propionic acid	0.000015
517	propylene	38.74
518	propylene oxide	23.53
525	triethanolamine	0.37
528	trimellitic anhydride	2.70
532	vinylidene chloride	753
533	vinyl toluene	48
534	o-xylene	0.77 to 23.6

ANNEX E

Photochemical Ozone Creation Potentials, Ozone Depletion Potentials and Global Warming Potentials

Table E1Values of POCP, ODP and GWP_{100}*

Reference No	Compound	POCP value	ODP value	GWP_{100} value
2	(e)-2-butene	99		
4	(e)-2-pentene	95		
6	(z)-2-butene	99		
8	(z)-2-pentene	95		
11	1,1,1-trichlorotrifluoroethane			5000
16	1,1-dichlorotetrafluoroethane			
17	1,2,3-trimethylbenzene	125		
18	1,2,4-trimethylbenzene	132		
24	1,2-dichlorotetrafluoroethane		0.85	9300
33	1-butene	113		
45	1-pentene	104		
46	1-propanol	22		
47	2 methyl-1-propene	70		
54	2,2-dimethyl butane	32		
65	2-butanol	47		
66	2-butanone	51		
76	2-methyl-1-butene	83		
78	2-methyl-1-propanol (isobutyl alcohol)	59		
80	2-methyl-2-butene (amylene)	77		
82	2-methylbutane	60		
85	2-methylhexane	72		
86	2-methylpentane	78		
91	2-propanol (isopropyl alcohol)	22		
98	3-methyl-1-butene	118		
102	3-methylhexane	73		
103	3-methylpentane	66		
117	acetaldehyde	65		
121	acetone (propanone)	18		
123	acetylene	28		
146	benzene	33		
154	butane	60		
159	butyl acetate	51		
160	butyl acetate (i-)	33		
180	carbon tetrachloride		1.20	1400
184	chlorodifluoromethane		0.04	1700
186	chloroethene (vinyl chloride)	27		
187	chlorofluorocarbons			6000
189	chloroform (trichloromethane)			5
190	chloromethane		0.2	
196	cyclohexane	60		
197	cyclohexanol	62		
199	acetic acid	16		
201	decane	68		
206	dichlorodifluoromethane		0.82	8500
208	dichloromethane (methylene chloride or dichloride) or	3		9

*GWP_{100} denotes a potential for global warming on a 100-year time horizon.

215	difluoromethane			580
219	dimethyl ether	26		
230	dodecane	58		
234	ethane	14		
237	ethanol	45		
239	ethyl acetate	33		
244	ethylbenzene	81		
245	ethylene	100		
250	formaldehyde	55		
260	heptane	77		
271	hexane	65		
279	isobutane	43		
280	isobutyraldehyde (2-methylpropanol)	86		
287	m-xylene	109		
293	mesitylene	130		
296	methane	3		24.5 7.5
298	methanol	21		
299	methyl acetate	5		
301	methyl bromide		0.64	
307	methyl cyclohexanone	73		
313	n-butanol	63		
322	nonane	69		
325	octane	68		
333	p-xylene	95		
338	pentanal	89		
339	pentane	62		
364	propanal	76		
365	propane	41		
366	propene (propylene)	108		
367	propylbenzene	71		
379	styrene	8		
384	tetrachloroethene (tetrachlorethylene, perchloroethylene) perchloroethylene)		4	
389	toluene	77		
393	1,1,2-trichloroethane		0.12	
393A	1,1,1-trichloroethane	0.2	0.12	110
394	trichloroethylene	8		
395	trichlorofluoromethane		1	4000
399	trifluoromethane			12100
404	undecane	62		
434	benzaldehyde	-6		
442	butyl glycol	63		
449	cyclohexanone	53		
475	2-ethyl toluene	85		
475a	3-ethyl toluene	99		
475b	4-ethyl toluene	94		
499	methyl-t-butyl ether	27		
505	methyl isobutyl ketone	84		
516	propionic acid	4		
	o-xylene	83	534	

