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Ecotoxicologically based environmental risk limits for several volatile aliphatic hydrocarbons

F.M.W. de Jong, C.J.A.M. Posthuma-Doodeman
and E.M.J. Verbruggen

Contact: Frank de Jong
Expertise Centre for Substances (SEC)
Frank.de.Jong@rivm.nl

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National Institute for Public Health and the Environment, PO Box 1, 3720 BA Bilthoven, The Netherlands.
Tel. 31-30-2749111, fax. 31-30-2742971

Rapport in het kort

Milieurisicogrenzen op basis van ecotoxicologische gegevens voor een aantal vluchtige organische verbindingen

In dit rapport worden ecotoxicologische milieurisicogrenzen voor een aantal vluchtige organische verbindingen afgeleid. Op basis van geëvalueerde literatuurgegevens doet het Rijksinstituut voor Volksgezondheid en Milieu (RIVM) voorstellen voor ecotoxicologische milieurisicogrenzen voor deze stoffen in water, bodem, sediment en lucht. De voorgestelde milieurisicogrenzen vormen de wetenschappelijke basis voor milieukwaliteitsnormen die worden vastgesteld door de interdepartementale Stuurgroep Stoffen. Er worden drie niveaus onderscheiden: een Verwaarloosbaar Risiconiveau (VR); een niveau waarbij geen schadelijke effecten zijn te verwachten (Maximaal Toelaatbaar Risiconiveau; MTR) en een niveau waarbij mogelijk ernstige effecten zijn te verwachten (Ernstig Risiconiveau; ER_{eco}). De milieukwaliteitsnormen spelen een belangrijke rol bij de uitvoering van het nationale stoffenbeleid.

De stoffen waarvoor in dit rapport gegevens zijn samengebracht, zijn: acrylonitril, ethyleen, ethyleenoxide, dichloormethaan, trichloormethaan, tetrachloormethaan, 1,1-dichloorethaan, 1,2-dichloorethaan, 1,1,1-trichloorethaan, 1,1,2-trichloorethaan, 1,1,2,2-tetrachloorethaan, pentachloorethaan, hexachloorethaan, 1,2-dichloorpropaan, 1,3-dichloorpropaan, chloorethyleen, 1,1-dichloorethyleen, 1,2-dichloorethyleen (*trans*- en *cis*-1,2-dichloorethyleen), trichloorethyleen, tetrachloorethyleen, 3-chloorpropeen, 1,3-dichloorpropeen (*trans*- en *cis*-1,3-dichloorpropeen), 2,3-dichloorpropeen, chloropreen en hexachloorbutadieen.

Voor acht stoffen zijn de milieurisicogrenzen afgeleid op basis van beschikbare EU-documenten, opgesteld in het kader van de Bestaande Stoffen Verordening of de Kaderrichtlijn Water (acrylonitril, dichloormethaan, trichloormethaan, tetrachloormethaan, 1,2-dichloorethaan, trichloorethyleen, tetrachloorethyleen en hexachloorbutadieen). Voor vier stoffen zijn te weinig betrouwbare gegevens beschikbaar om milieurisicogrenzen af te kunnen leiden (ethyleen, 1,1-dichloorethaan, chloorethyleen en 2,3-dichloorpropeen). In dit onderzoek is voor één stof, hexachloorbutadieen, gebleken dat de gemeten concentratie in Nederlands oppervlaktewater eenmalig hoger uitkwam dan het MTR.

Trefwoorden: milieukwaliteitsnormen; milieurisicogrenzen; vluchtige stoffen; maximaal toelaatbaar risiconiveau; verwaarloosbaar risiconiveau

Abstract

Ecotoxicologically based environmental risk limits for several volatile aliphatic hydrocarbons

This report describes ecotoxicological environmental risk limits derived for a number of volatile aliphatic hydrocarbons. On the basis of evaluated literature, the National Institute for Public Health and the Environment (RIVM) proposes ecotoxicological environmental risk limits for these compounds for water, soil, sediment and air. The proposed environmental risk limits are the scientific basis for Environmental Quality Standards set by the interdepartmental Steering Group 'Substances'. Three levels have been distinguished: Negligible Concentrations (NC); Maximum Permissible Concentrations (MPC), a level at which no harmful effects are to be expected, and Serious Risk Concentrations (SRC_{eco}), a level at which possible serious effects are to be expected. The environmental risk limits play an important role for the implementation of the national policy concerning substances.

The substances evaluated in this report are: acrylonitrile, ethylene, ethylene oxide, dichloromethane, trichloromethane, tetrachloromethane, 1,1-dichloroethane, 1,2-dichloroethane, 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,1,2,2-tetrachloroethane, pentachloroethane, hexachloroethane, 1,2-dichloropropane, 1,3-dichloropropane, chloroethylene, 1,1-dichloroethylene, 1,2-dichloroethylene (*trans*- and *cis*-1,2-dichloroethylene), trichloroethylene, tetrachloroethylene, 3-chloropropene, 1,3-dichloropropene (*trans*- and *cis*-1,3-dichloropropene), 2,3-dichloropropene, 2-chlorobutadiene and hexachlorobutadiene.

For eight substances, the risk limits were derived based on European Documents, drafted in the framework of the Existing Substance Regulation or the European Water Framework Directive (acrylonitrile, dichloromethane, trichloromethane, tetrachloromethane, 1,2-dichloroethane, trichloroethylene, tetrachloroethylene and hexachlorobutadiene). For four substances (ethylene, 1,1-dichloroethane, chloroethylene and 2,3-dichloropropene), too few reliable toxicity data were available to derive an environmental risk limit. In this study, the measured concentration of one of the substances, hexachloorbutadiene, exceeded the MPC in Dutch surface water in one case.

Key words: environmental quality standards, volatile hydrocarbons, maximum permissible concentrations; negligible concentration

Contents

Samenvatting

In dit rapport zijn Maximaal Toelaatbaar Risiconiveaus (MTR's), Verwaarloosbaar Risiconiveaus (VR's) en Ernstig Risiconiveaus voor ecosystemen (ER_{eco}'s) afgeleid voor alifatische vluchtige organische verbindingen. Humaan toxicologische aspecten zijn in dit rapport buiten beschouwing gelaten.

De milieurisicogrenzen worden afgeleid met gebruik van ecotoxicologische en milieuchemische data, en geven het kritisch effectniveau aan van stoffen voor een ecosysteem. De milieurisicogrenzen vormen de basis voor milieukwaliteitsnormen die vervolgens worden vastgesteld door de Stuurgroep Stoffen.

De onderzochte stoffen zijn ethyleen, ethyleenoxide, 1,1-dichloorethaan, 1,1,1-trichloorethaan, 1,1,2-trichloorethaan, 1,1,2,2-tetrachloorethaan, pentachloorethaan, hexachloorethaan, 1,2-dichloorpropaan, 1,3-dichloorpropaan, chloorethyleen, 1,1-dichloorethyleen, 1,2-dichloorethyleen (*trans*- en *cis*-1,2-dichloorethyleen), 3-chloorpropeen, 1,3-dichloorpropeen (*trans*- en *cis*-1,3-dichloorpropeen), 2,3-dichloorpropeen en chloropreen. Voor enkele stoffen is reeds een EU-Risk Assessment Report (RAR) beschikbaar, opgesteld in het kader de bestaande stoffen verordening (EG 793/93) of zijn milieukwaliteitsnormen afgeleid voor de EU Kaderrichtlijn Water. Voor deze stoffen (acrylonitril, dichloormethaan, trichloormethaan (chloroform), tetrachloormethaan, 1,2-dichloorethaan, trichloorethyleen, tetrachloorethyleen en hexachloorbutadieen) zijn de waarden uit de EU-RAR of de Kaderrichtlijn overgenomen. Voor vier stoffen (ethyleen, 1,1-dichloorethaan, chloorethyleen (vinylchloride) en 2,3-dichloorpropeen), waren er onvoldoende betrouwbare toxiciteitsgegevens beschikbaar om een milieurisicogrens voor water, sediment of bodem af te leiden. Voor ethyleen, etheenoxide, 1,1,1-trichloorethaan, 1,1,2,2-terachloooerethaan, tetrachlooretheen and *trans*-1,2-dichlooretheen is een voorlopige risicogrens voor lucht afgeleid.

Alleen toxiciteitstudies met eindpunten die gerelateerd zijn aan overleving, groei of reproductie zijn in beschouwing genomen. Voor bodem zijn alleen voor tetrachloroethyleen en 1,2-dichloorpropaan toxiciteitsgegevens gevonden die gebruikt kunnen worden voor het afleiden van de ER_{eco}- en MTR- en VR-waarden. Voor sediment geldt dit alleen voor trichloromethaan. Voor alle andere stoffen zijn de $ER_{bodem/sediment}$ en $MTR_{bodem/sediment}$ afgeleid met behulp van de evenwichtspartitiemethode. Voor een overzicht van de afgeleide milieurisicogrenzen zie Tabellen 1 t/m 4.

Zoetwater monitoringgegevens voor Nederland laten zien dat, op hexachloorbutadieen na, het MTR voor geen van de stoffen wordt overschreden. De maximaal gemeten waarde ligt ook altijd minimaal een factor 10 onder het MTR. Het VR wordt voor 10 van de 18 stoffen, waarvoor monitoringgegevens zijn gevonden, overschreden. Een complicerende factor hierbij is dat in een groot aantal gevallen de detectielimiet hoger is dan het VR. Hierdoor kan geen uitspraak worden gedaan over de daadwerkelijke overschrijding.

In dit rapport zijn alleen normen afgeleid voor de ecotoxicologische eindpunten. Voor een aantal stoffen moet er ook nog een MTR worden afgeleid voor humaan-toxicologische aspecten. Dit zal in een afzonderlijk rapport worden gerapporteerd.

Tabel 1: Milieurisicogrenzen voor alifatische vluchtige organische verbindingen in zoet oppervlaktewater (AF = assessment factor voor MTR-afleiding).

	SRC_{eco} [mg/l]	MTR [mg/l]	AF	VR [mg/l]
acrylonitril[a]	1,3	0,017	10	0,00017
ethyleen[c]				
ethyleenoxide	19	0,084	1000	0,00084
dichloormethaan[b]	44	1,7	50	0,017
trichloormethaan[b]	23	0,15	10	0,0015
tetrachloormethaan[b]	5,0	0,012		0,00012
1,1-dichloorethaan[c]				
1,2-dichloorethaan[b]	64	1,1	10	0,011
1,1,1-trichloorethaan	1,5	0,021	10	0,00021
1,1,2-trichloorethaan	16	0,3	10	0,003
1,1,2,2-tetrachloorethaan	1,7	0,008	100	0,00008
pentachloorethaan	0,89	0,028	10	0,00028
hexachloorethaan	0,11	0,00067	100	0,0000067
1,2-dichloorpropaan	20	0,28	10	0,0028
1,3-dichloorpropaan	6,0	0,03	100	0,0003
chloorethyleen[c]				
1,1-dichloorethyleen	11	0,009	1000	0,00009
1,2-dichloorethyleen	11	0,0068	1000	0,000068
trans-1,2-dichloorethyleen	11	0,0068	1000	0,000068
cis-1,2-dichloorethyleen	11	0,0068	1000	0,000068
trichloorethyleen[a]	4,6	0,12	50	0,0012
tetrachloorethyleen[a]	7,8	0,051	10	0,00051
3-chloorpropeen	1,9	0,00034	1000	0,0000034
1,3-dichloorpropeen	0,028	0,00018	50	0,0000018
trans-1,3-dichloorpropeen	0,028	0,00018	50	0,0000018
cis-1,3-dichloorpropeen	0,028	0,00018	50	0,0000018
2,3-dichloorpropeen[c]				
2-chloorbutadieen	1,9	0,019	100	0,00019
hexachloorbutadieen[b]	6,1	0,0000033	doorvergif-tiging	0,000000033

Opmerkingen:
a: milieurisicogrenzen worden afgeleid op basis van de EU-RAR (MTR=PNEC [Predicted No-Effect-Concentration])
b: milieurisicogrenzen worden afgeleid op basis van de kaderrichtlijn water (MTR=AA-EQS [Annual Average – Environmental Quality Standard])
c: onvoldoende data om milieurisicogrenzen af te leiden

Tabel 2: Milieurisicogrenzen voor alifatische vluchtige organische verbindingen in marien oppervlaktewater.

	SRC_{eco} [mg/l]	MTR [mg/l]	AF	VR [mg/l]
acrylonitril[a]	1,3	0,0017	100	0,000017
ethyleen[c]				
ethyleenoxide	19	0,0084	10000	0,000084
dichloormethaan[b]	44	1,7	50	0,017
trichloormethaan[a]	23	0,15	10	0,0015
tetrachloormethaan[b]	5,0	0,012		0,00012
1,1-dichloorethaan[c]				
1,2-dichloorethaan[b]	64	1,1	10	0,011
1,1,1-trichloorethaan	1,5	0,0021	100	0,000021
1,1,2-trichloorethaan	16	0,03	100	0,0003
1,1,2,2-tetrachloorethaan	1,7	0,0008	1000	0,000008
pentachloorethaan	0,89	0,0028	100	0,000028
hexachloorethaan	0,11	0,000067	1000	0,00000067
1,2-dichloorpropaan	20	0,028	100	0,00028
1,3-dichloorpropaan	6,0	0,003	1000	0,00003
chloorethyleen[c]				
1,1-dichloorethyleen	11	0,0009	10000	0,000009
1,2-dichloorethyleen	11	0,00068	10000	0,0000068
trans-1,2-dichloorethyleen	11	0,00068	10000	0,0000068
cis-1,2-dichloorethyleen	11	0,00068	10000	0,0000068
trichloorethyleen[a]	4,6	0,012	500	0,00012
tetrachloorethyleen[a]	7,8	0,0051	100	0,000051
3-chloorpropeen	1,9	0,000034	10000	0,00000034
1,3-dichloorpropeen	0,028	0,000018	500	0,00000018
trans-1,3-dichloorpropeen	0,028	0,000018	500	0,00000018
cis-1,3-dichloorpropeen	0,028	0,000018	500	0,00000018
2,3-dichloorpropeen[c]				
2-chloorbutadieen	1,9	0,0019	1000	0,000019
hexachloorbutadieen[b]	6,1	0,0000033	doorvergif-tiging	0,000000033

Opmerkingen:
a: milieurisicogrenzen worden afgeleid op basis van de EU-RAR (MTR=PNEC)
b: milieurisicogrenzen worden afgeleid op basis van de kaderrichtlijn water (MTR=AA-EQS)
c: onvoldoende data om milieurisicogrenzen af te leiden

Tabel 3: Milieurisicogrenzen voor alifatische vluchtige organische verbindingen in bodem en sediment.

	$ER_{eco, bodem}$ [mg/kg_{dw}]	MTR_{bodem} [mg/kg_{dw}]	VR_{bodem} [mg/kg_{dw}]	$SRC_{eco, sediment}$ [mg/kg_{dw}]	$MTR_{sediment}$ [mg/kg_{dw}]	$VR_{sediment}$ [mg/kg_{dw}]
acrylonitril[a]	1,5	0,02	0,0002	3,7	0,05	0,0005
ethyleen[c]						
ethyleenoxide	8,7	0,039	0,00039	41	0,18	0,0018
dichloormethaan[b]	130	4,8	0,045	200	7,5	0,075
trichloormethaane[a]	26	1,7	0,017	1,0	0,081	0,00081
tetrachloormethaan[b]	29	0,069	0,00069	35	0,084	0,00084
1,1-dichloorethaan[c]						
1,2-dichloorethaan[b]	180	3,0	0,030	290	4,8	0,048
1,1,1-trichloorethaan	10	0,15	0,0015	12	0,18	0,0018
1,1,2-trichloorethaan	91	1,7	0,017	120	2,2	0,022
1,1,2,2-tetrachloorethaan	14	0,07	0,0007	17	0,08	0,0008
pentachloorethaan	27	0,86	0,0086	29	0,90	0,0090
hexachloorethaan	16	0,10	0,0010	16	0,10	0,0010
1,2-dichloorpropaan	59	3,9	0,039	92	1,3	0,013
1,3-dichloorpropaan	21	0,11	0,0011	31	0,16	0,0016
chloorethyleen[c]						
1,1-dichloorethyleen	53	0,044	0,00044	65	0,054	0,00054
1,2-dichloorethyleen	32	0,020	0,00020	48	0,031	0,00031
trans-1,2-dichloorethyleen	44	0,028	0,00028	61	0,039	0,00039
cis-1,2-dichloorethyleen	31	0,019	0,00019	48	0,031	0,00031
trichloorethyleen[a]	27	0,68	0,0068	34	0,86	0,0086
tetrachloorethyleen[a]	8,1	0,033	0,00033	130	0,86	0,0086
3-chloorpropeen	3,7	0,00065	0,0000065	6,4	0,0011	0,000011
1,3-dichloorpropeen	0,087	0,00056	0,0000056	0,13	0,00084	0,0000084
trans-1,3-dichloorpropeen	0,087	0,00056	0,0000056	0,13	0,00084	0,0000084
cis-1,3-dichloorpropeen	0,087	0,00056	0,0000056	0,13	0,00084	0,0000084
2,3-dichloorpropeen[c]						
2-chloorbutadieen	10	0,10	0,0010	12	0,12	0,0012
hexachloorbutadieen[b]	4000	0,019	0,00019	4000	0,29	0,0029

Opmerkingen:
a: milieurisicogrenzen worden afgeleid op basis van de EU-RAR (MTR=PNEC)
b: milieurisicogrenzen voor sediment afgeleid op basis van de kaderrichtlijn water (MTR=AA-EQS)
c: onvoldoende data om milieurisicogrenzen af te leiden

Tabel 4: *Voorlopige milieurisicogrenzen voor alifatische vluchtige organische verbindingen in lucht.*

	MTR afgeleid van gegevens voor lucht mg/l
ethyleenoxide	0,0012
1,1,1-trichloorethaan	0,013
1,1,2,2-tetrachlooorethaan	0,000065
trans-1,2-dichloorethyleen	0,078
tetrachloorethyleen	0,0000092

Summary

In this report Maximum Permissible Concentrations (MPCs), Negligible Concentrations (NCs) and Serious Risk Concentrations (SRC_{eco}s) are derived for a number of volatile aliphatic hydrocarbons. Human toxicological aspects were beyond the scope of this report. The environmental risk limits (ERLs) are derived using data on (eco)toxicology and environmental chemistry and are the scientific basis for Environmental Quality Standards (EQS) set by the Steering Committee for Substances.

The substances that were evaluated are: ethylene, ethylene oxide, 1,1-dichloroethane, 1,1,1-trichloroethane, 1,1,2-trichloroethane, 1,1,2,2-tetrachloroethane, pentachloroethane, hexachloroethane, 1,2-dichloropropane, 1,3-dichloropropane, chloroethylene, 1,1-dichloroethylene, 1,2-dichloroethylene (*trans*- and *cis*-1,2-dichloroethylene), 3-chloropropene, 1,3-dichloropropene (*trans*- and *cis*-1,3-dichloropropene), 2,3-dichloropropene and 2-chlorobutadiene. For some substances an EU Risk Assessment Report (RAR), drawn up in the framework of the Exisiting Substances Regulation (EU 793/93), was available or an EQS was already derived in the framework of the EU Water Framework Directive (WFD). For these substances (acrylonitrile, dichloromethane, trichloromethane, tetrachloromethane, 1,2-dichloroethane, trichloroethylene, tetrachloroethylene and hexachlorobutadiene) the standards of the EU-RAR or the WFD were taken. For four substances (ethane, 1,1-dichloroethane, chloroethylene and 2,3-dichloropropene), insufficient toxicity data were available to derive a reliable environmental risk limit for water, sediment, or soil. For ethylene, ethylene oxide, 1,1,1-trichloroethane, 1,1,2,2-terachloroethane, tetrachloroethylene and *trans*-1,2-dichloroethylene primarily ERLs were derived for the air compartment.

Only toxicity studies with endpoints related to survival, growth or reproduction are taken into account. For sediment and soil, no ecotoxicity data were retrieved that could be used for the derivation of MPC, NC or SRC_{eco} values, with the exception of tetrachloroethylene and 1,2-dichloropropane (soil), and trichloromethane (sediment). For all other substances the risk limits for soil and sediment were derived by the equilibrium partitioning method. For an overview of the derived environmental risk limits, see Table 1, 2, 3 and 4.

Freshwater monitoring data for the Netherlands show that the measured values for those substances for which an MPC was derived, do not exceed the MPC with the exception of hexachlorobutadiene. The maximum measured value is in all cases more than a factor of 10 below the MPC. The NC is exceeded for 10 out of 18 substances. A complicating aspect is that in a considerable number of cases the limit of detection is higher than the NC. Therefore, no conclusion can be drawn about the actual exceeding of the NC.

In this report, standards are derived for ecotoxicological endpoints only. For several substances an MPC has to be derived for human toxicological aspects as well. This will be reported in a separate report.

Table 1: Environmental risk limits for several volatile aliphatic hydrocarbons in freshwater (AF = assessment factor for derivation of MPC).

