Emission estimates for diffuse sources
Netherlands Emission Inventory

Chemical weed control on pavements

Version dated June 2008

NETHERLANDS NATIONAL WATER BOARD - WATER UNIT
in cooperation with DELTARES and TNO

Chemical weed control on pavements

1 Description of emission source

Emissions are caused by the application of herbicides on paved areas. Herbicides are used to control weeds. The herbicide lands not only on the weeds but also on the paved area itself. When it rains, the product is flushed into the sewers. Glyphosate is the main herbicide currently in use. This emission source is allocated to the governmental target sector "Trade and Services" within the national emission inventory.

2 Explanation of calculation method

Emissions are calculated by multiplying an activity rate (AR), in this case herbicide use, by an emission factor (EF), expressed as a flushing percentage. This method of calculation is explained in detail in the Guide to the Regional approach to diffuse sources [1].

Emission = AR x EF

Where:
AR = Herbicide use (kg)
EF = Herbicide emission factor (kg/kg)

3 Activity Rates

It is not possible to ascertain what activity rate was used in 1990 or 1995. Numbers taken from [2] form the basis for the calculations for 2000 to 2006.

Table 1: Activity rate: Herbicide use (kg)

	1990	1995	2000	2005	2006
Total use			117,000	169,000	169,000

4 Emission factors

In defining the emission factor, it is assumed that 50% of the herbicide used is flushed into sewer systems [2]. A removal efficiency of 50% in urban waste water treatment plants is additionally assumed for the years from 2000 up to and including 2006 [3].

5 Effects of policy measures

Simazine and Diuron were no longer allowed in this application from 2001, and consequently emissions of these substances are no longer calculated.

6 Emissions calculated

Table 2 shows emissions of simazine, diuron and glyphosate. Emissions in 2000, 2005 and 2006 were taken from an assessment of sustainable crop protection [2].

Table 2: Emission (kg)

	1990	1995	2000	2005	2006
Simazine		8			
Glyphosate	450	1,570	21,000	50,800	50,800
Diuron	1,250	214			

7 Release into environmental compartments

All emissions from paved area leaching enter the sewers (indirect emissions).

8 Description of emission pathways to water

Emissions into water arise indirectly as a result of emissions from the sewer system, combined sewer overflows, and effluents from urban waste water treatment plants. The fact sheet "Effluents from waste water treatment plants and sewer systems" [4] describes this in further detail.

9 Spatial allocation

The spatial allocation of emissions is assigned on the basis of a set of digital maps held by the Netherlands Environmental Assessment Agency (PBL) drawn up using emission records. These maps present the spatial distribution of all kinds of parameters throughout the Netherlands, such as population density, traffic intensity, area of agricultural crops, etc. For the purposes of emission registration these maps are used as 'locators' to determine the spatial distribution of emissions. The range of possible locators is limited (see [5] for a list of available locators), as not every conceivable parameter can be used as a locator. In practice the locator judged to be the best proxy of the activity efficiency of the emission in question is applied for the distribution of emissions.
It is assumed that the distribution of emissions throughout the country is proportional to the national distribution of the locator.

The table below shows the locator used for the spatial allocation of the various emission sources.

Table 3: summary of spatial allocation method

Element	Locators
Paved area leaching	Number of inhabitants per grid cell measuring 500x500 metres

The method used to determine the locators is described in [5]:

Number of inhabitants
The number of inhabitants per grid cell measuring 500x500 metres is derived from the MNP's map of grid cell distribution based on the number of inhabitants, residential dwelling units and inhabitants per sewage unit. This map is based on data produced by Statistics Netherlands (CBS) on numbers of inhabitants and numbers of residential dwelling units in each local authority (for 2005). The distribution of inhabitants among grid cells in a local authority was calculated using the comprehensive database of address coordinates in the Netherlands (which contains addresses and types of dwelling unit) and the 2003 sewage area database.

10 Comments and changes in regard to previous version

No changes have been made to the method as used in previous version.

11 Accuracy and indicated subjects for improvement

The method used in the Emission Inventory publications has been followed as far as possible in classifying the quality of information [6]. It is based on the CORINAIR (CORe emission INventories AIR) methodology, which applies the following quality classifications:

A: a value based on a large number of measurements from representative sources;
B: a value based on a number of measurements from some of the sources that are representative of the sector;
C: a value based on a limited number of measurements, together with estimates based on technical knowledge of the process;
D: a value based on a small number of measurements, together with estimates based on assumptions;
E: a value based on a technical calculation on the basis of a number of assumptions.

In recent years the activity rate has been based on extensive studies and investigations into the import and use of herbicides. Current use figures appear to be close to actual use. It is suspected that use figures for previous years are too low as they were not subject to such rigorous investigation. The AR is classified in reliability class D.
The emission factor is based on measurements and assumptions as to application methods. Here again the more recent figures are likely to be more reliable than those for earlier years. Class D is the appropriate classification here as well.

It is assumed that all the herbicides end up in the sewer system. Studies have been carried out showing that 98% [2] or 90% [3] of flushed material enters the sewers. Allocation to compartments is classified in class D. It is assumed that all sewer emissions end up in water, and therefore emission pathways into water are given reliability class C.

Spatial allocation is carried out on the basis of numbers of inhabitants. These statistics are known to quite a good degree of accuracy, but this does not represent the most suitable locator for emissions caused by weed control on pavements as individual municipalities have different weed control policies. For this reason this parameter is classified as C.

Element of emission calculation	**Reliability class**
Activity rates	D
Emission factor	D
Distribution among compartments	D
Emission pathways to water	C
Spatial allocation	C

Areas for improvement:
- Reference [2] also took account of UWWTP removal efficiencys. This means that the emissions calculated for 2000 to 2006 are actually surface water pollution. The removal efficiency is deducted from the emission, and the same process is applied to these emissions in the emissions inventory.
- The emissions calculated for 1990 and 1995 are slightly lower than those for subsequent years. Underestimation of emissions may have taken place for these years.
- Distribution of emissions over environmental compartments could be further improved. It is currently assumed that all emissions end up in the sewers, but some studies have shown that a more correct figure would be 98% [2] or 90% [3].
- No account is taken at present of the conversion of glyphosate into AMPA.

12 Request for reactions

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13 References

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