ANNEX F

Proposed Categorised List of VOCs

Table F1 Proposed categorised list of VOCs

Footnotes are printed after the table

Substance Name	*CAS No._*	*Toxicity*	*POCP*[1]	*ODP*[2]	*GWP*[3]	*Odour*[4]	*Category*
acetaldehyde (ethanal)	75-07-0	Cat. 3 Carcinogen	65			0.066	medium
acetate esters		-					low
acetic acid (ethanoic acid)	64-19-7	Harmful	16			0.016	low
acetic anhydride	108-24-7	Harmful				0.00029	low
acetone (propanone)	67-64-1	Unclassified	18			4.58	low
acetonitrile	75-05-8	Toxic				1.96	medium
acetyl acetone	123-54-6	Toxic					low
acetyl chloride	75-36-5	Harmful					low
acetylene (ethyne)	74-86-2	Unclassified	28			620	low
acrylamide	79-06-1	Cat. 2 Carcinogen and Mutagen					high
acrylates - total not otherwise specified		-					low
acrylic acid	79-10-7	Toxic (Ingestion); Categorised on inhalation data				0.0004	low
acrylonitrile	107-13-1	Cat. 2 Carcinogen				1.96	high
adipic acid	124-04-9	Irritant					low
alcohols		-					low
aldehydes		-					low
aldrin	309-00-2	Cat. 3 Carcinogen[5]					medium
amines		-					low
2-aminoethanol (monoethanolamine)	141-43-5	Harmful				2.6	low
2-(2-aminoethylamino)ethanol		-					low
2-amino-2-methyl propanol	124-68-5	Irritant					low
amitrole (aminotriazole)	61-82-5	Cat. 3 Carcinogen[5]					medium
ammonium pentadecafluorooctanoate	3825-26-1	Toxic (Inhalation)					low
amyl alcohol	71-41-0	Unclassified				0.0051	low
aniline	62-53-3	Cat. 3 Carcinogen				0.2	medium
anthracene	120-12-7	Unclassified					low
anthraquinone	84-65-1	Toxic (Inhalation)[5]					low
l-aspartic acid (including z-blocked)	86-84-4	-					low
atrazine	1912-24-9	Cat. 3 Carcinogen and Mutagen[5]					medium
azinphos-methyl	86-50-0	Very Toxic[5]					high
benzaldehyde	100-52-7	Toxic; categorised by inhalation data	-6			2×10^{-6} to 3×10^{-5}	medium
benzamide	55-21-0	Unclassified					low
benzene	71-43-2	Cat. 1 Carcinogen	33			8.65	high
benzene-1,2,4-tricarboxylic acid 1,2-anhydride	552-30-7	R42					high
benzo (a) anthracene	56-55-3	Cat. 2 Carcinogen					high
benzo (a) fluorene	238-84-6	Unclassified					low

benzo (b) fluorene	30777-19-6	-					low
benzo (b) fluoranthene	205-99-2	Cat. 2 Carcinogen					high
benzo (k) fluoranthene	207-08-9	Cat. 2 Carcinogen					high
benzo (j) fluoranthene	205-82-3	Cat 2 Carcinogen					high
benzo (g,h,i) perylene	191-24-2	Unclassified					low
benzo (a) pyrene	50-32-8	Cat 2 Carcinogen, Mutagen and Teratogen					high
benzo (e) pyrene	192-97-2	Unclassified					low
p-benzoquinone (quinone, benzoquinone)	106-51-4	Toxic (ingestion); no inhalation data					low
1,2-benzo iso thiazol-3(2h)-one	2634-33-5	-					low
benzyl alcohol	100-51-6	Harmful					low
benzyl chloride	100-44-7	Cat. 3 Carcinogen				0.045-1.5	medium
benzyl chloride	see chlorotoluene						
benzyl-dimethylamine	103-83-3	Harmful					low
biocides - total not otherwise specified		-[5]					low
bis(2-hydroxyethyl)ether (1,1-oxydiethanol)	111-46-6	Unclassified					low
bisol k		-					low
bromoethane	74-96-4	Toxic					medium
4-bromophenyl acetate		-					low
1-bromopropane	106-94-5	Harmful					low
2-bromopropane	75-26-3	Unclassified					low
3-bromopropene	106-95-6	Toxic (Ingestion); Categorised on inhalation data					low
butadiene	106-99-0	Cat. 2 Carcinogen				0.45	high
butane	106-97-8	Unclassified	60			2100	low
i-butane	75-28-5	-	43				low
butanethiols	109-79-5	Harmful				0.000348	low
n-butanol	71-36-3	Harmful	63			0.04	low
2-butanol	see sec-butyl alcohol						
2-butanone (methyl ethyl ketone)	78-93-3	Irritant	51			0.27	low
2-butanone oxime (methyl ethyl ketoxime)	96-29-7	Harmful					low
1-butene	106-98-9	Unclassified	113				medium
(e)-2-butene	624-64-6	-	99			810	medium
(z)-2-butene	590-18-1	-	99			810	medium
butenes	107-01-7	Unclassified					medium[6]
2-(2-butoxyethoxy)ethyl acetate	124-17-4	Unclassified				0.016	low
2-butoxyethyl acetate	112-07-2	Harmful				0.0063	low
butyl acetate	123-86-4	Unclassified	51			0.0066	low
i-butyl acetate	540-88-5	-				0.0066	low
n-butyl acetate	see butyl acetate						
n-butyl acrylate	141-32-2	Harmful				0.18	low
sec-butyl alcohol	78-92-2	Harmful				7.8	low
butylamine	109-73-9	Harmful				0.24-219	low
tert-butylamine		Toxic (Ingestion); Categorised on inhalation data				0.08	low