	SRC_{eco} [mg/l]	MPC [mg/l]	AF	NC [mg/l]
acrylonitrile[a]	1.3	0.017	10	0.00017
ethylene[c]				
ethylene oxide	19	0.084	1000	0.00084
dichloromethane[b]	44	1.7	50	0.017
trichloromethane[b]	23	0.15	10	0.0015
tetrachloromethane[b]	5.0	0.012		0.00012
1,1-dichloroethane[c]				
1,2-dichloroethane[b]	64	1.1	10	0.011
1,1,1-trichloroethane	1.5	0.021	10	0.00021
1,1,2-trichloroethane	16	0.3	10	0.003
1,1,2,2-tetrachloroethane	1.7	0.008	100	0.00008
pentachloroethane	0.89	0.028	10	0.00028
hexachloroethane	0.11	0.00067	100	0.0000067
1,2-dichloropropane	20	0.28	10	0.0028
1,3-dichloropropane	6.0	0.03	100	0.0003
chloroethylene[c]				
1,1-dichloroethylene	11	0.009	1000	0.00009
1,2-dichloroethylene	11	0.0068	1000	0.000068
trans-1,2-dichloroethylene	11	0.0068	1000	0.000068
cis-1,2-dichloroethylene	11	0.0068	1000	0.000068
trichloroethylene[a]	4.6	0.12	50	0.0012
tetrachloroethylene[a]	7.8	0.051	10	0.00051
3-chloropropene	1.9	0.00034	1000	0.0000034
1,3-dichloropropene	0.028	0.00018	50	0.0000018
trans-1,3-dichloropropene	0.028	0.00018	50	0.0000018
cis-1,3-dichloropropene	0.028	0.00018	50	0.0000018
2,3-dichloropropene[c]				
2-chlorobutadiene	1.9	0.019	100	0.00019
hexachlorobutadiene[b]	6.1	0.0000033	secondary poisoning	0.000000033

Notes:
a: environmental risk limits derived on basis of the EU-RAR (MPC=PNEC)
b: environmental risk limits derived on basis of the EU WFD (MPC=AA-EQS)
c: data insufficient for deriving environmental risk limits

Table 2: Environmental risk limits for several volatile aliphatic hydrocarbons in marine surface water.

	SRC_{eco} [mg/l]	MPC [mg/l]	AF	NC [mg/l]
acrylonitrile[a]	1.3	0.0017	100	0.000017
ethylene[c]				
ethylene oxide	19	0.0084	10000	0.000084
dichloromethane[b]	44	1.7	50	0.017
trichloromethane[b]	23	0.15	10	0.0015
tetrachloromethane[b]	5.0	0.012		0.00012
1,1-dichloroethane[c]				
1,2-dichloroethane[b]	64	1.1	10	0.011
1,1,1-trichloroethane	1.5	0.0021	100	0.000021
1,1,2-trichloroethane	16	0.03	100	0.0003
1,1,2,2-tetrachloroethane	1.7	0.0008	1000	0.000008
pentachloroethane	0.89	0.0028	100	0.000028
hexachloroethane	0.11	0.000067	1000	0.00000067
1,2-dichloropropane	20	0.028	100	0.00028
1,3-dichloropropane	6.0	0.003	1000	0.00003
chloroethylene[c]				
1,1-dichloroethylene	11	0.0009	10000	0.000009
1,2-dichloroethylene	11	0.00068	10000	0.0000068
trans-1,2-dichloroethylene	11	0.00068	10000	0.0000068
cis-1,2-dichloroethylene	11	0.00068	10000	0.0000068
trichloroethylene[a]	4.6	0.012	500	0.00012
tetrachloroethylene[a]	7.8	0.0051	100	0.000051
3-chloropropene	1.9	0.000034	10000	0.00000034
1,3-dichloropropene	0.028	0.000018	500	0.00000018
trans-1,3-dichloropropene	0.028	0.000018	500	0.00000018
cis-1,3-dichloropropene	0.028	0.000018	500	0.00000018
2,3-dichloropropene				
2-chlorobutadiene	1.9	0.0019	1000	0.000019
hexachlorobutadiene[b]	6.1	0.0000033	secondary poisoning	0.000000033

Notes:
a: environmental risk limits derived on basis of the EU-RAR (MPC=PNEC)
b: environmental risk limits derived on basis of the EU WFD (MPC=AA-EQS)
c: data insufficient for deriving environmental risk limits

Table3: Environmental risk limits for several volatile aliphatic hydrocarbons in soil and sediment.

	$SRC_{eco, soil}$ [mg/kg$_{dw}$]	MPC_{soil} [mg/kg$_{dw}$]	NC_{soil} [mg/kg$_{dw}$]	$SRC_{eco, sediment}$ [mg/kg$_{dw}$]	$MPC_{sediment}$ [mg/kg$_{dw}$]	$NC_{sediment}$ [mg/kg$_{dw}$]
acrylonitrile[a]	1.5	0.02	0.0002	3.7	0.05	0.0005
ethylene[c]						
ethylene oxide	8.7	0.039	0.00039	41	0.18	0.0018
dichloromethane[b]	130	4.8	0.045	200	7.5	0.075
trichloromethane[b]	26	1.7	0.017	1.0	0.081	0.00081
tetrachloromethane[b]	29	0.069	0.00069	35	0.084	0.00084
1,1-dichloroethane						
1,2-dichloroethane[b]	180	3.0	0.030	290	4.8	0.048
1,1,1-trichloroethane	11	0.15	0.0015	13	0.19	0.0019
1,1,2-trichloroethane	91	1.7	0.017	120	2.2	0.022
1,1,2,2-tetrachloroethane	14	0.07	0.0007	17	0.08	0.0008
pentachloroethane	27	0.86	0.0086	29	0.90	0.0090
hexachloroethane	16	0.10	0.0010	16	0.10	0.0010
1,2-dichloropropane	59	3.9	0.039	92	1.3	0.013
1,3-dichloropropane	21	0.11	0.0011	31	0.16	0.0016
chloroethylene[c]						
1,1-dichloroethylene	53	0.044	0.00044	65	0.054	0.00054
1,2-dichloroethylene	32	0.020	0.00020	48	0.031	0.00031
trans-1,2-dichloroethylene	44	0.028	0.00028	61	0.039	0.00039
cis-1,2-dichloroethylene	31	0.019	0.00019	48	0.031	0.00031
trichloroethylene[a]	27	0.68	0.0068	34	0.86	0.0086
tetrachloroethylene[a]	8.1	0.033	0.00033	130	0.86	0.0086
3-chloropropene	3.7	0.00065	0.0000065	6.4	0.0011	0.000011
1,3-dichloropropene	0.087	0.00056	0.0000056	0.13	0.00084	0.0000084
trans-1,3-dichloropropene	0.087	0.00056	0.0000056	0.13	0.00084	0.0000084
cis-1,3-dichloropropene	0.087	0.00056	0.0000056	0.13	0.00084	0.0000084
2,3-dichloropropene[c]						
2-chlorobutadiene	10	0.10	0.0010	12	0.12	0.0012
hexachlorobutadiene[b]	4000	0.019	0.00019	4000	0.29	0.0029

Notes:
a: environmental risk limits derived on basis of the EU-RAR (MPC=PNEC)
b: environmental risk limits for sediment derived on basis of the EU WFD (MPC=AA-EQS)
c: data insufficient for deriving environmental risk limits

Table 4: Preliminary environmental risk limits for several volatile aliphatic hydrocarbons in air.

	MPC [mg/l]
ethylene	0.0000007
ethylene oxide	0.0012
1,1,1-trichloroethane	0.013
1,1,2,2-tetrachloroethane	0.000065
trans-1,2-dichloroethylene	0.078
tetrachloroethylene	0.0000092

1. Introduction

In this report, environmental risk limits (ERLs) are derived for several volatile aliphatic hydrocarbons. Humane toxicological aspects were left out of consideration for this report. The human toxicological part of the environmental risk limits will be dealt with in a separate report for those compounds for which these aspects must be taken into account. This report is a result of the project ‘International and National environmental quality standards for Substances in the Netherlands’. Until 1-1-2004 this project was called ‘Setting Integrated Environmental Quality Standards’, abbreviated with INS. The abbreviation INS is still used as acronym for the project. The most important change with respect to content is that the *guidance* used to derive environmental risk limits is now the Technical Guidance Document (TGD), issued by the European Commission and developed in support of the risk assessment of new notified chemical substances, existing substances and biocides (European Commission, 2003), and the report of the Fraunhofer Institute (Lepper, 2005) developed in support of the Water Framework Directive.

The aim of the project INS is to derive environmental risk limits for substances in the environment for the compartments air, (ground)water, sediment and soil. Environmental risk limits serve as advisory values to set environmental quality standards (EQS) by the Ministry of Housing, Spatial Planning and the Environment (VROM) for various policy purposes. The term EQS is used to designate all legally and non-legally binding standards that are used in Dutch environmental policy and Table 1.1 shows the correspondence between ERLs and EQSs. The various ERLs are:

- the negligible concentration (NC) for water, soil, groundwater, sediment and air
- the maximum permissible concentration (MPC) for water, soil, groundwater, sediment and air
- the ecotoxicological serious risk concentration (SRC_{eco}) for water, soil, groundwater and sediment

Table 1.1: Environmental risk limits (ERLs) and the related environmental quality standards (EQS) that are set by the Dutch government in the Netherlands for the protection of ecosystems.

Description	ERL	EQS
The NC represents a value causing negligible effects to ecosystems. The NC is derived from the MPC by dividing it by 100. This factor is applied to take into account possible combined effects.	NC (for air, water, soil, groundwater and sediment)	Target value (for air, water, soil, groundwater and sediment)
The MPC is the concentration of a substance in air, water, soil or sediment that should protect all species in ecosystems as well as humans exposed indirectly via the environment from adverse effects of that substance.	MPC (for air, water, soil, groundwater and sediment)	MPC (for air, water and sediment)
The SRC_{eco} is the concentration of a substance in the soil, sediment or groundwater at which functions in these compartments will be seriously affected or are threatened to be negatively affected. This is assumed to occur when 50% of the species and/or 50% of the microbial and enzymatic processes are possibly affected, the $HC_{50,NOEC}$ (HC = Hazard Concentration)	SRC_{eco} (for water, soil, groundwater and sediment)	Intervention value after comparison with SRC_{human} (for soil, sediment and groundwater)

The process of deriving integrated ERLs is shown schematically in Figure 1.1. ERLs for soil and sediment are calculated for a standardised soil. Each of the ERLs and its corresponding EQS represents a different level of protection, with increasing numerical values in the order NC < MPC[1] < SRC_{eco}. The EQS demands different actions when one of them is exceeded, explained elsewhere (VROM, 2001).

At the EU guidance for deriving standards for groundwater is under development. Therefore, in this report no standards for groundwater are derived.

In the series of RIVM reports that were published in the framework of the project 'Setting Integrated Environmental Quality Standards', (now called 'International and National Environmental Quality Standards for Substances in the Netherlands'), ERLs were derived for approximately 250 substances and groups of substances. For an overview of the EQSs set by the Ministry of VROM, see (VROM, 2001). The Expert Centre for Substances of RIVM has recently launched a website at which all EQSs are available. The website can be found at: http://www.stoffen-risico.nl.

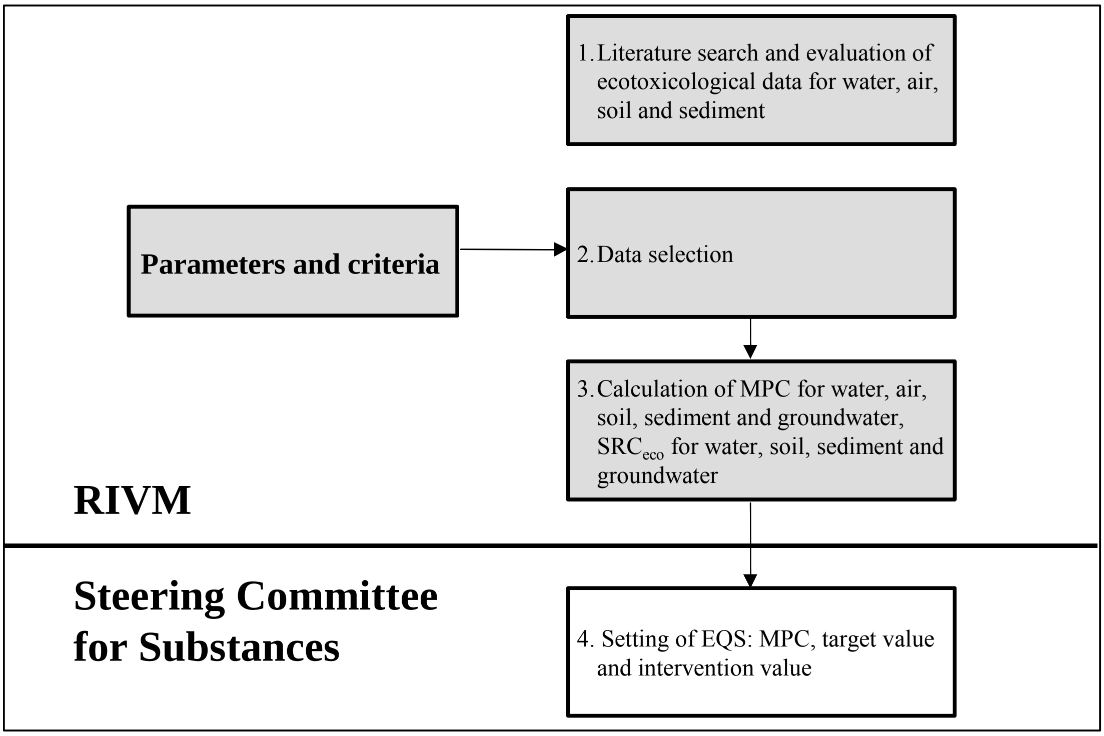


Figure 1.1: The process of deriving Integrated Environmental Risk Limits. Above the line the method to derive ERLs is indicated, i.e. MPC, NC and SRC_{eco}. Below the dashed line the MPC, Target Value, and Intervention Value are indicated, set by the Steering Committee for Substances.

For substances, for which toxicity data have been collected and evaluated within the European Existing Substances Regulation (EU-RAR), the MPCs for water, soil and sediment will be derived from the PNEC (Predicted No-Effect-Concentration) values mentioned in these reports, and the SRC_{eco} values will be based on the data underlying these PNECs. In the ecotoxicology part, reference will be made to the EU-RAR documents. The same procedure is followed for substances that have been assessed for the EU Water Framework Directive. For these compounds the MPC is set equal to the AA-EQS.

[1] A complicating factor is that the term MPC is used both as an ERL and as an EQS. For historical reasons, however, the same abbreviation is used.

The Steering Committee for Substances proposed to derive new EQSs for a number of volatile substances because these substances are regularly found in the environment. For a number of volatile compounds MPCs were set in 1993 (Van der Plassche et al., 1993). Since the data used are more than ten years old, and the methodology for deriving MPCs is changed considerably, an update of the standards was deemed necessary.

2. Substance properties and use

2.1 Physico-chemical properties

In this section an overview of the physicochemical properties is given for the substances that are considered in this report.

Table 2.1: General information and physical-chemical properties of acrylonitrile (2-propenenitrile).

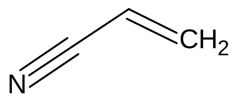
Properties	Value(s)	Reference
IUPAC	acrylonitrile	
Structure		
CAS number	107-13-1	
EINECS number	203-466-5	
Empirical formula	C3H3N	
Smiles code	N#CC=C	
Molar Mass (g/mol)	53.06	
n-Octanol/water partition coefficient (log K_{ow})	0.25 (shake-flask)	(Pratesi et al., 1979) in (BioByte, 2004); (EC, 2004a)
	0.30	(Tonogai et al., 1982)
	0.09	(Tanii and Hashimoto, 1984)
	0.21 (fragment constant estimate)	(U.S. EPA, 2004)
	0.29 (fragment constant estimate)	(BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.10 (silt loam)	(Walton et al., 1992)
	1.01 (sandy loam)	(Walton et al., 1992)
	1.15 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 0.25, non-hydrophobics)	(EC, 2004a)
	0.92 (molecular connectivity estimate)	(U.S. EPA, 2004)
Vapour pressure (Pa)	13330 (22.8 ºC)	(Stull, 1947)
	14100 (25 ºC)	(Hoy, 1970)
	14720 (25 ºC, Antoine eqn.)	(Boublik et al., 1984)
	14370 (25 ºC)	(Daubert and Danner, 1985)
	15240 (25 ºC, Antoine eqn.)	(Dean, 1985)
	14530 (25 ºC)	(Howard et al., 1986)
	11000 (20 ºC)	(Riddick et al., 1986)
	6279 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	14.0 (25 ºC, bond method)	(U.S. EPA, 2004)
	14.0 (25 ºC, group method)	(U.S. EPA, 2004)
	9.6	(EC, 2004a)
Water solubility (mg/l)	73500 (20 ºC)	(Windholz, 1976)
	73240 (25 ºC, shake flask LSC method)	(Veith et al., 1980)
	73500 (20 ºC)	(Riddick et al., 1986)
	69000 (20 ºC, shake flask GC)	(Stephenson, 1994)
	66400 (30 ºC, shake flask GC)	(Stephenson, 1994)
	49070 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	86474 (from fragments)	(U.S. EPA, 2004)

Table 2.2: General information and physical-chemical properties of ethylene (ethene).

Properties	Value(s)	Reference
IUPAC Name	ethylene	
Structure	$H_2C{=}CH_2$	
CAS number	74-85-1	
EINECS number	200-815-3	
Empirical formula	C2H4	
Smiles code	C=C	
Molar Mass (g/mol)	28.05	
n-Octanol/water partition coefficient (log K_{ow})	1.13	(Jow and Hansch) in (BioByte, 2004)
	1.27 (fragment constant estimate)	(U.S. EPA, 2004)
	1.27 (fragment constant estimate)	(BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.56	(U.S. EPA, 2004)
	1.02 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 1.13, predominantly hydrophobic)	
Vapour pressure (Pa)	963921 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	9909 (25 ºC, bond method)	(U.S. EPA, 2004)
	16415 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	2641 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	771 (from fragments)	(U.S. EPA, 2004)

Table 2.3: General information and physical-chemical properties of ethylene oxide (oxirane).

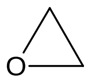
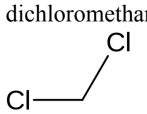
Properties	Value(s)	Reference
IUPAC	ethylene oxide	
Structure		
CAS number	75-21-8	
EINECS number	200-849-9	
Empirical formula	C2H4O	
Smiles code	O(C1)C1	
Molar Mass (g/mol)	44.05	
n-Octanol/water partition coefficient (log K_{ow})	-0.05 (fragment constant estimate)	(U.S. EPA, 2004)
	0.27 (fragment constant estimate)	(BioByte, 2004)
	-0.30 (both phases analyzed)	(Jow and Hansch) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	0.16	(U.S. EPA, 2004)
	0.34	(Tao et al., 1999)
	-0.14 (calculated according to (Sabljic et al., 1995) from Log K_{ow} -0.30, predominantly hydrophobic)	
Vapour pressure (Pa)	157320 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	12.16 (25 ºC, bond method)	(U.S. EPA, 2004)
	5.30 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	143900 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	320720 (from fragments)	(U.S. EPA, 2004)

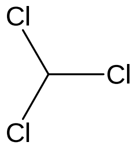
Table 2.4: General information and physical-chemical properties of dichloromethane (methylene-dichloride).

Properties	Value(s)	Reference
IUPAC	dichloromethane	
Structure		
CAS number	75-09-2	
EINECS number	200-838-9	
Empirical formula	CH2Cl2	

Properties	Value(s)	Reference
Smiles code	C(Cl)Cl	
Molar Mass (g/mol)	84.94	
n-Octanol/water partition coefficient (log K_{ow})	1.25 (shake flask)	(Hansch et al., 1975)
	1.25 (estimated HPLC-k')	(Tomlinson and Hafkenscheid, 1986)
	1.51	(Hansch and Leo, 1979)
	1.15	(Abernethy et al., 1988)
	1.34 (fragment constant estimate)	(U.S. EPA, 2004)
	1.25 (fragment constant estimate)	(BioByte, 2004)
	1.25	(Jow and Hansch) in (BioByte, 2004)
	1.37	(Tse and Sandler, 1994) in (BioByte, 2004)
	1.35	(Bhatia and Sandler, 1995) in (BioByte, 2004)
	1.37	(Bhatia and Sandler, 1995) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.38	(U.S. EPA, 2004)
	1.44	(Tao et al., 1999)
	1.44	(Bahnick and Doucette, 1988)
	1.11 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 1.25, predominantly hydrophobic)	
	1.68 (calculated)	(Environmental Quality Standards (EQS), 2005a)
	8.8 (sediment)	(Environmental Quality Standards (EQS), 2005a)
	7.8 (calculated from log K_{ow})	(Environmental Quality Standards (EQS), 2005a)
	390 (sewage sludge, aerobic)	(Environmental Quality Standards (EQS), 2005a)
	157 (sewage sludge, anaerobic)	(Environmental Quality Standards (EQS), 2005a)
Vapour pressure (Pa)	46508 (20 ºC)	(Rex, 1906)
	68170 (30 ºC)	(Rex, 1906)
	57120 (25 º)	(McGovern, 1943)
	57477 (25 ºC, Antoine eqn.)	(Stull, 1947)
	58100 (25 ºC, Antoine eqn.)	(Dreisbach, 1959)
	57388 (25 ºC, Antoine eqn.)	(Weast, 1972-1973)
	58275 (25 ºC, Antoine eqn.)	(Boublik et al., 1973)
	57267 (25 ºC, Antoine eqn.)	(Boublik et al., 1973)
	57970 (25 ºC, Antoine eqn.)	(Boublik et al., 1984)
	48200 (20 ºC)	(McConnell et al., 1975)
	46530 (20 ºC)	(Neely, 1976)
	58400 (25 ºC)	(Dilling, 1977)
	57990 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	11426 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	301.0	(McConnell et al., 1975)
	271.5	(Dilling, 1977)
	229.1 (20 ºC)	(Lincoff and Gossett, 1983)
	227.9 (20 ºC)	(Lincoff and Gossett, 1984)
	199.6 (20 ºC, Batch Stripping)	(Lincoff and Gossett, 1984)
	222.0	(Gossett, 1987)
	173.0 (20 ºC)	(Gossett, 1987)
	187.7 (20 ºC)	(Yurteri et al., 1987)
	212.7 (20 ºC)	(Tse et al., 1992)
	314.1 (30 ºC)	(Tse et al., 1992)
	926 (25 ºC, bond method)	(U.S. EPA, 2004)
	305 (25 ºC, group method)	(U.S. EPA, 2004)
	270 (20 ºC)	(Environmental Quality Standards (EQS), 2005a)
Water solubility (mg/l)	20000 (20 ºC, volumetric)	(Rex, 1906)
	19690 (30 ºC, volumetric)	(Rex, 1906)
	19912 (25 ºC)	(Seidell, 1940)
	13200 (25 ºC)	(McGovern, 1943)

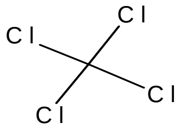
Properties	Value(s)	Reference
	2000 (25 ºC)	(Pechiney-Saint-Gobain., 1971)
	13200 (20 ºC)	(McConnell et al., 1975)
	20000 (25 ºC)	(Archer and Stevens, 1977)
	19400 (25 ºC)	(Dilling, 1977)
	18000 (17.5 ºC, shake flask GC/TC)	(Stephenson, 1992)
	17200 (26.8 ºC, shake flask GC/TC)	(Stephenson, 1992)
	9162 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	11665 (25 ºC, from fragments)	(U.S. EPA, 2004)

Table 2.5: General information and physical-chemical properties of trichloromethane (chloroform).

Properties	Value(s)	Reference
IUPAC	trichloromethane	
Structure		
CAS number	67-66-3	
EINECS number	200-663-8	
Empirical formula	CHCl3	
Smiles code	C(Cl)(Cl)Cl	
Molar Mass (g/mol)	119.38	
n-Octanol/water partition coefficient (log K_{ow})	1.97 (shake flask-AS)	(Hansch et al., 1968)
	1.90 (shake flask LSC)	(Banerjee et al., 1980)
	2.15 (HPLC-k')	(Wells et al., 1981)
	2.14, 2.13, 2.03 (HPLC-k')	(Tomlinson and Hafkenscheid, 1986)
	1.94 (estimated-HPLC-k')	(Tomlinson and Hafkenscheid, 1986)
	1.52 (fragment constant estimate)	(U.S. EPA, 2004)
	1.95 (fragment constant estimate)	(BioByte, 2004)
	1.94 (in D_2O & D_2O saturated octanol)	(Jow and Hansch) in (BioByte, 2004)
	1.95 (labelled, in D_2O & D_2O saturated octanol)	(Jow and Hansch) in (BioByte, 2004)
	2.09 (infinite dilution activities)	(Tse and Sandler, 1994) in (BioByte, 2004)
	2.00	(Bhatia and Sandler, 1995) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.44 (20 ºC, soil, sand and loess)	(Grathwohl, 1990)
	1.98 (20 ºC, weathered shale, mudrock)	(Grathwohl, 1990)
	2.79 (20 ºC, unweathered shale and mudrock)	(Grathwohl, 1990)
	1.53 (soil)	(Howard, 1990)
	1.54	(U.S. EPA, 2004)
	1.57 (silty loam)	(Walton et al., 1992)
	1.46 (sandy loam)	(Walton et al., 1992)
	1.65	(Tao et al., 1999)
	2.20 (river Leie sediment, 2.3 ºC)	(Dewulf et al., 1999)
	2.24 (river Leie sediment, 3.8 ºC)	(Dewulf et al., 1999)
	2.24 (river Leie sediment, 6.2 ºC)	(Dewulf et al., 1999)
	2.25 (river Leie sediment, 8 ºC)	(Dewulf et al., 1999)
	2.28 (river Leie sediment, 13.5 ºC)	(Dewulf et al., 1999)
	2.27 (river Leie sediment, 18.6 ºC)	(Dewulf et al., 1999)
	2.33 (river Leie sediment, 25 ºC)	(Dewulf et al., 1999)
	1.69 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 1.97, predominantly hydrophobic)	
	2.27	(Environmental Quality Standards (EQS), 2004)
Vapour pressure (Pa)	21115 (20 ºC)	(Rex, 1906)
	31990 (30 ºC)	(Rex, 1906)
	27030 (25 ºC)	(Stull, 1947)
	26240 (25 ºC)	(McGlashan et al., 1954)

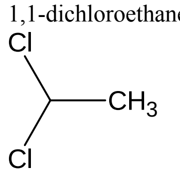
Properties	Value(s)	Reference
	26126 (25 ºC)	(Moelwyn-Hughes and Missen, 1957)
	26270 (25 ºC)	(Mueller and Kearns, 1958)
	25700 (25 ºC, Antoine eqn.)	(Stull, 1947)
	32790 (25 ºC)	(Gallant, 1966)
	26310 (25 ºC, Antoine eqn.)	(Dreisbach, 1959)
	26116 (25 ºC, Static method)	(Bissell and Williamson, 1975)
	20000 (20 ºC)	(Pearson and McConnell, 1975)
	32790 (20 ºC)	(Neely, 1976)
	26220 (25 ºC, Antoine eqn.)	(Boublik et al., 1984)
	32084 (25 ºC, Antoine eqn.)	(Boublik et al., 1984)
	26220 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	7279 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	314.1 (20 ºC)	(Dilling et al., 1975)
	293.4 (20 ºC)	(McConnell et al., 1975)
	486.3 (20 ºC)	(ESE (Environmental Science and Engineering, 1980)
	364.7 (20 ºC)	(Symons et al., 1981)
	536.9 (batch stripping)	(Munz and Roberts, 1982)
	237.4 (20 ºC)	(Lincoff and Gossett, 1984)
	308.0 (20 ºC, batch stripping)	(Lincoff and Gossett, 1984)
	303.9 (20 ºC, batch stripping)	(Nicholson et al., 1984)
	372.0	(Gossett, 1987)
	347.0	(Munz and Roberts, 1987)
	427.0	(Ashworth et al., 1988)
	326.3 (25 ºC, bond method)	(U.S. EPA, 2004)
	411.4 (25 ºC, group method)	(U.S. EPA, 2004)
	275 (20 ºC)	(Environmental Quality Standards (EQS), 2004)
Water solubility (mg/l)	8220 (20 ºC, volumetric)	(Rex, 1906)
	7760 (30 ºC, volumetric)	(Rex, 1906)
	7710 (30 ºC, shake flask interferometer)	(Gross and Saylor, 1931)
	8520 (15 ºC, shake flask interferometer)	(Gross and Saylor, 1931)
	8000 (25 ºC)	(Wright and Schaffer, 1932)
	7361 (25 ºC)	(Seidell, 1940)
	7700 (25 ºC)	(Seidell, 1941)
	7900 (25 ºC)	(McGovern, 1943)
	13320 (25 ºC)	(Booth and Everson, 1948)
	7950 (25 ºC)	(Marsden and Mann, 1962)
	8000 (20 ºC)	(Stephen and Stephen, 1963)
	8150 (20 ºC)	(Riddick and Bunger, 1970)
	8200 (20 ºC shake flask-GC)	(Pearson and McConnell, 1975)
	8000 (20 ºC)	(Neely, 1976)
	7230 (25 ºC, shake flask LSC)	(Banerjee et al., 1980)
	2525 (30 ºC, headspace GC)	(McNally and Grob, 1984)
	8200 (25 ºC, radiometric method)	(Lo et al., 1986)
	8668 (23-34 ºC, shake flask-GC)	(Broholm et al., 1992)
	8200 (19.6 ºC, shake flask GC/TC)	(Stephenson, 1992)
	7900 (29.5 ºC, shake flask GC/TC)	(Stephenson, 1992)
	5069 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	8630 (from fragments)	(U.S. EPA, 2004)

Table 2.6: General information and physical-chemical properties of tetrachloromethane (carbon-tetrachloride).

Properties	Value(s)	Reference
IUPAC	tetrachloromethane	
Structure		
CAS number	56-23-5	
EINECS number	200-262-8	
Empirical formula	CCl4	
Smiles code	C(Cl)(Cl)(Cl)Cl	
Molar Mass (g/mol)	153.82	
n-Octanol/water partition coefficient (log K_{ow})	2.64	(Macy, 1948)
	2.64	(Leo et al., 1971)
	2.62 (shake flask-GC)	(Chiou et al., 1977)
	2.83	(Hansch and Leo, 1979)
	2.73 (shake flask-LSC)	(Banerjee et al., 1980)
	2.73 (shake flask-LSC)	(Veith et al., 1980)
	2.94 (estimated-HPLC-k’)	(McDuffie, 1981)
	2.72, 2.83	(Geyer et al., 1984)
	2.03 (estimated-HPLC)	(Eadsforth, 1986)
	2.79	(Abernethy and Mackay, 1987)
	2.73 (estimated-HPLC-k’)	(Tomlinson and Hafkenscheid, 1986)
	2.44 (fragment constant estimate)	(U.S. EPA, 2004)
	2.88 (fragment constant estimate)	(BioByte, 2004)
	2.89 (infinite dilution activities)	(Tse and Sandler, 1994) in (BioByte, 2004)
	2.73	(Bhatia and Sandler, 1995) in (BioByte, 2004)
	2.64	(Platford, 1979) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.26 (DTMA-clay)	(Smith et al., 1990)
	1.34 (TTMA-clay)	(Smith et al., 1990)
	1.70 (HTMA-clay)	(Smith et al., 1990)
	1.96 (BDHA-clay)	(Smith et al., 1990)
	2.07 (DDPA-clay)	(Smith et al., 1990)
	1.69 (20 ºC, 80%DTMA-clay)	(Smith and Jaffé, 1991)
	1.69	(U.S. EPA, 2004)
	2.16 (silty loam)	(Walton et al., 1992)
	1.69 (sandy loam)	(Walton et al., 1992)
	1.85	(Tao et al., 1999)
	3.50	(Bahnick and Doucette, 1988)
	1.26 (North Sea Sediment)	(Dewulf et al., 1996)
	2.39 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 2.83, predominantly hydrophobic)	
Vapour pressure (Pa)	17170 (20 ºC)	(Rex, 1906)
	18810 (30 ºC)	(Rex, 1906)
	15184 (25 ºC)	(Scatchard et al., 1939)
	14530 (25 ºC)	(McGovern, 1943)
	14340 (25 ºC, Antoine eqn.)	(Stull, 1947)
	15193 (25 ºC)	(McGlashan et al., 1954)
	15096 (25 ºC)	(Moelwyn-Hughes and Missen, 1957)
	155356 (25 ºC, Antoine eqn.)	(Dreisbach, 1959)
	15220 (25 ºC)	(Hildenbrand and McDonald, 1959)
	15230 (25 ºC)	(Marsh, 1986)
	13190 (25 ºC, Antoine eqn.)	(Weast, 1972-1973)
	15190 (25 ºC, Static method)	(Bissell and Williamson, 1975)
	12000 (20 ºC)	(Pearson and McConnell, 1975)
	12130 (20 ºC)	(Neely, 1976)
	15226 (25 ºC, Antoine eqn.)	(Boublik et al., 1984)
	15170 (25 ºC)	(Daubert and Danner, 1985)

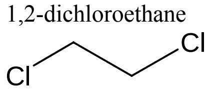
Properties	Value(s)	Reference
	15060 (25 ºC)	(Gossett, 1987)
	15214 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	11452 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	2216 (20 ºC)	(McConnell et al., 1975)
	2000	(Dilling, 1977)
	2776 (batch stripping)	(Mackay et al., 1979)
	2454 (20 ºC, batch stripping)	(Munz and Roberts, 1982)
	3081 (20 ºC)	(Lincoff and Gossett, 1983)
	2930 (20 ºC)	(Ashworth, 1986)
	3080	(Gossett, 1987)
	2367 (20 ºC)	(Gossett, 1987)
	3027	(Munz and Roberts, 1987)
	2281 (20 ºC)	(Yurteri et al., 1987)
	2989	(Ashworth et al., 1988)
	2875 (purge & trap-GC-ECD)	(Tancréde and Yanagisawa, 1990)
	2067 (20 ºC)	(Tse et al., 1992)
	3413 (30 ºC)	(Tse et al., 1992)
	2573 (25 ºC, bond method)	(U.S. EPA, 2004)
	3040 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	800 (20 ºC, volumetric)	(Rex, 1906)
	850 (30 ºC, volumetric)	(Rex, 1906)
	770 (25 ºC)	(Gross, 1929b; Gross, 1929a)
	770 (15 ºC, shake flask-interferometer)	(Gross and Saylor, 1931)
	810 (30 ºC, shake flask-interferometer)	(Gross and Saylor, 1931)
	800 (20 ºC)	(Smith, 1932)
	771 (25 ºC)	(Seidell, 1940)
	780 (25 ºC)	(Seidell, 1941)
	800 (25 ºC)	(McGovern, 1943)
	770 (15 ºC)	(Jones et al., 1957)
	762 (25 ºC)	(Liu and Huang, 1961)
	800 (20 ºC)	(Metcalf, 1962)
	810 (15 ºC)	(Svetlanov et al., 1971)
	762 (25 ºC)	(Gmelins, 1974)
	800 (20 ºC)	(Neely et al., 1974)
	785 (20 ºC, shake flask-GC)	(McConnell et al., 1975)
	800 (25 ºC GC/ECD)	(Dilling, 1977)
	788 (20 ºC)	(Selenka and Bauer, 1987)
	870 (25 ºC)	(Aref'eva et al., 1979)
	757 (25 ºC, shake flask-LSC)	(Banerjee et al., 1980)
	800 (25 ºC, radiometric method)	(Lo et al., 1986)
	780 (23-24 ºC, shake flask-GC)	(Broholm et al., 1992)
	600 (20.5 ºC, shake flask-GC/TC)	(Stephenson, 1992)
	720 (31.0 ºC, shake flask-GC/TC)	(Stephenson, 1992)
	599 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	1721 (from fragments)	(U.S. EPA, 2004)

Table 2.7: General information and physical-chemical properties of 1,1-dichloroethane.

Properties	Value(s)	Reference
IUPAC Name	1,1-dichloroethane	
Structure		
CAS number	75-34-3	
EINECS number	200-863-5	
Empirical formula	C2H4Cl2	
Smiles code	C(Cl)(Cl)C	
Molar Mass (g/mol)	98.96	
n-Octanol/water partition coefficient (log K_{ow})	1.79 (shake flask GC)	(Hansch et al., 1975)

Properties	Value(s)	Reference
	1.92	(Hansch and Leo, 1979)
	1.76 (fragment constant estimate)	(U.S. EPA, 2004)
	1.78 (fragment constant estimate)	(BioByte, 2004)
	1.89 (infinite dilution activities)	(Tse and Sandler, 1994) in (BioByte, 2004)
	1.82	(Bhatia and Sandler, 1995) in (BioByte, 2004)
	1.68	(Bhatia and Sandler, 1995) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.54	(U.S. EPA, 2004)
	1.48	(Tao et al., 1999)
	1.43 (river Leie sediment, 2.3 ºC)	(Dewulf et al., 1999)
	1.46 (river Leie sediment, 3.8 ºC)	(Dewulf et al., 1999)
	1.43 (river Leie sediment, 6.2 ºC)	(Dewulf et al., 1999)
	1.48 (river Leie sediment, 8 ºC)	(Dewulf et al., 1999)
	1.50 (river Leie sediment, 13.5 ºC)	(Dewulf et al., 1999)
	1.49 (river Leie sediment, 18.6 ºC)	(Dewulf et al., 1999)
	1.55 (river Leie sediment, 25 ºC)	(Dewulf et al., 1999)
	1.06 (North Sea Sediment)	(Dewulf et al., 1996)
	1.55 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 1.79, predominantly hydrophobic)	
Vapour pressure (Pa)	24274 (20 ºC) 36950 (30 ºC)	(Rex, 1906)
	29810 (25 ºC, Antoine eqn.)	(Stull, 1947)
	25930 (25 ºC, Antoine eqn.)	(Weast, 1972-1973)
	30260 (25 ºC, Antoine eqn.)	(Boublik et al., 1973)
	30100 (25 ºC)	(Neely, 1976)
	30100 (25 ºC)	(Dilling, 1977)
	30260 (25 ºC)	(Boublik et al., 1984)
	30360 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	23331 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	569.0	(Gossett, 1987)
	466.0 (20 ºC)	(Tse et al., 1992)
	709.2 (30 ºC)	(Tse et al., 1992)
	1226 (25 ºC, bond method)	(U.S. EPA, 2004)
	483 (25 ºC, group methods)	(U.S. EPA, 2004)
Water solubility (mg/l)	5500 (20 ºC, volumetric)	(Rex, 1906)
	5400 (30 ºC, volumetric)	(Rex, 1906)
	5060 (25 ºC)	(Gross, 1929b; Gross, 1929a)
	5555 (25 ºC)	(Wright and Schaffer, 1932)
	5075 (25 ºC)	(Seidell, 1940)
	5060 (25 ºC)	(Seidell, 1941)
	5100 (25 ºC)	(Neely, 1976)
	4842 (25 ºC)	(Nirmalakhandan and Speece, 1988)
	5495 (25 ºC)	(Isnard and Lambert, 1989)
	3712 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	6614 (from fragments)	(U.S. EPA, 2004)

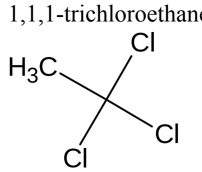
Table 2.8: General information and physical-chemical properties of 1,2-dichloroethane.