butylcyclohexanes	1678-93-9/3178-22-1	-					low
1,3-butylene-glycol	107-88-0	Unclassified					low
1,3-butylene glycol diacrylate	19485-03-1	Harmful					low
butyl glycol	11-76-2	Harmful	63				low
butyl glycol acetate	112-07-2	Harmful					low
butyl glycolate		-					low
butyl lactate	138-22-7	Unclassified				7	low
butyl propionate	590-01-2	Unclassified					low
2-butylthiophene		-					low
i-butyraldehyde (2-methylpropanal)	78-84-2	Harmful	86				medium
butyrolactone(gamma)	96-48-0	Harmful					low
C_9+ alkanes		-					low
C_6 alkenes		-					low
C_7 alkenes		-					low
C_8 alkenes		-					low
C_9 alkenes		-					low
C_3 alkylbenzenes		-					low
C_3,C_4 & C_5 alkylbenzenes		-					low
C_{10} aromatic		-					low
C_8H_{10} aromatic		-					low
C_9H_{12} aromatic		-					low
$C_{10}H_{14}$ aromatic		-					low
C_7 cycloparaffins		-					low
C_8 cycloparaffins		-					low
$C_{12}H_{26}$ branched hydrocarbon		-					low
C_{13} hydrocarbons		-					low
C_2 & up substituted benzene		-					low
camphor/fenchone	464-49-3/76-22-2	-				0.27	low
carbon disulphide	75-15-0	Cat. 2 Teratogen				0.11	high
carbon tetrachloride	56-23-5	Cat. 3 Carcinogen		1.20	1400	40.73	medium
carbonyl sulphide	463-58-1	-				0.012	low
carboxylic acids	68937-68-8/68603-84-9	-					low
chlorobenzene (monochlorobenzene)	108-90-7	Harmful				0.042	low
chlorobromo propane	109-70-6	Harmful					low
chlorodifluoromethane (HCFC 22)	75-45-6	-		0.04	1700		medium
1-chloro-2,3-epoxypropane (epichlorohydrin)	106-89-8	Cat. 2 Carcinogen				0.93	high
chloroethane (ethyl chloride)	75-00-3	Unclassified				4.2	low
chloroethene (chloroethylene, vinyl chloride)	75-01-4	Cat. 1 Carcinogen	27			190	high
chlorofluorocarbons		-			6000		medium
chlorofluoromethane	593-70-4	-					low
chloroform (trichloromethane)	67-66-3	Cat 3 Carcinogen			5	85	medium

chloromethane	74-87-3	Cat 3 Carcinogen		0.02			medium
N-[3-chloro-4-methoxyphenyl]-N, N-dimethylurea	96-31-1	-					low
(chloromethyl) ethylbenzene	30030-25-2	-					low
1-chloro-2-nitrobenzene (o-chloronitrobenzene)	88-73-3	Harmful					low
1-chloro-3-nitrobenzene (m-chloronitrobenzene)	121-73-3	Harmful					low
1-chloro-4-nitrobenzene (p-chloronitrobenzene)	100-00-5	Toxic					low
chlorophenols	95-57-8/108-43-0/106-48-9	Harmful				0.3	low
chloropropanes	26446-76-4	Unclassified					low
m-chlorotoluene	108-41-8	Harmful					low
o-chlorotoluene	95-49-8	Harmful					low
p-chlorotoluene	106-43-4	ful					low
chrysene	218-01-9	Unclassified					low
cresol - all isomers	108-39-4/95-48-7/106-44-5	Toxic (Ingestion); Categorised on inhalation data				0.00047	low
cumene	98-82-8	Harmful				0.008	low
cyanamide	156-62-7	Very Toxic (Inhalation)[5]					high
cyanamide (ACGIH, OSHA)	420-04-2	Very Toxic[5]					high
cyclohexane	110-82-7	Unclassified	60			83.8	low
cyclohexanol	108-93-0	Harmful	62			0.15	low
cyclohexanone	108-94-1	Harmful	53			3.53	low
1,3 cyclohexanone	504-02-9	Unclassified				0.083	low
cyclopentane	287-92-3	-					low
cyclopentene	142-29-0	Harmful					low
ddt - all isomers (1,1,1-trichloro-2,2-bis(p-chlorophenyl) ethane)	50-29-3	Cat.3 Carcinogen[5]					medium
decane	124-18-5	-	68				low
decane isomers		-					low
2-decanone	693-54-9	-					low
1-decene	872-05-9	-					low
decenes	-	-				7	low
diallate	2303-16-4	Cat. 3 Carcinogen[5]					medium
diallyl maleate	999-21-3	Harmful					low
1,2-diaminoethane (ethylenediamine)	107-15-3	Harmful				1	low
dibenzo (a,h) anthracene	53-70-3	Cat. 2 Carcinogen					high
dibenzo (a,e) pyrene	192-65-4	IARC Gp 2B					medium
dibenzo (a, h) pyrene	189-64-0	IARC Gp 2B					medium
dibenzo (a, i) pyrene	189-55-9	IARC Gp 2B					medium
1,1-dibromoethane	74-95-3	-					low
2,4-dibromophenyl acetate		-					low
dibutyl maleate	015-76-0	Unclassified					low
dibutyl phthalate	84-74-2	Harmful[5]					low
1,2-dichlorobenzene	95-50-1	Harmful				0.64	low
1,3-dichlorobenzene	541-73-1	Harmful					low

1,4-dichlorobenzene	106-46-7	IARC Gp 2B					medium
dichlorobutenes		Unclassified					low
dichlorodifluoromethane (CFC-12)	75-71-8	-		0.82	8500		medium
1,1-dichloroethane (ethylidene dichloride)	75-34-3	Harmful					low
1,1-dichloroethene (vinylidene chloride)	75-35-4	Toxic				0.003	low
1,2-dichloroethane (ethylene dichloride)	107-06-2	Cat. 2 Carcinogen				0.0033	high
1,2-dichloroethenes	540-59-0/156-60-5	Harmful				0.0033	low
dichlorofluoromethane	75-43-4	-					low
1,6-dichlorohexane (dichlorohexane)	2163-00-0	-					low
dichloromethane (methylene chloride or dichloride)	75-09-2	Cat. 3 Carcinogen	3		9	0.912	medium
1,1-dichlorotetrafluoroethane (CFC 114a)	374-07-2	-		~0.85			medium
1,2-dichlorotetrafluoroethane (CFC 114)	76-14-2	-		0.85	9300		medium
dichlorvos	62-73-7	Very Toxic[5]					high
dicyandiamide	461-58-5	Unclassified					low
1,6-dicyanohexane (dicyanohexane)	629-40-3	Harmful					low
dieldrin	60-57-1	Very Toxic[5]					high
diethanolamine	see 2,2'-iminodiethanol						
diethylamine	109-89-7	Harmful				5.16	low
N,N-diethylaniline	91-66-7	Toxic; categorised by inhalation data					low
2,6-diethylaniline	579-66-8	Harmful					low
3,4-diethylaniline	54675-14-8	Unclassified					low
diethyl disulphide	110-81-6	-					low
diethylene triamine	see 2,2'-iminodi(ethylamine)						
diethyl ether	60-29-7	Harmful					low
diethyl oxalate	95-92-1	Harmful					low
diethyl sulphate	64-67-5	Cat. 2 Carcinogen and Mutagen					high
difluoromethane	75-10-5	-			580		medium
di-iso-amylene		Unclassified					low
di-iso-butylene	107-40-4	Unclassified					low
diisopropyl ether	108-20-3	Unclassified				0.07	low
dimethylamine	124-40-3	Harmful				0.047	low
1,1'-dimethyl-4,4'-bipyridinium (paraquat)	4685-14-7	Toxic (ingestion); no inhalation data[5]					low
2,2-dimethylbutane	79-29-8	-	32				low
dimethyl disulphide	624-92-0	Very Toxic					high
dimethyl esters		-					low
dimethyl ether	115-10-6	Unclassified	26			2	low
dimethylformamide	68-12-2	IARC Gp 2B				2.2	medium
2,5-dimethylhexane		-					low
dimethyl isobutyl ketone		Unclassified					low
2,2-dimethyl-3-methylbutane		-					low

3,3-dimethylpentane		-					low
2,2-dimethylpropane	463-82-1	Unclassified					low
N,N-dimethylpyridin-4-amine	1558-17-4	-					low
dimethyl sulphate	77-78-1	Cat. 2 Carcinogen					high
dimethyl sulphide	75-18-3	Unclassified				0.00033	low
dimethyl-o-toluidine	609-72-3	Unclassified					low
dimethyl-p-toluidine	99-97-8	Unclassified					low
dimethyl trisulphide	3658-80-8	-					low
dinoseb	88-85-7	Cat. 2 Teratogen[5]					high
4,8-dioxa-1-dodecanol	112-59-4	Harmful					low
1,4 dioxane	123-91-1	Cat 3 Carcinogen				3.0	medium
1,3-dioxolane	646-06-0	Unclassified					low
dipentene	see 1,8-p-menthadiene						
dipropylene glycol	110-98-5	Unclassified					low
dipropyl ethers		-					low
diquat dibromide (diquat)	2764-72-9	Toxic (Ingestion); Categorised on inhalation data[5]					low
dithiocarbamates - total not otherwise specified		-[5]					low
dodecane	112-40-3	-	58				low
endosulfan	115-29-7	Very Toxic[5]					high
endrin	72-20-8	Very Toxic[5]					high
1,2-epoxypropane (methyloxirane)	see propylene oxide						
esters		-					low
ethane	74-84-0	-	14			120000	low
ethane-1,2-diol (ethylene glycol)	107-21-1	Harmful					low
1,2-ethanediol diacetate	111-55-7	-					low
ethanethiol	75-08-1	Harmful				0.000238	low
ethanoic acid	see acetic acid						
ethanol	64-17-5	Unclassified	45			0.136	low
ethofumesate	26225-79-6	Harmful[5]					low
2-ethoxyethanol	110-80-5	Cat. 2 Teratogen				2.7	high
2-(2-ethoxyethoxy)ethanol	111-90-0	Unclassified					low
2-(2-ethoxyethoxy)ethyl acetate	112-15-2	Unclassified					low
ethoxy ethyl acetate	111-15-9	Toxic; categorised by inhalation data				0.3	low
2-ethoxyethyl acetate	115-15-9	Cat. 2 Teratogen				0.056	high
1-ethoxy-2-propanol	1569-02-4	Unclassified				0.035	low
ethoxy propyl acetate	54839-24-6	Unclassified					low
1-ethoxy-2-propyl acetate		-				0.0008	low
ethyl acetate	141-78-6	Unclassified	33			0.61	low
ethyl acrylate	140-88-5	IARC Gp 2B				0.0002	medium
ethylamine	75-04-7	Irritant				0.27	low
ethylbenzene	100-41-4	Harmful	81			2.3	low
ethyl chloride	see chloroethane						
ethylene	74-85-1	Unclassified	100			260	medium
ethylenediamine	see 1,2-diaminoethane						