Properties	Value(s)	Reference
IUPAC Name	1,2-dichloroethane	
Structure		
CAS number	107-06-2	
EINECS number	203-458-1	
Empirical formula	C2H4Cl2	
Smiles code	ClCCCl	
Molar Mass (g/mol)	98.96	
n-Octanol/water partition coefficient (log K_{ow})	1.48 (shake flask-GC)	(Leo et al., 1975)
	1.48	(Radding et al., 1977)
	1.48	(Hansch and Leo, 1979)
	1.45 (shake flask-LSC)	(Banerjee et al., 1980)

Properties	Value(s)	Reference
	1.45	(Veith et al., 1980)
	1.54 (octanol & water mutual solubility considered)	(Arbuckle, 1983)
	1.45	(Mackay et al., 2000)
	1.76	(Abernethy et al., 1988)
	1.83 (fragment constant estimate)	(U.S. EPA, 2004)
	1.46 (fragment constant estimate)	(BioByte, 2004)
	1.47 (both phases analyzed)	(Jow and Hansch) in (BioByte, 2004)
	1.55 (infinite dilution activities)	(Tse and Sandler, 1994) in (BioByte, 2004)
	1.51	(Bhatia and Sandler, 1995) in (BioByte, 2004)
	1.53	(Bhatia and Sandler, 1995) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.51	(Karickhoff, 1981)
	1.09	(Mackay et al., 2000)
	1.64	(U.S. EPA, 2004)
	1.56	(Tao et al., 1999)
	1.64 (river Leie sediment, 2.3 ºC)	(Dewulf et al., 1999)
	1.65 (river Leie sediment, 3.8 ºC)	(Dewulf et al., 1999)
	1.64 (river Leie sediment, 6.2 ºC)	(Dewulf et al., 1999)
	1.68 (river Leie sediment, 8 ºC)	(Dewulf et al., 1999)
	1.70 (river Leie sediment, 13.5 ºC)	(Dewulf et al., 1999)
	1.65 (river Leie sediment, 18.6 ºC)	(Dewulf et al., 1999)
	1.68 (river Leie sediment, 25 ºC)	(Dewulf et al., 1999)
	1.28 (silt loam, 20 ºC)	(Chiou et al., 1979),
	1.91 (sandy soil, room temp.)	(Kommalapati et al., 2002; Valsaraj et al., 1999)
	2.21 (clayey, room temp.)	(Kommalapati et al., 2002; Valsaraj et al., 1999)
	1.80 (silty clayey, room temp.)	(Kommalapati et al., 2002; Valsaraj et al., 1999)
	1.29 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 1.47, predominantly hydrophobic)	
	19-152	(Environmental Quality Standards (EQS), 2005b)
	11-220	(Environmental Quality Standards (EQS), 2005b)
Vapour pressure (Pa)	8131 (20 ºC)	(Rex, 1906)
	12983 (30 ºC)	(Rex, 1906)
	10740 (25 ºC, Antoine eqn.)	(Stull, 1947)
	10704 (25 ºC, Antoine eqn.)	(Dreisbach, 1959)
	10154 (25 ºC, Antoine eqn.)	(Weast, 1972-1973)
	10536 (25 ºC, Antoine eqn.)	(Boublik et al., 1973)
	8520 (25 ºC)	(McConnell et al., 1975)
	8400 (25 ºC)	(Pearson and McConnell, 1975)
	8500 (20 ºC)	(Ullmann, 1975)
	8930 (20 ºC)	(Neely, 1976)
	10490 (25 ºC)	(Boublik et al., 1984)
	11109 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	10462 (25 ºC, resistance measurements Antoine eqn.)	(Foco et al., 1992)
	4080 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	99.00	(Dilling, 1977)
	112.5	(Gossett, 1987)
	143.00	(Ashworth et al., 1988)
	101.3 (20 ºC)	(Tse et al., 1992)
	152.0 (30 ºC)	(Tse et al., 1992)
	1226 (25 ºC, bond method)	(U.S. EPA, 2004)
	19.6 (25 ºC, group method)	(U.S. EPA, 2004)
	110	(Environmental Quality Standards (EQS), 2005b)
Water solubility (mg/l)	8690 (20 ºC)	(Rex, 1906)

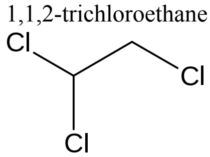
Properties	Value(s)	Reference
	8940 (30 ºC)	(Rex, 1906)
	8650 (25 ºC)	(Gross, 1929b)
	8720 (15 ºC)	(Gross and Saylor, 1931)
	9000 (30 ºC)	(Gross and Saylor, 1931)
	8696 (25 ºC)	(Wright and Schaffer, 1932)
	8620 (25 ºC)	(Seidell, 1940)
	8690 (25 ºC)	(CRC , 1962)
	8800 (25 ºC, shake flask-GC)	(McConnell et al., 1975)
	8000 (20 ºC)	(Pearson and McConnell, 1975)
	8000 (20 ºC)	(Neely, 1976)
	8700 (25 ºC)	(Dilling, 1977)
	7987 (25 ºC, shake flask-LSC)	(Banerjee et al., 1980)
	8524 (25 ºC)	(Horvath, 1982)
	8100 (25 ºC)	(Dean, 1985)
	8511 (25 ºC)	(Isnard and Lambert, 1989; Isnard and Lambert, 1988)
	7200 (19.7 ºC, shake flask-GT/TC)	(Stephenson, 1992)
	8100 (29.7 ºC, shake flask-GT/TC)	(Stephenson, 1992)
	3213 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	3947 (from fragments)	(U.S. EPA, 2004)

Table 2.9: General information and physical-chemical properties of 1,1,1-trichloroethane.

Properties	Value(s)	Reference
IUPAC Name	1,1,1-trichloroethane	
Structure		
CAS number	71-55-6	
EINECS number	200-756-3	
Empirical formula	C2H3Cl3	
Smiles code	C(Cl)(Cl)(Cl)C	
Molar Mass (g/mol)	133.41	
n-Octanol/water partition coefficient (log K_{ow})	2.17	(Tute, 1971)
	2.49	(Hansch and Leo, 1979)
	2.47 (shake flask-LSC)	(Banerjee et al., 1980)
	2.47 (shake flask-LSC)	(Veith et al., 1980)
	2.49	(Abernethy et al., 1986)
	2.68 (fragment constant estimate)	(U.S. EPA, 2004)
	2.48 (fragment constant estimate)	(BioByte, 2004)
	2.60 (infinite dilution activities)	(Tse and Sandler, 1994) in (BioByte, 2004)
	2.47	(Bhatia and Sandler, 1995) in (BioByte, 2004)
	2.52	(Bhatia and Sandler, 1995) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	2.26 (20 ºC, soil)	(Chiou et al., 1988)
	1.65 (20 ºC, soil, sand & loess)	(Grathwohl, 1990)
	2.22 (20 ºC, weathered shale & mudrock)	(Grathwohl, 1990)
	3.02 (20 ºC, unweathered shale & mudrock)	(Grathwohl, 1990)
	1.69	(U.S. EPA, 2004)
	2.26	(Tao et al., 1999)
	2.26	(Bahnick and Doucette, 1988)
	1.95 (river Leie sediment, 2.3 ºC)	(Dewulf et al., 1999)
	1.98 (river Leie sediment, 3.8 ºC)	(Dewulf et al., 1999)
	1.98 (river Leie sediment, 6.2 ºC)	(Dewulf et al., 1999)
	1.99 (river Leie sediment, 8 ºC)	(Dewulf et al., 1999)
	2.01 (river Leie sediment, 13.5 ºC)	(Dewulf et al., 1999)
	1.98 (river Leie sediment, 18.6 ºC)	(Dewulf et al., 1999)
	1.03 (river Leie sediment, 25 ºC)	(Dewulf et al., 1999)
	2.02	(Chiou et al., 1979)

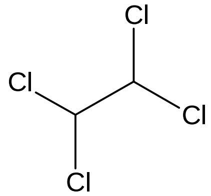
Properties	Value(s)	Reference
	1.59 (North Sea Sediment)	(Dewulf et al., 1996)
	2.12 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 2.49, predominantly hydrophobic)	
Vapour pressure (Pa)	16190 (25 ºC, Antoine eqn.)	(Stull, 1947)
	16445 (25 ºC, Antoine eqn.)	(Dreisbach, 1959)
	16170 (25 ºC, Antoine eqn.)	(Weast, 1972-1973)
	15330 (24 ºC)	(Weast, 1972-1973)
	17770 (25 ºC, Antoine eqn.)	(Boublik et al., 1973)
	12800 (20 ºC)	(Pearson and McConnell, 1975)
	13330 (20 ºC)	(Neely, 1976)
	16490 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	20932 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	3433 (20 ºC)	(McConnell et al., 1975)
	2025 (20 ºC, batch stripping)	(Mackay et al., 1979)
	1520 (20 ºC, batch stripping)	(Munz and Roberts, 1982)
	1743 (20 ºC)	(Lincoff and Gossett, 1983)
	1337 ((20 ºC)	(Lincoff and Gossett, 1984)
	1358 (20 ºC, batch stripping)	(Lincoff and Gossett, 1984)
	1735 (20 ºC)	(Ashworth, 1986)
	1345 (20 ºC)	(Gossett, 1987)
	1572 (20 ºC)	(Yurteri et al., 1987)
	1735	(Ashworth et al., 1988)
	1413	(Gossett, 1987)
	1276 (20 ºC)	(Tse et al., 1992)
	2026 (30 ºC)	(Tse et al., 1992)
	433 (25 ºC, bond method)	(U.S. EPA, 2004)
	1641 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	1320 (25 ºC)	(Van Arkel and Vles, 1936)
	1304 (25 ºC)	(Seidell, 1940)
	1300 (25 ºC)	(O'Connell, 1963)
	700 (25 ºC)	(Dow Chemical Company, 1972)
	1490 (25 ºC)	(Walraevens et al., 1974)
	1334 (25 ºC)	(Amidon et al., 1975)
	480 (20 ºC, shake flask-GC)	(Pearson and McConnell, 1975)
	260 (25 ºC)	(Aviado et al., 1976)
	700 (25 ºC)	(Archer and Stevens, 1977)
	730 (25 ºC)	(Dilling, 1977)
	1334 (25 ºC, shake flask-LSC)	(Banerjee et al., 1980)
	100 (25 ºC)	(Coca and Diaz, 1980)
	1850 (20 ºC, elution chromatography)	(Schwarz and Miller, 1980)
	1334 (25 ºC, shake flask-LSC)	(Veith et al., 1980)
	479.8 (30 ºC, headspace-GC)	(McNally and Grob, 1984)
	1252 (23-24 ºC, shake flask-GC)	(Broholm et al., 1992)
	700 (20.2 ºC, shake flask-GC/TC)	(Stephenson, 1992)
	760 (31.6 ºC, shake flask-GC/TC)	(Stephenson, 1992)
	1250 (25 ºC, shake flask-GC)	(Broholm and Feenstra, 1995)
	459 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	1380 (from fragments)	(U.S. EPA, 2004)

Table 2.10: General information and physical-chemical properties of 1,1,2-trichloroethane.

Properties	Value(s)	Reference
IUPAC Name	1,1,2-trichloroethane	
Structure		
CAS number	79-00-5	
EINECS number	201-166-9	
Empirical formula	C2H3Cl3	
Smiles code	C(Cl)(Cl)CCl	
Molar Mass (g/mol)	133.41	

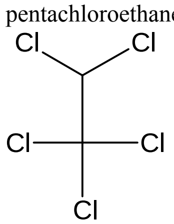
Properties	Value(s)	Reference
n-Octanol/water partition coefficient (log K_{ow})	2.38	(Hansch and Leo, 1979)
	2.01 (fragment constant estimate)	(U.S. EPA, 2004)
	2.05 (fragment constant estimate)	(BioByte, 2004)
	1.89	(Huang and Hansch) in (BioByte, 2004)
	2.07 (infinite dilution activities)	(Tse and Sandler, 1994) in (BioByte, 2004)
	1.98	(Bhatia and Sandler, 1995) in (BioByte, 2004)
	2.63	(Bhatia and Sandler, 1995) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.845 (sandy soil column)	(Wilson et al., 1981)
	1.83	(U.S. EPA, 2004)
	1.75	(Tao et al., 1999)
	2.07 (sandy soil, room temp.)	(Kommalapati et al., 2002; Valsaraj et al., 1999)
	2.28 (clayey soil, room temp.)	(Kommalapati et al., 2002; Valsaraj et al., 1999)
	1.96 (silty clayey soil, room temp.)	(Kommalapati et al., 2002; Valsaraj et al., 1999)
	1.78 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 2.07, predominantly hydrophobic)	
Vapour pressure (Pa)	3090 (25 ºC, Antoine eqn.)	(Stull, 1947)
	2998 (25 ºC, Antoine eqn.)	(Dreisbach, 1959)
	3088 (25 ºC, Antoine eqn.)	(Weast, 1972-1973)
	2913 (25 ºC, Antoine eqn.)	(Boublik et al., 1973)
	4040 (25 ºC)	(Dilling, 1977)
	3218 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	1480 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	81.1 (20 ºC)	(Gossett, 1987)
	92.2	(Ashworth et al., 1988)
	70.92 (20 ºC)	(Tse et al., 1992)
	115.5 (30 ºC)	(Tse et al., 1992)
	433 (25 ºC, bond method)	(U.S. EPA, 2004)
	10.33 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	3704 (25 ºC)	(Wright and Schaffer, 1932)
	4580 (25 ºC)	(Van Arkel and Vles, 1936)
	4418 (25 ºC)	(Seidell, 1940)
	4400 (25 ºC)	(McGovern, 1943)
	4500 (18.9 ºC)	(Gladis, 1960)
	4380 (25 ºC)	(Walraevens et al., 1974)
	4365 (30 ºC, headspace-GC)	(McNally and Grob, 1984)
	4800 (25 ºC)	(Dean, 1985)
	4580 (31.3 ºC, shake flask-GC/TC)	(Stephenson, 1992)
	1705 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	2801 (from fragments)	(U.S. EPA, 2004)

Table 2.11: General information and physical-chemical properties of 1,1,2,2-tetrachloroethane.

Properties	Value(s)	Reference
IUPAC Name	1,1,2,2-tetrachloroethane	
Structure		
CAS number	79-34-5	
EINECS number	201-197-8	
Empirical formula	C2H2Cl4	
Smiles code	C(Cl)(Cl)C(Cl)Cl	
Molar Mass (g/mol)	167.85	

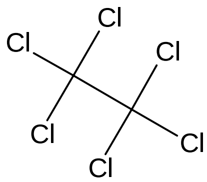
Properties	Value(s)	Reference
n-Octanol/water partition coefficient (log K_{ow})	2.39 (shake flask-LSC)	(Banerjee et al., 1980)
	2.39 (shake flask-LSC)	(Veith et al., 1980)
	3.01	(Abernethy and Mackay, 1987)
	2.19 (fragment constant estimate)	(U.S. EPA, 2004)
	2.64 (fragment constant estimate)	(BioByte, 2004)
	2.62	(Bhatia and Sandler, 1995) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.90 (silt loam)	(Chiou et al., 1979)
	2.03	(U.S. EPA, 2004)
	1.66 (silt loam, 20 ºC)	(Chiou et al., 1979)
	2.37 (sandy soil, room temp.)	(Kommalapati et al., 2002; Valsaraj et al., 1999)
	2.33 (clayey soil, room temp.)	(Kommalapati et al., 2002; Valsaraj et al., 1999)
	2.24 (silty clayey soil, room temp.)	(Kommalapati et al., 2002; Valsaraj et al., 1999)
	2.22 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 2.62, predominantly hydrophobic)	
Vapour pressure (Pa)	850 (25 ºC, Antoine eqn.)	(Stull, 1947)
	851 (25 ºC, Antoine eqn.)	(Weast, 1972-1973)
	582 (25 ºC, Antoine eqn.)	(Boublik et al., 1973)
	867 (25 ºC)	(Dilling, 1977)
	800 (25 ºC)	(Dilling, 1977)
	793 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	537 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	25.33	(Nicholson et al., 1984)
	30.39 (20 ºC)	(Tse et al., 1992)
	50.65 (30 ºC)	(Tse et al., 1992)
	153 (25 ºC, bond method)	(U.S. EPA, 2004)
	5.42 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	2857 (25 ºC)	(Wright and Schaffer, 1932)
	2880 (20 ºC)	(Van Arkel and Vles, 1936)
	2850 (25 ºC)	(Seidell, 1940)
	2900 (25 ºC)	(McGovern, 1943)
	3200 (25 ºC)	(Neely et al., 1974)
	480 (25 ºC)	(Afghan and Mackay, 1980)
	2970 ((25 ºC, shake flask-LSC)	(Banerjee et al., 1980)
	2960 (23.5 ºC, elution chromatograp.)	(Schwarz, 1980)
	3850 (20 ºC, elution chromatography)	(Schwarz and Miller, 1980)
	3670 (30 ºC, elution chromatography)	(Schwarz and Miller, 1980)
	2985 (25 ºC, shake flask-LSC)	(Veith et al., 1980)
	2915 (30 ºC, headspace-HC)	(McNally and Grob, 1984)
	2910 (20 ºC, shake flask-GC/TC)	(Stephenson, 1992)
	2920 (30 ºC, shake flask-GC/TC)	(Stephenson, 1992)
	844 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	1855 (from fragments)	(U.S. EPA, 2004)

Table 2.12: General information and physical-chemical properties of pentachloroethane.

Properties	Value(s)	Reference
IUPAC Name	pentachloroethane	
Structure		
CAS number	76-01-7	
EINECS number	200-925-1	
Empirical formula	C2HCl5	
Smiles code	C(C(Cl)Cl)(Cl)(Cl)Cl	
Molar Mass (g/mol)	202.30	

Properties	Value(s)	Reference
n-Octanol/water partition coefficient (log K_{ow})	2.89 (shake flask-LSC)	(Veith et al., 1980)
	3.21	(Veith and Kosian, 1983)
	3.58	(Abernethy et al., 1988)
	3.11 (fragment constant estimate)	(U.S. EPA, 2004)
	3.63 (fragment constant estimate)	(BioByte, 2004)
	3.22	(Gould and Hansch) in (BioByte, 2004)
	3.05 (HPLC, regression from log k)	(McDuffie, 1981) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	2.19	(U.S. EPA, 2004)
	2.71 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 3.22, predominantly hydrophobic)	
Vapour pressure (Pa)	596.3 (25 ºC, Antoine eqn.)	(Stull, 1947)
	595.8 (25 ºC, Antoine eqn.)	(Weast, 1972-1973)
	465.0 (25 ºC, Antoine eqn.)	(Boublik et al., 1973)
	467.0 (25 ºC)	(Boublik et al., 1984)
	624.9 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	483 (25 ºC, mean of Antoine & Grain method)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	53.7 (25 ºC, bond method)	(U.S. EPA, 2004)
	18.3 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	345 (25 ºC)	(Wright and Schaffer, 1932)
	463 (25 ºC)	(Seidell, 1940)
	500 (25 ºC)	(McGovern, 1943)
	470 (25 ºC)	(O'Connell, 1963)
	480 (25 ºC)	(Dilling et al., 1975)
	776 (25 ºC, shake flask-LC)	(Veith et al., 1980)
	500 (25 ºC)	(Dean, 1985)
	94 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	346 (from fragments)	(U.S. EPA, 2004)

Table 2.13: General information and physical-chemical properties of hexachloroethane.

Properties	Value(s)	Reference
IUPAC Name	hexachloroethane	
Structure		
CAS number	67-72-1	
EINECS number	200-666-4	
Empirical formula	C2Cl6	
Smiles code	C(Cl)(Cl)(Cl)C(Cl)(Cl)Cl	
Molar Mass (g/mol)	236.74	
n-Octanol/water partition coefficient (log K_{ow})	3.93 (shake flask-LSC)	(Veith et al., 1980)
	3.93	(Veith and Kosian, 1983)
	4.03 (fragment constant estimate)	(U.S. EPA, 2004)
	4.61 (fragment constant estimate)	(BioByte, 2004)
	4.14	(Chiou, 1985) in (BioByte, 2004)
	4.04 (HPLC, regression from log K)	(McDuffie, 1981) in (BioByte, 2004)
	3.82 (HPLC, regression from log K)	(Könemann et al., 1979) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	2.35	(U.S. EPA, 2004)
	3.34	(Tao et al., 1999)
	3.45 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 4.14, predominantly hydrophobic)	
Vapour pressure (Pa)	28.0 (20 ºC)	(Neely, 1976)
	44.0 (25 ºC)	(Dilling, 1977)
	49.5 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)

Properties	Value(s)	Reference
	435 (25 ºC, mean of Antoine & Grain method)	
Henry's law constant (Pa. m^3. mol^{-1})	424 (25 ºC, bond method)	(U.S. EPA, 2004)
	62 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	50 (22.3 ºC)	(Van Arkel and Vles, 1936)
	50 (22.3 ºC)	(McGovern, 1943)
	50 (22 ºC)	(Neely, 1976)
	8.0 (25 ºC)	(Dilling, 1977)
	27.2 (25 ºC, shake flask-LSC)	(Veith et al., 1980)
	10.0 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	62.7 (from fragments)	(U.S. EPA, 2004)

Table 2.14: General information and physical-chemical properties of 1,2-dichloropropane.

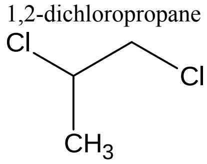
Properties	Value(s)	Reference
IUPAC Name	1,2-dichloropropane	
Structure		
CAS number	78-87-5	
EINECS number	201-152-2	
Empirical formula	C3H6Cl2	
Smiles code	C(C)(Cl)CCl	
Molar Mass (g/mol)	112.99	
n-Octanol/water partition coefficient (log K_{ow})	2.00	(Hansch and Leo, 1979)
	1.99	U.S. EPA 1987
	1.99 (fragment constant estimate)	(BioByte, 2004)
	2.25 (fragment constant estimate)	(U.S. EPA, 2004)
	1.99	(Bhatia and Sandler, 1995) in (BioByte, 2004)
	2.02	(Abraham et al., 1994) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.67 (silt loam soil)	(Chiou et al., 1979)
	1.83	(U.S. EPA, 2004)
	1.71	(Tao et al., 1999)
	1.43 (silt loam, 20 ºC)	(Chiou et al., 1979)
	1.71 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 1.99, predominantly hydrophobic)	
Vapour pressure (Pa)	7198 (25 ºC)	(Nelson and Young, 1933)
	6932 (25 ºC)	(McGovern, 1943)
	6777 (25 ºC, Antoine eqn.)	(Stull, 1947)
	6621 (25 ºC, Antoine eqn.)	(Dreisbach, 1959)
	6724 (25 ºC, Antoine eqn.)	(Boublik et al., 1973)
	6617 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	4746 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	287 (concentration ratio-GC)	(Leighton Jr. and Calo, 1981)
	1631 (25 ºC, bond method)	(U.S. EPA, 2004)
	31.9 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	2800 (25 ºC)	(Gross, 1929b)
	2700 (20 ºC)	(McGovern, 1943)
	2750 (25 ºC, measured by Dow)	(Dreisbach, 1955-1961)
	2096 (25 ºC, shake flask-GC)	(Jones et al., 1977-1987)
	2600 (25 ºC)	(Dean, 1985)
	3000 (20 ºC, shake flask-GC/TC)	(Stephenson, 1992)
	2900 (29.7 ºC, shake flask-GC/TC)	(Stephenson, 1992)
	1275 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	2193 (from fragments)	(U.S. EPA, 2004)

Table 2.15: General information and physical-chemical properties of 1,3-dichloropropane.