ethylene dichloride	see 1,2-dichloroethane						
ethylene glycol	see ethane-1,2-diol						
ethylene oxide	75-21-8	Cat. 2 Carcinogen and Mutagen				260	high
ethyl formate	109-94-4	Harmful				31	low
2-ethyl hexane-1,3-diol	94-96-2	Harmful[5]					low
2-ethyl hexanol	104-76-7	Harmful					low
2-ethyl hexyl acrylate	103-11-7	Irritant				0.6	low
ethyl mercaptan	see ethanethiol						
ethyl methyl ether	see methyl ethyl ether						
3-ethyl toluene or m-ethyl toluene	620-14-4	Unclassified	99				medium
2-ethyl toluene or o-ethyl toluene	611-14-3	Unclassified	85				low
4-ethyl toluene or p-ethyl toluene	622-96-8	Unclassified	94				medium
fenitrothion	122-14-5	-[5]					low
fentin hydroxide (triphenyl tin oxide)	76-87-9	-[5]					low
finasteride ("proscar") - (prescription drug)		-					low
fluoranthrene	206-44-0	Unclassified					low
formaldehyde	50-00-0	Cat. 3 Carcinogen[5]	55			0.2	medium
formanilide	103-70-8	-					low
formic acid	64-18-6	Harmful				49	low
freon r502	39432-81-0	-					low
fumaric acid	110-17-8	Irritant					low
galaxolide		-					low
glycerol	56-81-5	Unclassified					low
glycidyl acrylate	106-90-1	Toxic					low
glycol	see ethane-1,2-diol						
glyoxal	107-22-2	Harmful					low
halons - total not otherwise specified		-		~5 to ~12			medium
heptadienes		-				9	low
heptanal	111-71-7	Unclassified				0.003	low
heptane	142-82-5	-	77			150	low
heptane (other isomers)		-					low
1-heptene	592-76-7	-					low
3-heptene	14686-14-7	-					low
heptenes		-					low
hexachlorobenzene	118-74-1	Cat. 2 Carcinogen					high
hexachlorobuta-1,3-diene (hexachlorobutadiene)	87-68-3	Toxic (ingestion); no inhalation data					low
hexachlorocyclohexane	608-73-1	Cat. 3 Carcinogen[5]					medium
hexachlorocyclohexane - gamma isomer	58-89-9	Toxic (Ingestion); Categorised on inhalation data)[5]					low
hexafluoropropene	116-15-4	Harmful					low
hexamethyldisilane	999-97-3	Harmful					low
hexamethylenediamine	124-09-4	Harmful					low
hexanal	66-25-1	Unclassified				0.0045	low
hexane (n-hexane)	110-54-3	Harmful	65			130	low

hexane (other isomers)		-				130	low
n-hexanol	111-27-3	Harmful				0.00004	low
2-hexanol	626-93-7	Unclassified					low
1-hexene	592-41-6	-					low
(e)-2-hexene	4050-45-7	-					low
(z)-2-hexene	7688-21-3	-					low
hexenes		-					low
2-(1-hexoxy)ethanol		-					low
hexylbenzene	1077-16-3	-					low
2-hexylthiophene		-					low
hydrobromo fluorocarbons							low
hydrocarbon vapour unspec		-					low
hydrochloro fluorocarbons							low
hydroquinone	123-31-9	Harmful					low
2-hydroxyethyl acrylate	818-61-1	Toxic; categorised by inhalation data					medium
hydroxypropyl acrylate	999-61-1	Toxic					low
hydroxyl propyl methacrylate	27813-02-1	Irritant					low
2-hydroxy propyl methacrylate	923-26-2	Irritant					low
2,2'-iminodiethanol (diethanolamine)	111-42-2	Harmful				0.27	low
2,2'-iminodi(ethylamine) (diethylene triamine)	111-40-0	Harmful					low
indane	496-11-7	-					low
indeno (1,2,3-cd) pyrene	193-39-5	IARC Gp 2B					medium
industrial methylated spirits							low
iodomethane	74-88-4	Cat. 3 Carcinogen				0.005	medium
isoamyl alcohol	see 3-methylbutan-1-ol						
isobutyl alcohol	see 2-methyl-1-propanol						
isobutylene	see 2-methyl-1-propene						
isobutyric acid	79-31-2	Harmful					low
isopentane	see 2-methylbutane						
isophorone	78-59-1	Harmful				1.3-23	low
isophorone di-iso cyanate	4098-71-9	Very Toxic					high
isophthalic acid	121-91-5	Unclassified					low
isopropyl alcohol	see 2-propanol						
isopropyl ether	see diisopropyl ether						
iso-valeraldehyde (3-methylbutanal)	see 3-methylbutanal						
lauryl methacrylate	142-90-5	Unclassified					low
malathion	121-75-5	Harmful[5]					low
maleic anhydride	108-31-6	R42				0.32	high
manganese compounds - total		-					low
1,8-p-menthadiene	138-86-3	Irritant					low
menthene	1124-27-2	-					low
mercaptans total - not otherwise specified		-					low
mesitylene (1,3,5-	108-67-8	Irritant	130				medium

trimethyl benzene)							
methacrylic acid (methyl methacrylate)	79-41-4	Harmful				0.083	low
methane	74-82-8	Unclassified	3		24.5 ± 7.5		medium
methanethiol	see methyl mercaptan						
methanol	67-56-1	Toxic (Ingestion); Categorised on Inhalation Data	21			4	low
1-methoxy-2-propanol	107-98-2	Unclassified				0.003	low
2-methoxy-1-propanol	1589-47-5	Unclassified					low
methoxy-1-propanol	28677-93-2	Unclassified					low
1-methoxy-2-propyl acetate	70657-70-4	-				0.0014	low
methyl acetate	79-20-9	-	5			0.21	low
methylacrylamide	79-39-0	Harmful					low
methyl acrylate	96-33-3	Harmful				0.0048	low
methylamine	74-89-5	Toxic; categorised by inhalation data				0.0012-0.065	medium
methyl bromide	74-83-9	Harmful		0.64			medium
2-methylbutanal (2-methylbutyraldehyde)	96-17-3	Unclassified				0.0004	low
3-methylbutanal	590-86-3	Unclassified				0.0004	low
2-methylbutane (isopentane)	78-78-4	-	60				low
methyl butanoate	623-42-7	Unclassified					low
3-methylbutan-1-ol (isoamyl alcohol)	123-51-3	Harmful				0.041	low
2-methyl-1-butene	563-46-2	-	83				low
2-methyl-2-butene (amylene)	513-35-9	-	77				low
3-methyl-1-butene	563-45-1	-	118				medium
methyl chloroform	see 1,1,1-trichloroethane						
methylcyclohexane	108-87-2	-	73			630	low
methylcyclopentane	90-37-7	-					low
4-methyl-1,3-dioxol-2-one	108-32-7	Unclassified					low
methyl diphenyl di-isocyanate		Unclassified					low
4,4'-methylenebis[2-chloroanaline]	101-14-4	Cat. 2 Carcinogen					high
methylene chloride	see dichloromethane						
4,4'-methylenedianiline (methylene dianaline)	101-77-9	IARC Gp 2B					medium
4-4'-methylenediphenyl diisocyanate	101-68-8	Very Toxic (Inhalation)					high
methyl ethyl ether	540-67-0	-					low
methyl ethyl ketone	see 2-butanone						
methyl formate	107-31-3	Unclassified				840-4916	low
methyl furans	920-27-8/534-22-5	-					low
3-methylheptane	589-81-1	-					low
methyl hexahydro phthalic anhydride	25550-51-0	Unclassified					low
2-methylhexane	591-76-4	-	72				low
3-methylhexane	589-34-4	-	73				low
5-methyl-2-hexanone	110-12-3	Unclassified					low
4-methyl-4-hydroxy-2-	123-42-2	Unclassified					low

pentanone							
methyl isobutyl ketone	108-10-1	Harmful	84			0.24-0.81	low
methyl isocyanate	624-83-9	Very Toxic				0.0069-0.0127-	high
methyl mercaptan	74-93-1	Toxic				0.004	low
methyl methacrylate	80-62-6	Irritant				21.03	low
8-methyl-1-nonanol		-					low
2-methylpentane	107-83-5	-	78				low
3-methylpentane	96-14-0	-	66				low
2-methyl-2,4-pentanediol	107-41-5	Irritant					low
methyl pentanoate	624-24-8	-					low
4-methyl-2-pentanol	108-11-2	Irritant					low
4-methyl-2-pentanone	see methyl isobutyl ketone						
2-methyl-1-pentene	763-29-1	Unclassified					low
2-methyl-2-pentene	625-27-4	Unclassified					low
(e)-3-methyl-2-pentene	922-62-3	-					low
2-methyl-1-propanol (isobutyl alcohol)	78-83-1	Unclassified	59			0.041	low
2 methyl-1-propene (isobutylene)	9003-27-4	-	70				low
methyl pyrrolidine	120-94-5	Unclassified					low
2-methyl pyrrolidine	765-38-8	Unclassified					low
n-methyl pyrrolidone	872-50-4	Irritant					low
methyl styrene	98-83-9/611-15-4	Irritant				0.003	low
methyl-tert-butyl ether	1634-04-4	Unclassified	27				low
morpholine	110-91-8	Harmful				0.01	low
naphthalene	91-17-8	Harmful				0.03	low
nitrobenzene	98-95-3	Very Toxic				0.018	high
nitromethane	75-52-5	Harmful					low
nitrophenols	100-02-7	Harmful					low
1-nitropropane	108-03-2	Harmful				11	low
2-nitropropane	79-46-9	Cat. 2 Carcinogen					high
nonadienes		-				11.5	low
nonane	111-84-2	-	69			65	low
1-nonene	124-11-8	-				5	low
nonenes		-				9	low
octanal	124-13-0	Unclassified				0.00136	low
octane	111-65-9	Unclassified	68			0.1	low
octane (other isomers)		-				0.1	low
organics - brominated		-					low
organics - chlorinated		-					low
organics - fluorinated		-					low
organic sulphides & mercaptan(as methyl mercaptan)		-					low
organic - tin compounds		-					low
paraquat	see 1,1'-dimethyl-4,4'-bipyridinium						
pentachlorophenol	87-86-5	IARC Gp 2B					medium
pentachlorophenol compounds		Toxic ; Categorised on inhalation data					low
pentadienes		-					low