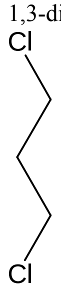
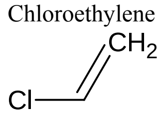
Properties	Value(s)	Reference
IUPAC Name	1,3-dichloropropane	
Structure		
CAS number	142-28-9	
EINECS number	205-531-3	
Empirical formula	C3H6Cl2	
Smiles code	C(CCl)CCl	
Molar Mass (g/mol)	112.99	
n-Octanol/water partition coefficient (log K_{ow})	2.32 (fragment constant estimate) 1.71 (fragment constant estimate) 2.0	(U.S. EPA, 2004) (BioByte, 2004) (Jow and Hansch) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.91 1.72 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 2.0, predominantly hydrophobic)	(U.S. EPA, 2004)
Vapour pressure (Pa)	1453 (25 ºC, mean of Antoine & Grain method)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	1631 (25 ºC, bond method) 27.8 (25 ºC, group method)	(U.S. EPA, 2004) (U.S. EPA, 2004)
Water solubility (mg/l)	1104 (25 ºC, from log K_{ow}) 1308 (25 ºC, from fragments)	(U.S. EPA, 2004) (U.S. EPA, 2004)

Table 2.16: General information and physical-chemical properties of chloroethylene (vinyl chloride).

Properties	Value(s)	Reference
IUPAC Name	Chloroethylene	
Structure		
CAS number	75-01-4	
EINECS number	200-831-0	
Empirical formula	C2H3Cl	
Smiles code	C(=C)Cl	
Molar Mass (g/mol)	62.50	
n-Octanol/water partition coefficient (log K_{ow})	0.60 1.380 1.62 (fragment constant estimate) 1.52 (fragment constant estimate) 2.79	(Callahan et al., 1979) (Hansch and Leo, 1985) (U.S. EPA, 2004) (BioByte, 2004) (Gould and Hansch) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.38 1.33 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 1.52, predominantly hydrophobic)	(U.S. EPA, 2004)
Vapour pressure (Pa)	538000 (25 ºC, Antoine eqn.) 354578 (25 ºC, Antoine eqn.) 546801 (25 ºC, Antoine eqn.) 392798 (25 ºC, Antoine eqn.) 309300 (25 ºC) 308000 (20 ºC) 344000 (20 ºC) 354600 (25 ºC) 207983 (25 ºC, mean of Antoine & Grain methods)	(Stull, 1947) (Dreisbach, 1959) (Weast, 1972-1973) (Boublik et al., 1973) (Pearson and McConnell, 1975) (Pearson and McConnell, 1975) (Neely, 1976) (Riddick et al., 1986) (U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	2817 2685	(Gossett, 1987) (Ashworth et al., 1988)

Properties	Value(s)	Reference
Water solubility (mg/l)	2230	(Pankow and Rosen, 1988)
	4499 (25 ºC, bond method)	(U.S. EPA, 2004)
	5674 (25 ºC, group method)	(U.S. EPA, 2004)
	2700 (25 ºC)	(Hayduk and Laudie, 1974)
	2700 (25 ºC)	(Dilling, 1977)
	90 (20 ºC)	(Neely, 1976)
	8800 (25 ºC, solubility bomb-GC head space)	(DeLassus and Schmidt, 1981)
	2763 (25 ºC)	(Horvath, 1982)
	1100 (25 ºC)	(Horvath, 1982)
	5631 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	4120 (from fragments)	(U.S. EPA, 2004)

Table 2.17: General information and physical-chemical properties of 1,1-dichloroethylene.

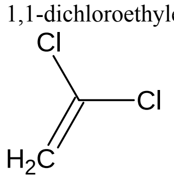
Properties	Value(s)	Reference
IUPAC Name	1,1-dichloroethylene	
Structure		
CAS number	75-35-4	
EINECS number	200-864-0	
Empirical formula	C2H2Cl2	
Smiles code	C(=C)(Cl)Cl	
Molar Mass (g/mol)	96.94	
n-Octanol/water partition coefficient (log K_{ow})	2.13	(Hansch and Leo, 1985)
	2.12 (fragment constant estimate)	(U.S. EPA, 2004)
	2.37 (fragment constant estimate)	(BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.54	(U.S. EPA, 2004)
	1.81	(Tao et al., 1999)
	1.83 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 2.13, predominantly hydrophobic)	
Vapour pressure (Pa)	86433 (25 ºC, Antoine eqn.)	(Stull, 1947)
	84500 (25 ºC, Antoine eqn.)	(Weast, 1972-1973)
	80042 (25 ºC, Antoine eqn.)	(Boublik et al., 1973)
	66195 (20 ºC)	(McConnell et al., 1975)
	65900 (20 ºC)	(Pearson and McConnell, 1975)
	79713 (25 ºC)	(Dilling, 1977)
	73400 (23 ºC)	(Schmidt-Bleek et al., 1982)
	78780 (25 ºC)	(IARC, 1986)
	80063 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	66128 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	3729 (20 ºC, batch stripping)	(Mackay et al., 1979)
	2649 (20 ºC)	(Lincoff and Gossett, 1983)
	2569 (20 ºC)	(Ashworth, 1986)
	7529	(Gossett, 1987)
	7529 (20 ºC)	(Yurteri et al., 1987)
	2320 (20 ºC)	(Tse et al., 1992)
	3414 (30 ºC)	(Tse et al., 1992)
	3232 (25 ºC, bond method)	(U.S. EPA, 2004)
	5421 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	400 (20 ºC)	(McConnell et al., 1975)
	400 (20 ºC)	(Dilling, 1977)
	2250 (25 ºC, solubility bomb-GC head space)	(DeLassus and Schmidt, 1981)
	210 (25 ºC, at saturation pressure)	(Horvath, 1982)
	3344 (25 ºC, at atmospheric pressure)	(Horvath, 1982)
	210 (25 ºC)	(Dean, 1985)
	1862 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	1655 (from fragments)	(U.S. EPA, 2004)

Table 2.18: General information and physical-chemical properties of 1,2-dichloroethylene.

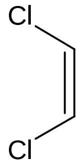
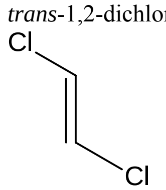
Properties	Value(s)	Reference
IUPAC Name	1,2-dichloroethylene	
Structure		
CAS number	540-59-0	
EINECS number	208-750-2	
Empirical formula	C2H2Cl2	
Smiles code	C(=CCl)Cl	
Molar Mass (g/mol)	96.94	
n-Octanol/water partition coefficient (log K_{ow})	1.98 (fragment constant estimate)	(U.S. EPA, 2004)
	1.77 (fragment constant estimate)	(BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.64	(U.S. EPA, 2004)
	1.61 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 1.86 (cis), predominantly hydrophobic)	
Vapour pressure (Pa)	35197 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	3232 (25 ºC, bond method)	(U.S. EPA, 2004)
	1966 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	2428 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	2153 (from fragments)	(U.S. EPA, 2004)

Table 2.19: General information and physical-chemical properties of trans-1,2-dichloroethylene.

Properties	Value(s)	Reference
IUPAC Name	*trans*-1,2-dichloroethylene	
Structure		
CAS number	156-60-5	
EINECS number	205-860-2	
Empirical formula	C2H2Cl2	
Smiles code	C(Cl)=CCl	
Molar Mass (g/mol)	96.94	
n-Octanol/water partition coefficient (log K_{ow})	2.06	(Hansch and Leo, 1985)
	1.98 (fragment constant estimate)	(U.S. EPA, 2004)
	1.77 (fragment constant estimate)	(BioByte, 2004)
	2.09	(Chan and Hansch) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.64	(U.S. EPA, 2004)
	1.77	(Tao et al., 1999)
	1.79 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 2.09, predominantly hydrophobic)	
Vapour pressure (Pa)	42177 (25 ºC, Antoine eqn.)	(Stull, 1947)
	43470 (25 ºC)	(Hardy, 1964)
	36743 (25 ºC, Antoine eqn.)	(Weast, 1972-1973)
	34650 (20 ºC)	(Neely, 1976)
	43456 (25 ºC)	(Dilling, 1977)
	44403 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	35197 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	950.5 (20 ºC)	(Lincoff and Gossett, 1983)
	940.8 (20 ºC)	(Ashworth, 1986)
	950	(Gossett, 1987)
	800.3 (20 ºC)	(Tse et al., 1992)
	1195 (30 ºC)	(Tse et al., 1992)
	3232 (25 ºC, bond method)	(U.S. EPA, 2004)

Properties	Value(s)	Reference
	1966 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	6259 (25 ºC)	(Seidell, 1940)
	6300 (25 ºC)	(McGovern, 1943)
	6300 (25 ºC)	(Dean, 1985)
	2428 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	2153 (from fragments)	(U.S. EPA, 2004)

Table 2.20: General information and physical-chemical properties of cis-1,2-dichloroethylene.

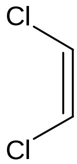
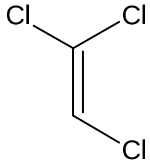
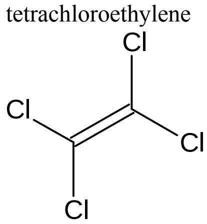
Properties	Value(s)	Reference
IUPAC Name	*cis*-1,2-dichloroethylene	
Structure		
CAS number	156-59-2	
EINECS number	205-859-7	
Empirical formula	C2H2Cl2	
Smiles code	C(=CCl)Cl	
Molar Mass (g/mol)	96.94	
n-Octanol/water partition coefficient (log K_{ow})	1.86	(Hansch and Leo, 1985)
	1.98 (fragment constant estimate)	(U.S. EPA, 2004)
	1.77 (fragment constant estimate)	(BioByte, 2004)
	1.86	(Chan and Hansch) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.64	(U.S. EPA, 2004)
	1.61 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 1.86, predominantly hydrophobic)	
Vapour pressure (Pa)	27261 (25 ºC, Antoine eqn.)	(Stull, 1947)
	23542 (25 ºC, Antoine eqn.)	(Weast, 1972-1973)
	27007 (25 ºC, Antoine eqn.)	(Boublik et al., 1973)
	26978 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	26660 (35 ºC)	(Riddick et al., 1986)
	35197 (mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	443.6 (20 ºC)	(Lincoff and Gossett, 1983)
	453.3 (20 ºC)	(Ashworth, 1986)
	299.8 (20 ºC)	(Gossett, 1987)
	413.0	(Gossett, 1987)
	441.1	(Yurteri et al., 1987)
	324.2 (20 ºC)	(Tse et al., 1992)
	496.4 (30 ºC)	(Tse et al., 1992)
	3232 (25 ºC, bond method)	(U.S. EPA, 2004)
	1966 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	3520 (25 ºC)	(Seidell, 1940)
	3500 (25 ºC)	(McGovern, 1943)
	7700 (25 ºC)	(Dean, 1985)
	2428 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	2153 (from fragments)	(U.S. EPA, 2004)

Table 2.21: General information and physical-chemical properties of trichloroethylene

Properties	Value(s)	Reference
IUPAC Name	trichloroethylene	
Structure		
CAS number	79-01-6	
EINECS number	201-167-4	
Empirical formula	C2HCl3	
Smiles code	C(=CCl)(Cl)Cl	
Molar Mass (g/mol)	131.39	
n-Octanol/water partition coefficient (log K_{ow})	2.37	(Leo et al., 1971)
	2.29	(Leo et al., 1971)
	2.61 (shake flask-GC/ECD)	(Chiou and Freed, 1977)
	2.42 (shake flask-LSC)	(Banerjee et al., 1980)
	2.53 (generator column-HPLC)	(Tewari et al., 1982)
	2.42	(Veith and Kosian, 1983)
	2.42	(Pavlou and Weston, 1983-1984)
	2.42	(Hansch and Leo, 1985)
	2.42	(Abernethy and Mackay, 1987), (Abernethy et al., 1988)
	2.47 (fragment constant estimate)	(U.S. EPA, 2004)
	2.63 (fragment constant estimate)	(BioByte, 2004)
	2.67	(Tse and Sandler, 1994) in (BioByte, 2004)
	2.29	(Glave and Hansch) in (BioByte, 2004)
	2.67	(Harnisch and Schulze, 1983) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	2.20	(Pavlou and Weston, 1983-1984)
	1.76 (ICN humic acid-coated Al2O3)	(Garbarini and Lion, 1985)
	2.20 (ICN humic acid-coated Al2O3)	(Garbarini and Lion, 1985)
	1.76 (Sapsucker Woods Humic acid)	(Garbarini and Lion, 1986)
	0.616 (Sapsucker Woods fulvic acid)	(Garbarini and Lion, 1986)
	1.238 (tanic acid)	(Garbarini and Lion, 1986)
	2.079 (lignin)	(Garbarini and Lion, 1986)
	2.045 (zein)	(Garbarini and Lion, 1986)
	0.30 (cellulose)	(Garbarini and Lion, 1986)
	1.827 (Aldrich humic acid)	(Garbarini and Lion, 1986)
	2.025 (Sapsucker Woods soil)	(Garbarini and Lion, 1986)
	2.086 (Sapsucker Woods ether-extracted soil)	(Garbarini and Lion, 1986)
	2.161 (humin)	(Garbarini and Lion, 1986)
	2.458 (oxidized humin)	(Garbarini and Lion, 1986)
	2.663 (fats waxes resins)	(Garbarini and Lion, 1986)
	2.03 (soil)	(Chiou et al., 1988)
	1.79 (20 ºC, humic acid)	(Peterson et al., 1988)
	2.09 (20 ºC, soil)	(Grathwohl, 1990)
	2.56 (20 ºC, weathered shale)	(Grathwohl, 1990)
	3.43 (20 ºC, unweathered shale)	(Grathwohl, 1990)
	2.20 (humic acid)	(Pavlostathis and Jaglal, 1991)
	1.78 (humic acid-coated Al2O3)	(Pavlostathis and Jaglal, 1991)
	2.03 (surface soil)	(Pavlostathis and Jaglal, 1991)
	2.00 (soil, organic component)	(Scheele, 1980) in (BioByte, 2004)
	1.52 (soil, organic component)	(Rutherford and Chiou, 1992) in (BioByte, 2004)
	1.83	(U.S. EPA, 2004)
	2.03	(Tao et al., 1999)
	2.00	(Bahnick and Doucette, 1988)
	2.23 (river Leie sediment, 2.3 ºC)	(Dewulf et al., 1999)
	2.33 (river Leie sediment, 3.8 ºC)	(Dewulf et al., 1999)
	2.35 (river Leie sediment, 6.2 ºC)	(Dewulf et al., 1999)
	2.34 (river Leie sediment, 8 ºC)	(Dewulf et al., 1999)

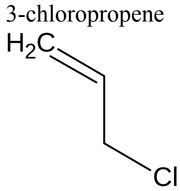
Properties	Value(s)	Reference
	2.34 (river Leie sediment, 13.5 ºC)	(Dewulf et al., 1999)
	2.36 (river Leie sediment, 18.6 ºC)	(Dewulf et al., 1999)
	2.41 (river Leie sediment, 25 ºC)	(Dewulf et al., 1999)
	1.68 (North Sea Sediment)	(Dewulf et al., 1996)
	2.21 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 2.61, predominantly hydrophobic)	
	1.96 (calculated from log K_{ow})	(EC, 2004b)
Vapour pressure (Pa)	9331 (25 ºC)	(McGovern, 1943)
	9735 (25 ºC, Antoine eqn.)	(Stull, 1947)
	9906 (25 ºC, Antoine eqn.)	(Dreisbach, 1959)
	9723 (25 ºC, Antoine eqn.)	(Weast, 1972-1973)
	9464 (25 ºC)	(Weast, 1972-1973)
	9224 (25 ºC, Antoine eqn.)	(Boublik et al., 1973)
	7998 (20 ºC)	(Perry and Chilton, 1973)
	9680 (25 ºC)	(Weast, 1973-1974)
	7700 (20 ºC)	(McConnell et al., 1975)
	8000 (20 ºC)	(Neely, 1976)
	9870 (25 ºC)	(Dilling, 1977)
	9198 (25 ºC, Antoine eqn.)	(Boublik et al., 1984)
	9911 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	9691 (25 ºC, resistance measurement Antoine eqn.)	(Foco et al., 1992)
	10639 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	904 (20 ºC)	(Dilling, 1977)
	984.7 (20 ºC, batch stripping)	(Mackay et al., 1979)
	989 (concentration ratio-GC)	(Leighton Jr. and Calo, 1981)
	999.3 (20 ºC, batch stripping)	(Munz and Roberts, 1982)
	970.0 (20 ºC)	(Lincoff and Gossett, 1983)
	774.0 (20 ºC)	(Lincoff and Gossett, 1984)
	682.8 (20 ºC, batch stripping)	(Lincoff and Gossett, 1984)
	1185 (adsorption isotherm)	(Urano and Murata, 1985)
	1016 (20 ºC)	(Ashworth, 1986)
	797.0 (20 ºC, multiple equilibration)	(Munz and Roberts, 1986)
	728.7 (20 ºC)	(Gossett, 1987)
	949.4	(Munz and Roberts, 1987)
	1048 (20 ºC)	(Yurteri et al., 1987)
	768.4 (purge & trap method)	(Tancréde and Yanagisawa, 1990)
	809.9 (22 ºC, shower spray data)	(Giardino et al., 1992)
	709.2 (20 ºC)	(Tse et al., 1992)
	1155 (30 ºC)	(Tse et al., 1992)
	2330 (25 ºC, bond method)	(U.S. EPA, 2004)
	1885 (25 ºC, group method)	(U.S. EPA, 2004)
	1030 (calculated)	(EC, 2004b)
Water solubility (mg/l)	1818 (25 ºC)	(Wright and Schaffer, 1932)
	997 (25 ºC)	(Seidell, 1940)
	1100 (25 ºC)	(McGovern, 1943)
	1000 (25 ºC)	(Lange, 1956)
	1288 (25 ºC)	(Vallaud et al., 1957)
	1100 (25 ºC)	(Sconce, 1962)
	1100 (25 ºC)	(O'Connell, 1963)
	1000 (25 ºC)	(Neely et al., 1974)
	1100 (20 ºC)	(McConnell et al., 1975)
	1000 (25 ºC)	(Aviado et al., 1976)
	1500 (25 ºC, shake flask-GC/ECD)	(Chiou and Freed, 1977)
	1100 (20 ºC, GC/ECD)	(Dilling, 1977)
	1472 (25 ºC, shake flask-LSC)	(Banerjee et al., 1980)
	1474 (25 ºC, shake flask-LSC)	(Veith et al., 1980)
	1366 (25 ºC, generator column-HPLC)	(Tewari et al., 1982)
	743.1 (30 ºC, headspace-GC)	(McNally and Grob, 1984)
	1421 (23-24 ºC, shake flask-GC)	(Broholm et al., 1992)
	701.5 (25 ºC, from log K_{ow}	(U.S. EPA, 2004)
	755.9 (from fragments)	(U.S. EPA, 2004)

Table 2.22: General information and physical-chemical properties of tetrachloroethylene.