pentanal (valeraldehyde)	110-62-3	Unclassified	89			0.0054	medium
pentane	109-66-0	Unclassified	62			400	low
pentane (other isomers)		-					low
pentanethiols	110-66-7	-					low
pentan-1-ol	see amyl alcohol						
2-pentanone	107-87-9	Harmful					low
1-pentene	109-67-1	-	104				medium
(e)-2-pentene	646-04-8	-	95				medium
(z)-2-pentene	627-20-3	-	95				medium
pentenes		-					low
i-pentyl acetate (isoamyl acetate)	123-92-2	Unclassified				0.025	low
pentyl benzene	538-68-1/29316-05-1/2049-95-8	-					low
2-pentylpyridine	2294-76-0	-					low
2-pentylthiophene	4861-58-9	-					low
perchloroethylene	see tetrachloroethene						
petrol	8002-05-9	Unclassified				L=800-33000 H-30ppm	low
petroleum ether - “ligroline”	8032-32-4	Harmful					low
phenanthrene	85-01-8	Unclassified					low
phenol	108-95-2	Very Toxic (inhalation)				0.01	high
phenols, monohydric		-					low
phenols - not otherwise specified		-					low
phenoxyacetic acid (phenoxy acid)	122-59-8	Harmful					low
phenylacetic acid	103-82-2	Unclassified					low
2-phenylpropene (methyl styrene)	98-83-9	Irritant				0.003	low
phorate	295-02-2	Very Toxic[5]					high
phosgene	75-44-5	Very Toxic				0.9	high
phthalic anhydride	85-44-9	Irritant				0.053	low
picric acid	88-89-1	Toxic; Categorised on inhalation data					low
pine oil	8002-09-3	Unclassified					low
polybrominated biphenyls		-					low
polybrominated naphthalenes		-					low
polybrominated terphenyls		-					low
polychlorinated biphenyls		IARC Gp 2A					high
polychlorinated dibenzo-p-dioxin - all congeners		-[7]					high
polychlorinated dibenzofuran - all congeners		-[7]					high
polychlorinated naphthalenes		-					low
polychlorinated terphenyls	61788-33-8/17760-93-9	-					low
polyether alcohol acetates		-					low
polyether alcohols		-					low

propanal	123-38-6	Irritant	76			0.009	low
propane	74-98-6	Unclassified	41			16000	low
1,3-propanediol	504-63-2	-					low
1-propanol	71-23-8	Harmful				36.6	low
2-propanol (propan-2-ol, isopropyl alcohol)	67-63-0	Unclassified	22			0.442	low
propanone	see acetone						
propene	115-07-1	Unclassified	108			22.5	medium
2-propen-1-ol (allyl alcohol)	107-18-6	Very Toxic (Inhalation)				0.000066	high
propionic acid	75-98-9	Harmful	4			0.000015	low
i-propylamine	75-31-0	Irritant				1.2	low
propylbenzene	103-65-1	Irritant	71			0.009	low
propylcyclohexanes		-					low
propylene	see propene						
propylene oxide	75-56-9	Cat. 2 Carcinogen				23.53	high
propyl formate	110-74-7	Unclassified					low
2-propylthiophene		-					low
pyrene	129-00-0	Very Toxic					high
pyridine	110-86-1	Harmful				0.001	low
salicylic acid	69-72-7	Harmful					low
simazine	122-34-9	Cat. 3 Carcinogen[5]					medium
sodium acetate	127-09-3	Unclassified					low
sodium acrylate		-					low
sodium benzoate	532-32-1	Unclassified					low
sodium 2-ethylhexanoate	19766-89-3	-					low
sodium methacrylate	5536-61-8	-					low
sodium phenoxide	139-02-6	-					low
sodium toluene-4-sulphonate	824-79-3	-					low
styrene	100-42-5	IARC Gp 2B	8			0.0344	medium
sulphanilamide	63-74-1	Unclassified					low
surfactants - total not otherwise specified		-					low
terephthalic acid	100-21-0	Unclassified					low
1,1,2,2-tetrachloroethane (tetrachlorethane)	79-34-6	Very toxic				0.21	high
tetrachloroethene (tetrachlorethylene, perchloroethylene)	127-18-4	IARC Gp 2B	4			4.68	medium
tetradecane	629-59-4	-					low
tetrafluoroethylene	116-14-3	Unclassified					low
tetrahydrofuran	109-99-9	Irritant					low
tetrahydro furfuryl alcohol	97-99-4	Harmful					low
3a,4,7,7a-tetrahydro-4,7-methanoindene	77-73-6	Harmful					low
tetrahydro phthalic anhydride	85-43-8	Irritant					low
tetramethylene diamine	110-60-1	Unclassified					low
thiocyanates - total not otherwise specified		-					low
toluene	108-88-3	Harmful	77			0.16	low