Properties	Value(s)	Reference
IUPAC Name	tetrachloroethylene	
Structure		
CAS number	127-18-4	
EINECS number	204-825-9	
Empirical formula	C2Cl4	
Smiles code	C(Cl)(Cl)=C(Cl)Cl	
Molar Mass (g/mol)	165.83	
n-Octanol/water partition coefficient (log K_{ow})	2.88	(Neely et al., 1974)
	2.60	(Kenaga, 1975; Kenaga, 1980)
	2.60	(Chiou et al., 1977)
	2.60	(Hansch and Leo, 1979)
	2.53 (shake flask-LSC)	(Banerjee et al., 1980)
	2.53 (shake flask-LSC)	(Veith et al., 1980)
	2.67 (estimated-RP HPLC)	(Veith et al., 1980)
	2.88	(Mackay, 1982)
	2.53	(Veith and Kosian, 1983)
	2.88	(Veith and Kosian, 1983)
	2.39	(THOR, 1986)
	2.97 (fragment constant estimate)	(U.S. EPA, 2004)
	3.48 (fragment constant estimate)	(BioByte, 2004)
	3.40	(Gould and Hansch) in (BioByte, 2004)
	3.78 (HPLC, regression from log P)	(McDuffie, 1981) in (BioByte, 2004)
	3.50 (HPLC)	(Brooke and Dobbs, 1986) in (BioByte, 2004)
	2.88	(Kenaga and Goring,) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	2.32	(Chiou et al., 1979)
	2.04	(Schwarzenbach and Westall, 1981)
	2.56 (soil)	(Chiou et al., 1988)
	2.64 (20 ºC, soil, sand & loess)	(Grathwohl, 1990)
	3.29 (20 ºC, weathered shale & mudrock)	(Grathwohl, 1990)
	4.03 (20 ºC, unweathered shale & mudrock)	(Grathwohl, 1990)
	2.39 (20 ºC)	(Grathwohl, 1990)
	2.45 (2.57 % organic carbon in surface soil)	(Pignatello, 1990) (Pignatello, 1991)
	3.60 (borden organic phase with no mineral sorption)	(Ball and Roberts, 1991)
	2.90 (borden organic phase with no mineral sorption but with Curtis et al. 1986 correlation)	(Ball and Roberts, 1991)
	2.03	(U.S. EPA, 2004)
	2.56	(Tao et al., 1999)
	2.62 (river Leie sediment, 2.3 ºC)	(Dewulf et al., 1999)
	2.79 (river Leie sediment, 3.8 ºC)	(Dewulf et al., 1999)
	2.74 (river Leie sediment, 6.2 ºC)	(Dewulf et al., 1999)
	2.80 (river Leie sediment, 8 ºC)	(Dewulf et al., 1999)
	2.85 (river Leie sediment, 13.5 ºC)	(Dewulf et al., 1999)
	2.78 (river Leie sediment, 18.6 ºC)	(Dewulf et al., 1999)
	2.83 (river Leie sediment, 25 ºC)	(Dewulf et al., 1999)
	2.30 (silt loam, 20 ºC)	(Chiou et al., 1979)
	2.26 (North Sea Sediment)	(Dewulf et al., 1996)
	2.85 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 3.4, predominantly hydrophobic)	

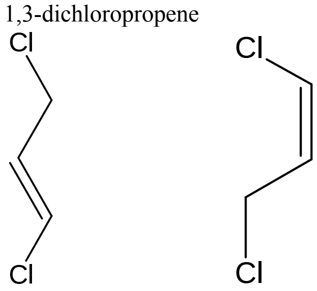
Properties	Value(s)	Reference
	2.40	(EC, 2005)
Vapour pressure (Pa)	2666 (25 ºC)	(McGovern, 1943)
	2397 (25 ºC, Antoine eqn.)	(Stull, 1947)
	2462 (25 ºC, Antoine eqn.)	(Dreisbach, 1959)
	2394 (25 ºC, Antoine eqn.)	(Weast, 1972-1973)
	2359 (25 ºC)	(Weast, 1972-1973)
	1866 (20 ºC)	(McConnell et al., 1975)
	1906 (20 ºC)	(Neely, 1976)
	2480 (25 ºC)	(Dilling, 1977)
	2417, 2456 (25 ºC, Antoine eqn.)	(Boublik et al., 1984)
	2465 (25 ºC)	(Daubert and Danner, 1985)
	2415 (25 ºC, Antoine eqn.)	(Stephenson and Malanowski, 1987)
	3186 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	1998 (20 ºC)	(McConnell et al., 1975)
	1621 (20 ºC , batch stripping)	(Mackay et al., 1979)
	1528 (20 ºC, batch stripping)	(Munz and Roberts, 1982)
	1316 (20 ºC)	(Lincoff and Gossett, 1983)
	1317 (20 ºC)	(Lincoff and Gossett, 1984)
	1175 (20 ºC, batch stripping)	(Lincoff and Gossett, 1984)
	1694 (20 ºC)	(Ashworth, 1986)
	1445 (20 ºC, multiple equilibration)	(Munz and Roberts, 1986)
	1338 (20 ºC)	(Gossett, 1987)
	1852	(Gossett, 1987)
	1762	(Munz and Roberts, 1987)
	1304 (20 ºC)	(Yurteri et al., 1987)
	1363 (purge & trap-GC/ECD)	(Tancréde and Yanagisawa, 1990)
	1672 (25 ºC, bond method)	(U.S. EPA, 2004)
	1793 (25 ºC, group method)	(U.S. EPA, 2004)
	2114 (20 ºC)	(EC, 2005
Water solubility (mg/l)	150 (25 ºC)	(McGovern, 1943)
	150 (25 ºC)	(Irmann, 1965)
	200 (25 ºC)	(Günther et al., 1968)
	150 (25 ºC)	(Miller, 1969)
	150 (25 ºC)	(Riddick and Bunger, 1970)
	150 (25 ºC)	(Hancock, 1973)
	400 (25 ºC)	(Neely et al., 1974)
	400 (25 ºC)	(Kenaga, 1975)
	400 (25 ºC)	(Matthews, 1975)
	150 (20 ºC, shake flask-GC)	(McConnell et al., 1975)
	200 (20 ºC, shake flask-GC)	(Chiou et al., 1977)
	486 (25 ºC, shake flask-LSC)	(Banerjee et al., 1980)
	478 (25 ºC, shake flask-LSC)	(Veith et al., 1980)
	400 (25 ºC)	(Dean, 1985)
	242 (23-24 ºC, shake flask-GC)	(Broholm et al., 1992)
	286 (19.5 ºC, 31.3 ºC, shake flask-GC/TC)	(Stephenson, 1992)
	188.8 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	247 (from fragments)	(U.S. EPA, 2004)

Table 2.23: General information and physical-chemical properties of 3-chloropropene.

Properties	Value(s)	Reference
IUPAC Name	3-chloropropene	
Structure		
CAS number	107-05-1	
EINECS number	203-457-6	
Empirical formula	C3H5Cl	
Smiles code	C(=C)CCl	
Molar Mass (g/mol)	76.53	

Properties	Value(s)	Reference
n-Octanol/water partition coefficient (log K_{ow})	1.93 (fragment constant estimate)	(U.S. EPA, 2004)
	1.51 (fragment constant estimate)	(BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.64	(U.S. EPA, 2004)
	1.32 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 1.51, predominantly hydrophobic)	
Vapour pressure (Pa)	24664 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	3455 (25 ºC, bond method)	(U.S. EPA, 2004)
	942 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	2968 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	2920 (from fragments)	(U.S. EPA, 2004)

Table 2.24: General information and physical-chemical properties of 1,3-dichloropropene.

Properties	Value(s)	Reference
IUPAC Name	1,3-dichloropropene	
Structure	 *Cis* *Trans*	
CAS number	542-75-6 (*cis*) 10061-02-6 (*trans*)	
EINECS number	208-826-5 (*cis*) 208-862-5 (*trans*)	
Empirical formula	C3H4Cl2	
Smiles code	C(CCl)=CCl (*cis*) C(=CCl)CCl (*trans*)	
Molar Mass (g/mol)	110.97	
n-Octanol/water partition coefficient (log K_{ow})	2.29 (fragment constant estimate)	(U.S. EPA, 2004)
	1.76 (fragment constant estimate)	(BioByte, 2004)
	1.82 (*cis*)	(Tomlin, 2002)
	2.28 (*cis*)	(Mackay et al., 1993) in (BioByte, 2004)
	1.98 (*cis*)	(Mills et al., 1982)
	2.03 (25 ºC)	(Tomlin, 2002)
	1.505 (*cis*)	(Wauchope et al., 1992)
Soil/sediment water sorption coefficient (log K_{oc})	1.91	(U.S. EPA, 2004)
	1.41 (trans)	(Tao et al., 1999)
	1.67 (sandy loam, 20 ºC) (*trans*)	(Kim et al., 2003)
	1.59 (sandy loam, 20 ºC) (*trans*)	(Kim et al., 2003)
	1.62 (sandy loam, 20 ºC) (*trans*)	(Kim et al., 2003)
	1.71 (sandy loam, 20 ºC) (*trans*)	(Kim et al., 2003)
	1.69 (sandy loam, 20 ºC) (*cis*)	(Kim et al., 2003)
	1.59 (sandy loam, 20 ºC) (*cis*)	(Kim et al., 2003)
	1.64 (sandy loam, 20 ºC) (*cis*)	(Kim et al., 2003)
	1.69 (sandy loam, 20 ºC) (*cis*)	(Kim et al., 2003)
	1.36 (soil, organic component) (*cis*)	(Kenaga, 1980) in (BioByte, 2004)
	1.41 (soil, organic component) (*cis*)	(Kenaga, 1980) in (BioByte, 2004)
	1.57 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 1.82, predominantly hydrophobic)	
Vapour pressure (Pa)	3560 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
	4533 (*trans*)	(Dilling, 1977)
	5733 (*cis*)	(Dilling, 1977)
	3333 (20°C, selected)	(Mills et al., 1982)
	3866 (20°C)	(Wauchope et al., 1992)

Properties	Value(s)	Reference
Henry's law constant (Pa. m^3. mol^{-1})	2482 (25 ºC, bond method)	(U.S. EPA, 2004)
	326.3 (25 ºC, group method)	(U.S. EPA, 2004)
Water solubility (mg/l)	2800 (25 ºC) (*cis*)	(Dilling, 1977)
	1071 (25 ºC, headspace-GC) (*cis*)	(McNally and Grob, 1983)
	1020 (30 ºC, headspace-GC) (*cis*)	(McNally and Grob, 1983)
	4531 (20 ºC) (*cis*)	(Wright et al., 1992)
	1196 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	1427 (from fragments)	(U.S. EPA, 2004)
	2700 (25 ºC) (*trans*)	(Dilling, 1977)
	1088 (25 ºC, headspace-GC) (*trans*)	(McNally and Grob, 1983)
	911 (30 ºC, headspace-GC) (*trans*)	(McNally and Grob, 1984)
	1000 (20 ºC)	(Wauchope et al., 1992)
	2250	(Wauchope et al., 1992)

Table 2.25: General information and physical-chemical properties of 2,3-dichloropropene.

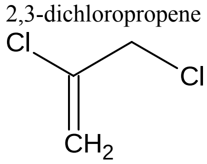
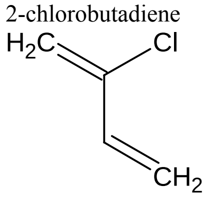
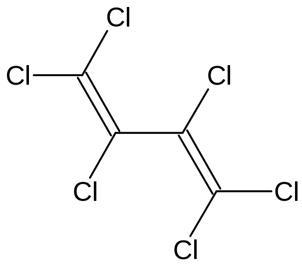
Properties	Value(s)	Reference
IUPAC Name	2,3-dichloropropene	
Structure		
CAS number	78-88-6	
EINECS number	201-153-8	
Empirical formula	C3H4Cl2	
Smiles code	C(=C)(Cl)CCl	
Molar Mass (g/mol)	110.97	
n-Octanol/water partition coefficient (log K_{ow})	2.42 (fragment constant estimate)	(U.S. EPA, 2004)
	2.04 (fragment constant estimate)	(BioByte, 2004)
	2.34	(Cascorbi et al., 1993) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.83	(U.S. EPA, 2004)
	2.00 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 2.34, predominantly hydrophobic)	
Vapour pressure (Pa)	7013 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	2482 (25 ºC, bond method)	(U.S. EPA, 2004)
Water solubility (mg/l)	917.8 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	1097 (from fragments)	(U.S. EPA, 2004)

Table 2.26: General information and physical-chemical properties of 2-chlorobutadiene (chloroprene).

Properties	Value(s)	Reference
IUPAC Name	2-chlorobutadiene	
Structure		
CAS number	126-99-8	
EINECS number	204-818-0	
Empirical formula	C4H5Cl	
Smiles code	C(C=C)(=C)Cl	
Molar Mass (g/mol)	88.54	
n-Octanol/water partition coefficient (log K_{ow})	2.03	(Howard, 1989)
	2.53 (fragment constant estimate)	(U.S. EPA, 2004)
	2.16 (fragment constant estimate)	(BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	1.83	(U.S. EPA, 2004)
	1.85 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 2.16, predominantly hydrophobic)	

Properties	Value(s)	Reference
Vapour pressure (Pa)	23194	(Boublik et al., 1984)
	43996 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	5684 (25 ºC, bond method)	(U.S. EPA, 2004)
Water solubility (mg/l)	874.9 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	836.9 (from fragments)	(U.S. EPA, 2004)

Table 2.27: General information and physical-chemical properties of hexachlorobutadiene.

Properties	Value(s)	Reference
IUPAC Name	hexachlorobutadiene	
Structure		
CAS number	87-68-3	
EINECS number	201-765-5	
Empirical formula	C4Cl6	
Smiles code	C(Cl)(=C(Cl)Cl)C(Cl)=C(Cl)Cl	
Molar Mass (g/mol)	260.76	
n-Octanol/water partition coefficient (log K_{ow})	4.78 (shake flask-HPLC)	(Banerjee et al., 1980)
	4.72 (fragment constant estimate)	(U.S. EPA, 2004)
	4.90 (fragment constant estimate)	(BioByte, 2004)
	4.74 (HPLC, regression from log P)	(Könemann et al., 1979) in (BioByte, 2004)
	4.90	(Chiou, 1985) in (BioByte, 2004)
Soil/sediment water sorption coefficient (log K_{oc})	3.00	(U.S. EPA, 2004)
	3.97 (calculated according to (Sabljic et al., 1995) from Log K_{ow} 4.78, predominantly hydrophobic)	
	4.05 (calculated)	(Environmental Quality Standards (EQS), 2005c)
Vapour pressure (Pa)	20.00 (20 ºC)	(Pearson and McConnell, 1975)
	32.26 (25 ºC, mean of Antoine & Grain methods)	(U.S. EPA, 2004)
Henry's law constant (Pa. m^3. mol^{-1})	1044 (batch stripping)	(Dobbs et al., 1989)
	1094 (25 ºC, bond method)	(U.S. EPA, 2004)
	1630 (25 ºC)	(Environmental Quality Standards (EQS), 2005c)
Water solubility (mg/l)	0.20 (25 ºC)	(Melnikov, 1971)
	2.00 (20 ºC)	(Pearson and McConnell, 1975)
	3.23 (25 ºC, shake flask-HPLC)	(Banerjee et al., 1980)
	1.93 (25 ºC, from log K_{ow})	(U.S. EPA, 2004)
	4.86 (from fragments)	(U.S. EPA, 2004)

2.2 Use, production and discharge

Production, use and release in the environment for acrylonitrile, trichloroethylene and tetrachloroethylene are extensively discussed in the EU-RAR, and it is referred to these documents; see (European Commission, 2004a; European Commission, 2004b; European Commission, 2001), respectively.

2.2.1 Ethylene

Production and use

According to (Lacson and Wong, 2002), the world production in 2001 was 90400 x 10^6 kg. It is used in the production of plastics, fibers and other organic chemicals. The end-use is in the packaging, transportation and construction industries and in a multitude of industrial and consumer markets. The main use is the production of polymers, principally poly ethylenes.

Release in the environment

Ethylene is a natural occurring substance as well, and the total global ethylene emission has been estimated to be 18-45 x 10^6 t/y, of which approximately 74% is released from natural sources and 26% from anthropogenic sources (OECD, 1998). Fuel oil combustion is $1.54.10^6$ t/y, equal to approximately 4% of total global emissions. In the Netherlands the contribution from anthropogenic sources is about 70% (Slooff et al., 1991).

2.2.2 Ethylene oxide (oxirane)

Production and use

In 1985, the production was estimated to be far over 5450 x 10^6 kg per year (IPCS, 1985a). Other sources report a lower figure (2172 x 10^6 kg per year, (ATSDR, 1990b)). Most of the ethylene oxide produced is an intermediate in the production of other chemicals. In the USA the most important products are: the antifreeze 1,2-ethanediol; polyethylene terephthalate polyester for fibers, films, and bottles; non-ionic surface active agents; glycol ethers, ethanol amines and choline (IPCS, 1985a).

Release in the environment

The most important emission route appears to be during production and sterilization via air vents. In 1980, the amount of emission in the USA was estimated to be 2% of the production (53 x 10^6 kg). Ethylene oxide can be removed from the atmosphere through oxidation by hydroxyl radicals. This would result in a theoretical half life of 5.8 days. In practice, however, a residence time of 100 – 215 days has been found (IPCS, 1985a).

2.2.3 Dichloromethane (methylene chloride)

Production and use

The world production of dichloromethane in 1980-1990 was 570 x 10^3 tonnes (IPCS, 1996). The main uses are as a solvent for paints, grease and plastics.

Release in the environment

The global annual emissions to the air are estimated to be 500,000 tonnes. Due to the properties, dichloromethane will partition to the atmosphere, where it has a life time of about six months (IPCS, 1996). The compound has been found in air in concentrations ranging from 0.07-0.29 $\mu g/m^3$.

2.2.4 Trichloromethane (methylene dichloride)

Production and use

The production of trichloromethane in 1984-1987 increased from 360 x 10^3 tonnes to 440 x 10^3 tonnes per year (IPCS, 1994). Furthermore indirect production plays for this substance a significant role, such as the formation of trichloromethane after the chlorination of drinking, cooling and wastewater, use in swimming pools, paper bleaching with chlorine. Furthermore the decomposition of 1,2-dichloroethane, trichloroethylene and 1,1,1-trichloroethane can contribute significantly to the indirect production. Trichloromethane is used in pesticide formulations as a solvent, but more than 80% of the produced chloroform is used for the production of chlorodifluoromethane.

Release in the environment
The estimation of the release to the environment cannot be quantified, since the available data show a very high variation. The main emission route is to the air, and in remote areas concentrations were measured up to 0.225 µg/m^3. In cities concentrations up to 30 µg/m^3 were measured.

2.2.5 Tetrachloromethane (carbon tetrachloride)

Production and use
The world production ranged from 850-960 x 10^3 tonnes per year in 1980-1988 (IPCS, 1999a). From 1990 onwards the production was phased out, and is planned to be completely stopped in 2010. The production as a by-product was in the same order of magnitude in the period 1980-1988. In the past tetrachloromethane has been used as a cleaning agent, a grain fumigant, pesticide, solvent, metal degreaser, fire extinguisher and flame retardant, and in the production of paint, ink, plastics, semi-conductors and petrol additives.

Release in the environment
For 1989, an emission to air of 2000 tonnes is reported for the USA (IPCS, 1999a). Given the properties, most of the emitted compound is expected to be present in the atmosphere, with a relatively long residence time of over 30 years. The compound has been measured in air throughout the world in concentrations of 0.5-1 µg/m^3.

2.2.6 1,1-Dichloroethane

Production and use
(ATSDR, 1990a) reported that the main use of l,l-dichloroethane is as an intermediate in the manufacture of other products such as choroethylene, l,l,l-trichloroethane, and to a lesser extent high vacuum rubber. A limited use was reported as a solvent for plastics, oils, and fats, and thus is employed as both a cleaning agent and a degreaser. Other uses of l,l-dichloroethane include fabric spreading, varnish and finish removers, organic synthesis, ore flotation, and as a fumigant and insecticide spray (ATSDR, 1990a). Concerning the use the only figure reported is that at least 45.5 x 10^6 kilograms were produced in 1977 (ATSDR, 1990a).

Release in the environment
The main emission route is evaporation (99% of emissions), of which 52% is released during the production of l,l,l-trichloroethane, and 35% during the production of 1,2-dichloroethane. Other sources of 1,1-dichoroethane might be the biodegradation of 1,1,1-trichloroethane. Additional sources of environmental release are fugitive emissions from storage, distribution, and disposal; use as an extraction solvent and fumigant; and as a constituent of medicines and stone, clay, and glass products (ATSDR, 1990a).

The compound is expected to evaporate to the atmosphere from water and soil. The residence time in the atmosphere is estimated to be 44 days.

2.2.7 1,2-Dichloroethane

Production and use

The production of 1,2-dichloroethane is relatively high in the order of several millions of tonnes in the 1980-1990s. The main use is as an intermediate for the production of vinyl chloride. In the past it has been used as a soil fumigant as well (IPCS, 1995).

Release in the environment

Due to the compound properties, the atmospheric route is expected to be the main emission route. No estimations of the worldwide emissions have been made. Ambient air concentrations ranged from lower than the detection limit up to 6 $\mu g/m^3$ in the period 1980-1990 (IPCS, 1995). Closer to production areas concentrations of several hundreds of $\mu g/m^3$ were found. In drinking and groundwater concentrations of several µg per litre were found.

2.2.8 1,1,1-Trichloroethane

Production and use

The estimated world production volume was 680 x 10^6 kg in 1988. The main use of 1,1,1-trichloroethane is as a metal degreaser and as a solvent in industrial and consumer products, such as adhesives, spot removers and aerosol cans. 1,1,1-Trichloroethane is also used as a chemical intermediate in the production of vinylidene chloride (IPCS, 1992).

Release in the environment

The main emission route is evaporation. 1,1,1-Trichloroethane has a residence time of six years in the troposphere, and can reach the stratosphere, were the release of Cl atoms contributes to the ozone depletion process. In 1978, 97.3% of the amount used was released in the environment, of which 86% to the air. Most release was found during use, not during production (IPCS, 1992).

2.2.9 1,1,2-Trichloroethane

Production and use

A very rough estimate of the production in 1979 is 187 x 10^6 kg (ATSDR, 1989a). The main use is as an intermediate in the production of 1,1-dichloroethane. Furthermore a limited use as solvent is indicated.

Release in the environment

Fugitive emission during use as a solvent and evaporation from wastewater are the main emission routes to air. Reliable quantitative data are lacking.

2.2.10 1,1,2,2-Tetrachloroethane

Production and use

Figures about the production of 1,1,2,2-tetrachloroethane as an end-product are only available from 1967 (199.5 x 10^6 kg) and 1974 (15.4 x 10^6 kg) in the USA. At that time, it was used as a solvent, in cleaning and degreasing metals, in paint removers, varnishes and lacquers, in photographic films, and as an extractant for oils and fats, and as a crop-protection agent. The production as an end-product apparently ceased after 1980 (ATSDR, 1996a). After this date the main role of 1,1,2,2-tetrachloroethane is as an intermediate in chemical production of for instance trichloroethylene, tetrachloroethylene, and 1,2-dichloroethylene, and as a by-product, for instance in the production of trichloroethylene from acetylene. 1,1,2,2-Tetrachloroethane is found in waste-streams.

Release in the environment
According to release data, based on a limited number of uses and facilities, the emission to air in the USA was 29,138 kg in 1991 and 12,820 kg in 1993. Based on the same data, releases to water were 953 kg in 1991 and 1331 kg in 1993. The half life in air is at least 53.3 days, indicating a potential for dispersal via the atmosphere.

2.2.11 Pentachloroethane

Production and use
No data are found in the IPCS and ATSDR databases.

Release in the environment
No reliable information found.

2.2.12 Hexachloroethane

Production and use
According to (ATSDR, 1997) hexachloroethane was not produced for commercial distribution in 1997. In 1977 the production in the USA was estimated to be 1-10 x 10^6 kg. The product ‘may be used’ for the production of tetrachloroethylene or tetrachloromethane. Current production volumes are not known. The production volumes of a limited number of producers in the USA amount to circa 5 x 10^6 kg in 1993. The main use was, and probably still is the use of hexachloroethane in military smoke pots, grenades and pyrotechnic devises. Apart from this, other important uses were the manufacturing of degassing pellets for the aluminium industry and anthelminthic and several other smaller uses.

Release in the environment
The release to the environment was (based on the selected number of producers en excluding the military uses) estimated at 23,000 kg in 1993, of which 97% is released to the air. Given the long half life in air (30 days), a wide dispersal can be expected, and hexachloroethane has been found in deposition to water, plants and soil, and has been found in air in remote and rural locations.

2.2.13 1,2-Dichloropropane

Production and use
The production of 1,2-dichloropropane in the USA was 66 x 10^6 kg in 1974, 32.2 x 10^6 kg in 1976 and 35 x 10^6 kg in 1980 (IPCS, 1993). According to (ATSDR, 1989b) the production in 1984 was 27.1 x 10^6 kg. 1,2-Dichloropropane is used as a solvent for oil and fats. Furthermore it has been used as a fumigant for crop protection, and is used in gum and oil processing, in the synthesis of organic chemicals, in the making of rubber, wax and scouring compounds, in furniture finishing, dry cleaning fluid, paint remover, and metal degreasing, and as an intermediate for the production of tetrachloroethylene and tetrachloromethane (IPCS, 1993). According to (ATSDR, 1989b) 95% of the use was used for the production of other chemicals, especially tetrachloroethylene.

Release in the environment
The release of the industrial use in the USA based on regulated releases (excluding use as pesticide) was estimated at 520 x 10^3 kg. The major part (350 x 10^3 kg) is released to air (ATSDR, 1989b). 1,2-Dichloropropane appears to be rather stable in air (half life >313 days). In soil the compound is rather persistent too. Since the compound is relatively highly soluble in water, it is found in groundwater and surface water. In the Netherlands, the substance is found in groundwater and drinking water wells, especially in the areas where it is used as a soil disinfectant (IPCS, 1993).

2.2.14 1,3-Dichloropropane

Production and use
1,3-Dichloropropane is mainly used as an intermediate in the production of tetrachloroethylene and other chlorinated products. It is also used as a solvent for fats, oils, resins, waxes, and rubber. Furthermore, it is used as a fumigant and an insecticide. It is also used as dry cleaning fluid, paint remover, metal degreasing agent, and lead scavenger for antiknock fluids (AquaMd, 2006).

Release in the environment
No reliable information found.

2.2.15 Chloroethylene (vinylchloride)

Production and use
The world production of chloroethylene was 16 x 10^9 kg in 1980, 17 x 10^9 kg in 1985, 20.7 x 10^9 kg in 1990, 26.4 x 10^9 kg in 1995, and circa 27 x 10^9 kg in 1998 (IPCS, 1990). The main (95%) use is the production of PVC by polymerisation. PVC forms 20% of the plastics and is used in a lot of industrial and consumer products. Furthermore, chloroethylene is used to form the chlorinated solvent 1,1,1-trichloroethane. Another source of chloroethylene in the environment is the degradation of chlorinated hydrocarbons from for instance landfills and waste deposits.

Release in the environment
The main emission route is the air. In 1992 the emission to air in the USA is estimated to be 0.55 x 10^6 kg, in Europe a release of 0.448 x 10^6 kg/year was reported, in Germany 0.3 x 10^6 kg/year and in England and Wales a release of 3.8 x 10^6 kg in 1993 and 18.9 x 10^6 kg in 1994 was reported (IPCS, 1999b).

2.2.16 1,1-Dichloroethylene

Production and use
In the U.S.A., the production was 80.8 x 10^6 kg/year until 1985, the estimated production in 1989 is 104 x 10^6 kg (ATSDR, 1994). In 1991, the production was 5 – 35 x 10^6 kg, based on a limited number of producers. 1,1-Dichloroethylene is used as an intermediate for the production of captive organic chemical synthesis and for the production of polyvinylidene chloride copolymers. This is used in all kinds of flexible packaging material, and also as a flame retardant coating.

Release in the environment
The emission takes place during the production process of 1,1-dichloroethylene and the transformation to other polymer products. Main emission route is to the air. In the USA the

total emission was estimated to be circa 0.65 x 10^6 kg in 1985. In 1991, based on a incomplete number of producers, the emission was estimated to be 0.13 x 10^6 kg.

2.2.17 1,2-Dichloroethylene

Production and use

As an end-product or by-product, dichloroethylene in general is a mixture of *trans* and *cis* isomers. As an intermediate the *trans* isomer is used more than the *cis* isomer (ATSDR, 1996b). Only indicative quantitative data are available; in the U.S.A., a production of several millions of kg of unspecified dichloroethylene is indicated.

As an intermediate dichloroethylene is used for the production of several other chlorinated solvents and compounds. As an end-product it is used as a solvent for products like waxes, rosins and perfumes, it is used in the extraction of rubber, as a refrigerant, in the manufacture of pharmaceuticals and artificial pearls, as an extractant of oils from animal material, and the low temperature extraction of organic materials such as decaffeinated coffee.

Release in the environment

1,2-Dichloroethylene is emitted to the atmosphere during production, from contaminated wastewaters and disposal sites, and the pyrolysis and combustion of polyvinyl chloride and some vinyl copolymers. Emission is also possible from use as a solvent and extractant, in organic synthesis, and in the manufacture of perfumes, lacquers, and thermoplastics. A quantitative indication of the emission can be given only for the manufacturing and processing facilities in the U.S.A. in 1993 (13 x 10^3 kg) (ATSDR, 1996b). The dominant removal process in air is predicted to be photochemically generated oxygenated species in the troposphere. The estimated atmospheric lifetimes for *cis*- and *trans*-1,2-dichloroethylene due to this removal process are 12 and 5 days, respectively.

2.2.18 *Trans*-1,2-dichloroethylene

See: 2.2.17

2.2.19 *Cis*-1,2-dichloroethylene

See: 2.2.17

2.2.20 3-Chloropropene

Production and use

The total European production is estimated at 280 x 10^6 kg yearly (Sijm, 1996). 90% is used as an intermediate in the manufacture of epichlorohydrin and glycerine. Other uses are as an intermediate in the production of allyl derivatives (allyl alcohol, diallyl phthalate, allylamine), in the synthesis of medical derivatives, agricultural chemicals and allyl starches, and as thermosetting resins for varnishes, plastics, and adhesives.

Release in the environment

Most important emissions will be to the atmosphere. The half life in air is relatively short (1 day).

2.2.21 1,3-Dichloropropene

Production and use

Before 1978, about 25 x 10^6 kg was produced yearly in the USA (IPCS, 1993). In Italy, 2 x 10^6 kg was produced in 1972. In California, about 1.3 x 10^6 kg pesticides containing 1,3-dichloropropene was used in 1971; in 1970-1977 this amount was 1.8 – 2.7 x 10^6 kg, and in 1981, this amount was 7.2 x 10^6 kg. In 1979 the estimated production was 5.4 – 6.3 x 10^6 kg yearly. In Europe, in 1979 the estimated production was 6-7 x 10^6 kg per year. The main use is as a soil fumigant in Telone II, effective against nematodes, and used in vegetables, potatoes and tobacco.

Release in the environment

After application, a part of the product will evaporate to the atmosphere. Furthermore a limited amount could reach the groundwater. The half lives of *cis*- and *trans*-1,3-dichloropropene were estimated 12 and 7 hours, respectively. An overview of the amount of 1,3-dichloropropane being released to the air as a result of the agricultural use is lacking.

2.2.22 2,3-Dichloropropene

No data were found concerning production, use and release in the environment.

2.2.23 2-Chlorobutadiene

No data were found for production, use and release in the environment.

2.2.24 Hexachlorobutadiene

Production and use

The main source of hexachlorobutadiene is as a by-product in the production of chlorinated hydrocarbons. In the USA the production as a by-product in 1972 was 3310-6580 tonnes (IPCS, 1994a). The annual world production of hexachlorobutadiene in heavy fractions in 1982 was estimated to be 10,000 tonnes.

Release in the environment

The global annual emission rate, based on model calculations, was estimated to be 3000 tonnes (IPCS, 1994a).

3. Methods

3.1 Literature search and data selection

For the studied compounds a lot of literature has already been collected in different frameworks. In the series ‘Environmental Health Criteria’ of IPCS the following compounds were regarded: acrylonitrile (IPCS, 1983), tetrachloromethane (IPCS, 1999a), trichloromethane (IPCS, 1994), 1,2-dichloroethane (IPCS, 1995), 1,3-dichloropropene (IPCS, 1993), 1,2-dichloropropane (IPCS, 1993), hexachlorobutadiene (IPCS, 1994a), trichloroethylene (IPCS, 1985b), tetrachloroethylene (IPCS, 1984), chloroethylene (IPCS, 1999b), 1,1-dichloroethylene (IPCS, 1990).

For the following compounds BUA (Beratergremium für Umweltrelevante Altstoffe) reports of the GDCh (Gesellschaft Deutscher Chemiker) are available: ethylene-oxide (GDCh, 1993), chloroethylene (GDCh, 1989b), 1,1-dichloroethylene (GDCh, 1988), 1,1,1-trichloroethane (GDCh, 1996), 1,1,2-trichloroethane (GDCh, 1995), 1,1,2,2-tetrachlorethane (GDCh, 1989a), 1,2-dichloropropane (GDCh, 1994), 2-chlorobutadiene (GDCh, 1991).

These sources have been used to collect data from. Further, a literature search was performed to collect additional data. Some literature was found from retrospective searching. As far as possible, original publications were checked. For the compounds considered in the risk assessment reports of the European Commission (EU-RAR) additional data were not searched for, and only the data used in the EU-RAR are reported. For compounds for which a datasheet of the Water Framework Directive is available, it was only searched for additional terrestrial data, since these are not considered in the WFD datasheets. Data were considered reliable if the experimental set-up is in accordance with internationally accepted guidelines, such as the OECD guidelines. For studies that deviate from these guidelines, Appendix III in the Technical Guidance Document of the EU (European Commission, 2003) gives information on the requirements these studies should fulfil with regards to the test substance, test species, exposure, water quality and so on. Toxicity data based on QSAR studies and data based on methods, which are considered not reliable, are not taken into consideration for the derivation of ERLs. This also applies for data that are unpublished or that can not be verified and for ‘higher or lower than’ values. Although not directly used for the derivation of ERL, the latter type of data are however shown in the tables of Appendix 3 and 4.

The effects that are considered as relevant for the derivation of environmental risk limits are those that affect the population dynamics, such as survival, immobilisation, growth, and reproduction. Other effects such as reburial or photosynthesis might be considered relevant as well, if they are strongly related to one of the above mentioned effects. Toxicity studies with endpoints such as biochemistry or animal behaviour are not taken into account for the derivation of ERLs, as they do not have a clear relationship with population dynamics. The most relevant parameter for algae is the growth rate of the population. If a result is available for growth rate, this is preferred above other endpoints, for example biomass.

When more data for the same species and the same endpoint are available, a geometric mean of these data is taken. In the TGD (European Commission, 2003), the use of a geometric mean is explicitly recommended for acute toxicity data and for chronic toxicity data when a statistical extrapolation technique is applied. The TGD does not mention this topic in the case that assessment factors are used. Here, in all cases a geometric mean is used when toxicity data are available for the same species and endpoint.

3.2 Derivation of environmental risk limits

3.2.1 Derivation of maximum permissible concentrations (MPCs)

For the derivation of the MPCs the procedures to derive the PNECs from aquatic, terrestrial and benthic toxicity data as documented in the TGD (European Commission, 2003) and the manual under the WFD for water and sediment (Lepper, 2005), which is largely based on the TGD, are followed.

In case an EU-RAR or a datasheet for the Water Framework Directive is available, the PNEC or AA-EQS values for freshwater and saltwater of these documents are used as MPC. In some cases no PNEC for saltwater has been derived; in that case the PNEC for saltwater is derived with the same rules as for the other substances.

Concentrations in soil from the toxicity tests are normalised to standard soil, by taking the organic matter content of both test and standard soil into account (European Commission, 2003). The environmental risk limits for soil and sediment in the Netherlands are based on a standard soil with 10% organic matter; the TGD standard soil contains 3.4% organic matter. Because environmental risk limits for the Netherlands are derived in this report, a normalisation to 10% organic matter has been applied to the terrestrial data.

For the derivation of the PNECs the assessment factors as mentioned in the TGD and the WFD manual are used. According to the TGD, statistical extrapolation techniques may only be applied if chronic toxicity data for at least 10 species from 8 different specific taxonomic groups are available (European Commission, 2003; Lepper, 2005).

For the derivation of ERLs salt- and freshwater data are combined if there are no (statistical) reasons to keep the data separated. This means that the ERLs are derived using the combined dataset. However, according to the TGD and the WFD manual separate PNECs, and thus MPCs, are derived for freshwater and saltwater. Because of the greater species diversity in the marine environment compared to freshwaters, a higher assessment factor is applied for deriving a PNEC for the marine environment. Only if enough additional toxicity data for specific marine species are available, the same assessment factor as for the derivation of the PNEC for freshwater may be applied to derive the PNEC for marine water (European Commission, 2003; Lepper, 2005).

If no data are available for benthic or terrestrial organisms, the MPCs for sediment and soil are calculated by equilibrium partitioning according to the TGD. If only acute toxicity data are available for benthic organisms or only one number for acute toxicity of terrestrial organisms, equilibrium partitioning is also used in comparison with the direct toxicity data. For the substances for which an EU-RAR or WFD datasheet is available, the PNEC for sediment and soil is recalculated using the method described in (Van Vlaardingen and Verbruggen, in prep.) normalised for Dutch soil and sediment conditions. The PNECs for sediment and soil thus can deviate from those mentioned in the EU-RAR or WFD factsheet.

For applying the equilibrium partitioning method the log K_{oc} and the Henry's law constant are needed as input parameters. For the substances for which an EU-RAR or a WFD Substance datasheet is available, the log K_{oc} and the Henry's law constant from the reports are used. For the other substances, for the log K_{oc} the average of all measured data from Table 5 to 32 and one calculated figure according to Sabljic et al. (1995) is used and for Henry's law constant the geometric mean of all measured values has been taken. When measured values are lacking, calculated values are used. The selected data are presented in Table 3.1.

Table 3.1: Log K_{oc} and Henry's law constant used for equilibrium partitioning from surface water to soil and sediment.

	Log K_{oc}	Henry's law constant Pa.m^3.mol^{-1}
acrylonitrile	1.15	9.6
ethylene	1.02	12753.7
ethylene oxide	0.10	8.0
dichloromethane[a]	1.62	270
trichloromethane	2.27	275
tetrachloromethane	1.92	2647.6
1,1-dichloroethane	1.44	572.9
1,2-dichloroethane	1.62[b]	110
1,1,1-trichloroethane	2.02	1668.6
1,1,2-trichloroethane	1.95	88.5
1,1,2,2-tetrachloroethane	2.12	33.9
pentachloroethane	2.71	31.3
hexachloroethane	3.40	162.1
1,2-dichloropropane	1.63	287.0
1,3-dichloropropane	1.72	212.9
chloroethylene	1.33	2564.6
1,1-dichloroethylene	1.82	3797.7
1,2-dichloroethylene	1.61	959.3[c]
trans-1,2-dichloroethylene	1.78	959.3
cis-1,2-dichloroethylene	1.61	404.4
trichloroethylene	1.96	1030
tetrachloroethylene	2.74	2114
3-chloropropene	1.32	1804.1
1,3-dichloropropene	1.64	899.9
cis-1,3-dichloropropene	1.64	899.9
trans-1,3-dichloropropene	1.63	899.9
2,3-dichloropropene	2.00	2482.0
2-chlorobutadiene	1.85	5684.0
hexachlorobutadiene	4.05	1630

a: In the WFD datasheet (Environmental Quality Standards (EQS), 2005a) a number of different data are reported. Since these data are not used in the WFD to derive a Quality Standard (QS) for sediment, no Log K_{oc} is proposed in the WFD datasheet, and the Log K_{oc} is calculated using the data of Table 2.8.
b: In the WFD datasheet (Environmental Quality Standards (EQS), 2005b) ranges of Log K_{oc} values are reported. Since for 1,2-dichloroethane a lot of data are available (see Table 2.8), and the value calculated is within the range of the WFD data, the value based on Table 2.8 is used.
c: measured value of trans-1,2-dichloroethylene taken

The MPCs calculated according to the TGD are for bulk (wet weight) sediment and soil. In the framework of INS, sediment and soil concentrations are normalised to dry weight, with the organic matter content of 10% for Dutch standard soil and sediment. This recalculation is performed according to the equations as documented in the guidance document for deriving Dutch Environmental Risk Limits (Van Vlaardingen and Verbruggen, in prep.). Due to the amount of a substance that is present in the (pore)water phase of sediment and soil, small differences between the MPC for sediment and soil may occur for less hydrophobic chemicals. This reflects the fact that although expressed as concentrations normalised to dry weight of sediment, the total amount of the substance in sediment or soil is determined by means of common extraction techniques.

3.2.2 Derivation of serious risk concentrations ($SRCs_{eco}$)

The $SRCs_{eco}$ are derived in accordance with (Van Vlaardingen and Verbruggen, in prep.). In principle, to the acute toxicity data an acute-to-chronic ratio (ACR) of 10 is applied to compare acute Lethal (Effect) Concentrations ($L(E)C_{50}$s) with chronic No Observed Effect Concentrations (NOECs) (or EC_{10}s). For the aquatic compartment, comparison between chronic data and acute data is no longer performed when chronic data are available for *at least* three species, which should represent the three specified trophic levels from the base set of the TGD: algae, *Daphnia* and fish. For the sediment and terrestrial compartment, comparison between chronic data and acute data is no longer performed when chronic data are available for two species, each of which should represent a different trophic level, e.g. bacteria and earthworms, insects and macrophytes, molluscs and crustaceans. The SRC_{eco} is always taken as the geometric mean of (either acute or chronic) toxicity data, irrespective of whether these data are log-normally distributed or not. For substances for which an EU-RAR or a Water Framework Directive Substance data sheet is available, the SRC_{eco} is derived using the data set from these sources.

3.2.3 Derivation of negligible concentrations (NCs)

Negligible concentrations (NCs) are derived by dividing the MPCs by a factor of 100. The NC represents a value causing negligible effects to ecosystems. This factor is supposed to function as protection against mixture toxicity, since species are always exposed in the environment to mixtures of chemicals. The toxicity of complex mixtures of chemicals are generally best described as concentration-additive (Van Leeuwen et al., 1996; Deneer, 2000).

4. Toxicity data and derivation of ERLs

In this chapter the derived environmental risk limits for the volatile aliphatic hydrocarbons are presented for fresh- and saltwater (section 4.1), soil and sediment (section 4.3) and air (section 4.4). The ERLs are summarised in section 4.5. In section 4.2 the ERLs based on secondary poisoning are described.

4.1 Derivation of ERLs for water

The aquatic toxicity data that are found for the volatile aliphatic hydrocarbons considered in this report are presented in Appendix 3. The selected toxicity data that are used for the derivation of the ERLs, are given in separate tables shown in Appendix 1.

4.1.1 Acrylonitrile (2-propenenitrile)

The toxicity data reported in the EU-RAR are presented in Table A1.1 and Table A1.2. Since chronic data are available for algae, daphnids and fish the MPC for aquatic organisms has been derived using an assessment factor of 10. Applying this factor to the lowest NOEC derived from a fish early life stage toxicity test with *Pimephales promelas* results in an MPC of 17 µg/l. In the EU-RAR no PNEC for marine species has been derived. For marine organisms, chronic data are only available for fish and algae. Therefore, the MPC is derived from the combined data set for marine and freshwater species, applying an assessment factor of 100 to the lowest NOEC, and the MPC is 1.7 µg/l.