p-toluene diamine	95-70-5	Toxic					high
toluene-3,4-diamine	496-72-0	Unclassified[8]					high
toluene-2,6-diamine	823-40-5	Unclassified[8]					high
toluene-1,3-diisocyanate	26471-62-5	IARC Gp 2B; R42					high
toluene-2,4-diisocyanate	584-84-9	IARC Gp 2B; R42					high
toluene-2,6-diisocyanate	91-08-7	IARC Gp 2B; R42					high
trichlorobenzene - all isomers	87-61-6/120-82-1/108-70-3/1002-48-1	Harmful				1.4	low
trichloroethane	see 1,1,1- or 1,1,2- trichloroethane						
1,1,1-trichloroethane (methyl chloroform)	71-55-6	Harmful	0.2	0.12	110	400	medium
1,1,2-trichloroethane	79-00-5	Harmful				16	low
trichloroethylene	79-01-6	Cat. 3 Carcinogen	8			1.36	medium
trichlorofluoromethane (CFC-11)	75-69-4	-		1.0	4000		medium
trichloromethane	see chloroform						
trichlorotoluene	98-07-7	IARC Gp 2B					medium
2,4,6-trichloro-1,3,5-triazine (cyanuric chloride)	108-77-0	Harmful					low
1,1,1-trichlorotrifluoroethane (CFC 113a)	359-28-4	-			5000	45	medium
tridecane	629-50-5	-					low
a tridecene	2437-56-1	-					low
triethanolamine	102-71-6	Unclassified				0.37	low
triethylamine	121-44-8	Harmful					low
triethylamine hydrochloride	554-68-7	-					low
triethylene glycol	112-27-6	Unclassified					low
trifluoromethane (freon 23)	75-46-7	-			12100		medium
trifluralin	1582-09-8	Harmful[5]					low
trimellitic anhydride	5520-30-7	R42				2.70	high
trimethylamine	75-50-3	Unclassified					low
1,2,3-trimethylbenzene	526-73-8	-	125			0.55	medium
1,2,4-trimethylbenzene	95-63-6	Harmful	132			0.55	medium
1,3,5-trimethylbenzene	see mesitylene						
trimethylbenzene (mixed isomers)	25551-13-7	Unclassified					medium[6]
trimethylcyclohexanes		-					low
3,5,5-trimethyl-2-cyclohexen-1-one	see isophorone						
trimethylfluorosilane	420-56-4	-					low
2,2,4-trimethylhexane	16747-26-5	-					low
2,2,5-trimethylhexane	3522-94-9	-					low
2,2,4-trimethylpentane-1,3-diol mono(2-methyl) propanoate	540-84-1	-					low
undecane	1120-21-4	-	62				low
undecene		-					low
urea	57-13-6	Unclassified					low
valeraldehyde	see pentanal						
vinyl acetate	108-05-4	Unclassified				0.09	low

vinyl chloride	see chloroethene						
vinyl cyclohexane	695-12-5	Unclassified					low
vinylidene chloride	see 1,1-dichloroethene						
vinyl toluene	25013-15-4	Unclassified				48	low
white spirit	64742-88-7	-					low
xylene (mixture of isomers)	1330-20-7	Harmful				0.16	medium[6]
m-xylene (1,3 dimethyl benzene)	108-38-3	Harmful	109			0.016	medium
o-xylene (1,2 dimethyl benzene)	95-47-6	Harmful	83			0.77-23.6	low
p-xylene (1.4 dimethyl benzene)	106-42-3	Harmful	95			0.016	medium

[1]POCP = Photochemical Ozone Creation Potential; see Section 6.3.
[2]ODP = Ozone Depletion Potential; see Section 6.4
[3]GWP = Global Warming Potential; see Section 6.5
[4]Odour Threshold Value, see Section 6.6
[5]These substances are agrochemicals and may have adverse effects on organisms other than man.
[6]On basis of POCP.
[7]Regarded as extremely toxic and persistent pollutants.
[8]Sensitizer at extremely low concentrations.

MANAGEMENT AND CONTACTS:

The Environment Agency delivers a service to its customers, with the emphasis on authority and accountability at the most local level possible. It aims to be cost-effective and efficient and to offer the best service and value for money.

Head Office is responsible for overall policy and relationships with national bodies including Government.

Rio House, Waterside Drive, Aztec West, Almondsbury, Bristol BSI 2 4U1D
Tel:01454624400 Fax:01454624409

ENVIRONMENT AGENCY REGIONAL OFFICES

ANGLIAN
Kingfisher House
Goldhay Way
Orton Goldhay
Peterborough PE2 5ZR
Tel: 01733 371 811 Fax: 01733 231 840

MIDLANDS
Sapphire East
550 Streetsbrook Road
Solihull B91 1QT
Tel: 0121 711 2324 Fax: 0121 711 5824

NORTH EAST Rivers House 21 Park Square
South Leeds LS] 2QG
Tel: 0113 244 0191 Fax: 0113 246 1889

NORTH WEST
Richard Fairclough House
Knutsford Road
Warrington WA4 1 HG
Tel: 01925653999
Fax:01925415961

SOUTHERN
Guildbourne House
Chatsworth Road
Worthing
West Sussex BN11 1LD
Tel: 01903 832 000 Fax: 01903 821 832

SOUTH WEST
Manley House
Kestrel Way
Exeter EX2 7LQ
Tel: 01392 444 000 Fax: 01392 444 238

THAMES
Kings Meadow House
Kings Meadow Road
Reading RGI 8DQ
Tel: 0118 953 5000 Fax: 0118 950 0388

WELSH
Rivers House/ Plas-yr-Afon
St Mellons Business Park
St Mellons
Cardiff CF3 OLT
Tel: 01222 770 088
Fax:01222798555

For general enquiries please call your local Environment Agency office. If you are unsure who to contact ' or which is your local office, please call our general enquiry line.

ENVIRONMENT AGENCY
GENERAL ENQUIRY LINE

0645 333 111

The 24-hour emergency hotline number for reporting all environmental incidents relating to air, land and water.

ENVIRONMENT AGENCY
EMERGENCY HOTLINE

0800807060

ENVIRONMENT AGENCY