The SRC_{eco} is based on the geometric mean of the chronic toxicity values and is 1.25 mg/l. In this case, the geometric mean of the acute value divided by an assessment factor of 10 would result in about the same value (1.29 mg/l).

4.1.2 Ethylene

For ethylene the very high Henry's law constant results in a very low chance of aquatic organisms to be exposed. Also few toxicity data were found. The only reliable data found are for algae (see Table A1.3). According to the TGD (European Commission, 2003) no PNEC can be derived based on these data. In the past, an MPC of 8.5 mg/l was used based on Quantitative Structure-Activity Relationships (QSARs) (Van der Plassche et al., 1993). From the available data an SRC_{eco} can be derived. Since the one NOEC found is less than a factor 10 below the EC_{50} value the SRC_{eco} is derived by the $EC_{50}/10$ and is 4 mg/l.

4.1.3 Ethylene oxide (oxirane)

For ethylene oxide no chronic toxicity data are available and acute data are available for daphnids and fish only (Table A1.4 and Table A1.5). In this case, the MPC can be derived by applying an assessment factor of 1000 on the lowest acute value and is 0.084 mg/l. For saltwater species data are available for *Artemia salina* only. Therefore the MPC for saltwater species is derived by applying an assessment factor of 10000 on the lowest acute value and is 0.0084 mg/l.

The SRC_{eco} is based on the geometric mean of the acute toxicity values divided by an assessment factor of 10 and is 18.6 mg/l.

4.1.4 Dichloromethane (methylene dichloride)

The toxicity data reported in the WFD substance data sheet (Environmental Quality Standards (EQS), 2005a) are presented in Table A1.6 and Table A1.7. Since chronic data are available for algae and fish but not for *Daphnia*, the MPC for aquatic organisms has been derived using an assessment factor of 50. Applying this factor to the lowest NOEC derived from a toxicity test with *Pimephales promelas* results in an MPC of 1.65 mg/l. For saltwater species it is argued in the WFD substance data sheet that there is no obvious difference in sensitivity of saltwater and freshwater species of the same taxonomic group. Furthermore, given the mode of toxic action, no significantly greater sensitivity of other marine taxonomic groups is expected, and therefore the same assessment factor as for freshwater is used and the MPC for saltwater species is 1.65 mg/l.

The SRC_{eco} is based on the geometric mean of the acute toxicity values divided by an assessment factor of 10 and is 43.6 mg/l. Chronic toxicity data are available for fish and cyanobacteria. The geometric mean of the NOECs is however 181 mg/l, and since this value is higher than the value based on acute data, the value for the acute data is used for the SRC_{eco}.

4.1.5 Trichloromethane (chloroform)

The toxicity data reported in the WFD substance data sheet (Environmental Quality Standards (EQS), 2004) are presented in Table A1.8 and Table A1.9. Since chronic data are available for algae, daphnids and fish, the MPC for aquatic organisms has been derived using an assessment factor of 10. Applying this factor to the lowest NOEC derived from a toxicity test with Oryzias latipes results in an MPC of 146 µg/l. To cope with the larger sensitivity for other marine groups, for deriving the MPC for saltwater normally an assessment factor of 100 is used. However, it is argued in the WFD sheet that based on the available data and the mode of toxic action, no greater sensitivity of other saltwater species has to be expected and the MPC for saltwater species is 146 µg/l.

The SRC_{eco} is based on the geometric mean of the chronic toxicity values and is 23.1 mg/l.

4.1.6 Tetrachloromethane (carbon tetrachloride)

An environmental quality standard is proposed for tetrachloromethane in the framework of the WFD, but not accepted yet (European Commission, 2006). For the time being the proposed value of 12 µg/l has been taken as the MPC for fresh and marine water. Table A1.10 and Table A1.11 show the selected toxicity data for tetrachloromethane. Since NOECs are available for three taxa from 3 functional groups, a safety factor of 10 is applied on the lowest NOEC for *Chlamydomonas reinhardtii* and the MPC derived would be 7 µg/l, which is close to the proposed value for the WFD. For the marine environment an extra safety factor of 10 would be applied, and the MPC would be 0.7 µg/l.

The SRC_{eco} is based on the geometric mean of the chronic toxicity values and is 5.0 mg/l.

4.1.7 1,1-Dichloroethane

The selected toxicity data are presented in Table A1.12 and Table A1.13. The only available figure for the standard test organisms is the acute value for fish (*Poecilia reticulata*). Furthermore data are available for freshwater and saltwater bacteria. In cases where the base-set is not complete and no data for Daphnia are available it is not possible to derive a PNEC ((European Commission, 2003): note a to Table 16). For marine organisms only data for bacteria *Vibrio fischeri* are known (Table A1.13). This is also not sufficient for deriving a reliable PNEC.

Because of a lack of chronic toxicity data, the SRC_{eco} is based on the geometric mean of the $L(E)C_{50}$ values divided by an assessment factor of 10 and is 9.5 mg/l.

4.1.8 1,2-Dichloroethane

The toxicity data reported in the WFD substance data sheet (Environmental Quality Standards (EQS), 2005b) are presented in Table A1.14 and Table A1.15. Since chronic data are available for algae, daphnids and fish the MPC for aquatic organisms has been derived using an assessment factor of 10. Applying this factor to the lowest NOEC derived from a toxicity test with *Daphnia magna* results in an MPC of 1.06 mg/l. According to the TGD the geometric mean of multiple toxicity values for the same species and the same endpoint should be calculated. Since there are five toxicity values with the same endpoint (reproduction), the geometric mean of these values would preferably have been used to derive the MPC. For the MPC for saltwater species it is argued in the WFD data sheet that the data do not show a difference in sensitivity between freshwater and saltwater species, and also the mode of toxic action does not give a reason to assume differences in sensitivity. Therefore for saltwater species the same assessment factor is used and the MPC is 1.06 mg/l.

The SRC_{eco} is based on the geometric mean of the chronic toxicity values and is 64 mg/l.

4.1.9 1,1,1-Trichloroethane

The selected toxicity data (see Table A1.16) show that chronic toxicity data are available for Daphnia, algae and fish. Therefore the PNEC is calculated using an assessment factor of 10 on the lowest NOEC. Since the lowest NOEC is 0.213 for the algae *Chlamydomonas reinhardtii*, the MPC for freshwater is 0.0213 mg/l. For saltwater species no chronic data are available, and the MPC is calculated by applying an assessment factor of 100, resulting in a value of 0.00213 mg/l.

For deriving an SRC_{eco} it is noticed that four NOECs are available from three different taxonomic groups and the geometric mean of the NOECs of 1.47 mg/l is used as SRC_{eco} without any further assessment factor. Besides that, the geometric mean of the NOECs is smaller than the geometric mean of the E(L)C50 values divided by a factor of 10.

4.1.10 1,1,2-Trichloroethane

The selected toxicity data are presented in Table A1.18 andTable A1.19. Since chronic data are available for algae, daphnids and fish, an assessment factor of 10 is applied on the lowest NOEC (3 mg/l for the fish species *Pleuronectus platessa*) and an MPC for freshwater of 0.30 mg/l is derived. Because three NOECs are available covering three trophic levels, the lowest NOEC can be used to base the MPC upon, according to the guidance of the TGD. However, this NOEC is not the lowest effect concentration. The lowest reported effect concentration for 1,1,2-trichloroethane is the EC_{50} for ammonia consumption of the bacterium species *Nitrosomonas* of 1.9 mg/l. Since 0.3 mg/l is well below this value, and the value for *Nitrosomonas* is the only value of 29 species reported that is below the lowest NOEC, the MPC is based on the NOECs. For saltwater species a larger diversity is assumed and an assessment factor of 100 is applied. The MPC for saltwater is therefore 0.030 mg/l.

Since ten NOECs are available from four taxonomic groups, the geometric mean of the NOEC values of 16 mg/l is taken as the SRC_{eco}. In this case, the geometric mean of the EC_{50} values (79 mg/l) is less than a factor of 10 higher than the geometric mean of the chronic toxicity data. This reflects the small difference between acute and chronic toxicity of this compounds to several species.

4.1.11 1,1,2,2-Tetrachloroethane

The selected toxicity data are presented in Table A1.20 and Table A1.21. Chronic data are available for freshwater daphnids and fish. The lowest NOECs are found for *Pimephales promelas* and *Oncorhynchus mykiss* (1.4 mg/l). The MPC derived by applying an assessment factor of 50 to the lowest NOEC of two taxonomic groups, would be 0.028 mg/l. In this case however, the lowest LC_{50} value, found for *Artemia salina* (0.8 mg/l), is lower than the lowest NOEC, and therefore the MPC is derived by applying an assessment factor of 100 on the lowest LC_{50} value (footnote c to Table 16 in the TGD) and the resulting MPC is 0.008 mg/l. For saltwater species an assessment factor of 1000 is used in this case (footnote c to Table 25 in the TGD) and the MPC is 0.0008 mg/l.

Since the geometric mean of the EC_{50} values/10 (1.69 mg/l) is lower than the geometric mean of the two available NOEC-values (2.9 mg/l), 1.69 mg/l is taken as the $SRC_{eco.}$

4.1.12 Pentachloroethane

The selected toxicity data for pentachloroethane are shown in Table A1.22 and Table A1.23. When freshwater and saltwater species are taken together, chronic toxicity data are found for algae, crustaceans and fish. For crustaceans chronic data are available for *Mysidopsis bahia* only. However the acute toxicity data show that *Mysidopsis bahia* is more sensitive than *Daphnia magna*. Therefore the MPC is derived by taking the lowest NOEC (0.28 mg/l for *Mysidopsis bahia*) and applying an assessment factor of 10. The MPC thus is 0.028 mg/l. For saltwater species an assessment factor of 100 is used and the MPC is 0.0028 mg/l.

For the SRC_{eco} the value is derived by taking the geometric mean of the four NOEC values, available for three taxonomic groups and set at 0.89 mg/l. [NB, this value is smaller than the geometric mean of the acute values/10 (1.6 mg/l)].

4.1.13 Hexachloroethane

The selected toxicity data are presented in Table A1.24 and Table A1.25. Long term toxicity data are available for fish only. According to the TGD a factor of 100 on such NOEC should only be applied when fish are the most sensitive species in the acute toxicity test. Although fish are among the most sensitive, in this case *Vibrio fischeri* is more sensitive. However for this substance 21 acute values are available for 8 different taxonomic groups, among which 2 more bacteria species that are less sensitive. Therefore in this case it is argued that the MPC can be derived by applying an assessment factor of 100 on the lowest chronic value (found for *Oncorhynchus mykiss*, 0.067 mg/l) and is 0.00067 mg/l. This value is well below (factor 200) the lowest acute value for bacteria. Applying a Species Sensitivity Distribution (SSD) approach on the acute toxicity data yields a HC5 value of 0.19 mg/l. This means that the MPC of 0.00067 mg/l is a factor 300 below the acute HC5 and can be considered protective. For saltwater species an assessment factor of 1000 is used and the MPC is 0.000067 mg/l.

For the SRC_{eco} the geometric mean of the two available NOEC values for fish (0.11 mg/l) is smaller than the geometric mean of the LC_{50} values/10 (0.34 mg/l). Therefore 0.11 mg/l is taken as the SRC_{eco}.

4.1.14 1,2-Dichloropropane

The selected toxicity data (see Table A1.26 and Table A1.27) show that chronic toxicity data are available for the four different taxonomic groups, among which algae, daphnids, and fish. Since the crustaceans are the most sensitive group in the acute toxicity tests, an MPC can be derived by applying an assessment factor of 10 on the lowest NOEC. In this case the lowest NOEC has been found for *Daphnia magna* (2.8 mg/l), so the MPC is 0.28 mg/l. For saltwater organisms an assessment factor of 100 is used and the MPC is 0.028 mg/l.

For the SRC_{eco} the geometric mean of the 8 NOECs (20 mg/l) is taken as the SRC_{eco}.

4.1.15 1,3-Dichloropropane

The selected toxicity data (See Table A1.28 and Table A1.29) show that chronic toxicity data are available for two taxonomic groups, fish and crustaceans. In this case however, it can be argued that the taxonomic group with the lowest acute toxicity (*Nitrosomonas sp.*, EC_{50} 4.8 mg/l) is not represented in the chronic values. Since the lowest acute value is not below the lowest chronic value (*Nitrosomonas sp.*, EC_{50} 4.8 mg/l), the MPC can be derived by applying an assessment factor of 100 on the lowest chronic value (*Mysidopsis bahia*) of 3 mg/l, and is set at 0.030 mg/l. For saltwater species an assessment factor of 1000 is used, resulting in an MPC of 0.0030 mg/l.

For deriving the SRC_{eco} the geometric mean of the acute values/10 (5.95 mg/l is lower than the geometric mean of the two available chronic values (9.2 mg/l) and therefore the SRC_{eco} is 5.95 mg/l.

4.1.16 Chloroethylene (vinylchloride)

The selected toxicity data for chloroethylene are shown in Table A1.30. It is clear that only a few acute data are available. Since data for algae and daphnids are lacking, it is not possible to derive a reliable MPC. The SRC_{eco} can be derived by taking the geometric mean of the available acute values with an assessment factor of 10 and is 81 mg/l.

4.1.17 1,1-Dichloroethylene

The selected toxicity data show that for 1,1-dichloroethylene no reliable chronic toxicity data could be selected (see Table A1.31 and Table A1.32). Since the base set for acute values is complete, the MPC can be derived by applying an assessment factor of 1000 on the lowest acute toxicity value, in this case found for *Chlamydomonas reinhardtii* (9 mg/l), resulting in an MPC of 0.009 mg/l. For saltwater species the MPC is 0.0009 mg/l.

The SRC_{eco} can only be derived by taking the geometric mean of the acute toxicity values/10 resulting in an SRC_{eco} of 10.9 mg/l.

4.1.18 1,2-Dichloroethylene

From the selected toxicity data (see Table A1.33 and Table A1.34) it is clear that only acute toxicity data are available. Data for algae and daphnids are lacking, and therefore it is not possible to derive a reliable MPC. For the isomer trans-1,2-dichloroethylene however, toxicity data are available for bacteria and *Daphnia* (see Table A1.35 and Table A1.36) and for the isomer cis-1,2-dichloroethylene data are available for fish and bacteria (see: Table A1.37 and Table A1.38). The available data do not indicate that substantial differences between the different isomers exist. Therefore it is decided to combine the toxicity data, in order to fulfil the requirements for deriving an MPC. Although data for algae are lacking, acute toxicity data are available for fish and crustaceans. The MPC therefore is derived by applying a safety factor of 1000 on the lowest acute toxicity value (6.8 mg/l for *Artemia salina*) and the MPC is set at 0.0068 mg/l. For the marine environment a safety factor of 10000 is used and the MPC is set at 0.00068 mg/l.

The SRC_{eco} is estimated by using the geometric mean of the acute toxicity values/10 and is set at 10.7 mg/l.

4.1.19 *trans*-1,2-Dichloroethylene and *cis*-1,2-dichloroethylene

See 4.1.18.

4.1.20 Trichloroethylene

The toxicity data reported in the EU RAR (European Commission, 2004b) are presented in Table A1.39 and Table A1.40. Since chronic data are available for algae and fish but not for *Daphnia*, the MPC for aquatic organisms has been derived using an assessment factor of 50. The UK reporter states that although the lowest actual toxicity result is for an invertebrate species, the overall acute results for fish and invertebrates are very similar. This is also seen in the QSAR predictions. It is therefore considered that a factor of 50 can be applied to the NOEC resulting from a toxicity test with *Jordanella floridae*. This results in an MPC of 115 μg/l. In the EU RAR, no PNEC for saltwater is derived. Since for saltwater species chronic data are available for one algae species only, the MPC is derived by using an assessment factor of 500 and is 11.5 μg/l.

For the SRC_{eco} chronic data are available for fish, algae and bacteria. The geometric mean of these values is 4.60 mg/l. The geometric mean of the acute values/10 is 5.24 mg/l. Therefore 4.60 mg/l is taken as the SRC_{eco}.

4.1.21 Tetrachloroethylene

The toxicity data reported in the EU-RAR (European Commission, 2001) are presented in Table A1.41 and Table A1.42. Since chronic data are available for algae, daphnids and fish the MPC for aquatic organisms has been derived using an assessment factor of 10. Applying this factor to the lowest NOEC derived from a toxicity study with *Daphnia magna* results in an MPC of 51 μg/l. This is however not according to the TGD. According to the TGD the geometric mean of multiple toxicity values for the same species and the same endpoint should be calculated. Since there are two toxicity values with the same endpoint (reproduction), the geometric mean of these values should have been used to derive the MPC. Since for saltwater species only one chronic value is available for bacteria, the MPC for saltwater species is derived by applying an assessment factor of 100 and is 5.1 μg/l.

The SRC_{eco} is based on the geometric mean of the chronic toxicity values and is 7.76 mg/l.

4.1.22 3-Chloropropene

The selected toxicity data are shown in Table A1.43 and Table A1.44. The tables show that chronic toxicity data are available, but not for *Daphnia* and fish. Furthermore the acute value for *Xenopus laevis* is lower than the lowest chronic value. Therefore in this case an assessment factor of 1000 is applied on the lowest acute value, and the MPC for freshwater species is 0.00034 mg/l. For saltwater, an assessment factor of 10000 is applied and the MPC is 0.000034 mg/l.

For estimating the SRC_{eco} the geometric mean of the acute values/10 is lower than the geometric mean of the chronic values and is set at 1.9 mg/l.

4.1.23 1,3-Dichloropropene

The selected toxicity data (see Table A1.45 and Table A1.46) show that chronic toxicity data are available for algae and *Daphnia*. It appears that the lowest acute values from single studies are for algae and *Daphnia*. In general, it appears that algae, daphnids and fish are comparably sensitive. Therefore the MPC is derived by applying an assessment factor of 50 on the lowest NOEC (0.009 mg/l for *Selenastrum capricornutum*) and the MPC is 0.00018 mg/l. For saltwater, a factor of 500 is applied and the MPC is set at 0.000018 mg/l.

For estimating the SRC_{eco}, the geometric mean of the chronic values is smaller than the acute values/10 and the SRC_{eco} is based on the chronic values and is 0.028 mg/l.

4.1.24 *Trans*-1,3-Dichloropropene and *cis*-1,3-dichloropropene

The toxicity data for *trans*-1,3-dichloropropene and *cis*-1,3-dichoropropene are presented in Table A1.47 and Table A1.48, respectively. Since acute data are available for algae, daphnids and fish the MPC can be derived by applying an assessment factor of 1000 on the lowest acute value, resulting in an MPC for *trans*-1,3-dichloropropene of 0.0031 mg/l and for *cis*-1,3-dichloropropene of 0.0014 mg/l. However, for 1,3-dichloropropene unspecified isomer (or mixture) chronic data are available, and therefore the MPC for 1,3-dichloropropene is taken as the MPC for *trans*-1,3-dichloropropene and *cis*-1,3-dichloropropene and is 0.00018 mg/l for freshwater species and 0.000018 mg/l for saltwater species, see section 4.1.23.

For the SRC_{eco} the same argument is used and the SRC_{eco} is 0.028 mg/l for both isomers.

4.1.25 2,3-Dichloropropene

The selected toxicity data (see Table A1.49) show that chronic toxicity data are not available for algae, daphnids and fish. Acute toxicity data are lacking for algae and daphnids, and therefore it is not possible to derive a reliable MPC.

For deriving the SRC_{eco} the geometric mean of the acute toxicity values/10 is the lowest value, thus the SRC_{eco} is 1.19 mg/l.

4.1.26 2-Chlorobutadiene

The selected toxicity data are shown in Table A1.50. From the table it is clear that chronic toxicity data are available for *Daphnia magna*. Therefore the MPC is derived by dividing this chronic value by a factor of 100 and is at 0.019 mg/l. For saltwater, a factor of 1000 is applied and the MPC is 0.0019 mg/l.

The SRC_{eco} is based on the chronic toxicity value and is 1.9 mg/l.

4.1.27 Hexachlorobutadiene

The toxicity data reported in the WFD substance data sheet (Environmental Quality Standards (EQS), 2005c) are presented in Table A1.51 and Table A1.52. Since chronic data are available for algae (no effect at highest concentration tested), daphnids and fish the MPC for aquatic organisms has been derived using an assessment factor of 10. Applying this factor to the lowest NOEC derived from a toxicity test with Daphnia magna results in an MPC of 0.44 µg/l. For saltwater species the same assessment factor is proposed in the WFD substance data sheet and the MPC is 0.44 µg/l.

In the WFD substance data sheet it is stated that it is not possible to judge whether saltwater and freshwater species of the same taxonomic group are equally sensitive to hexachlorobutadiene. However, in the EURO CHLOR risk assessment for hexachlorobutadiene it is stated that '*from and evaluation of the available toxicity data for other chlorinated aliphatic compounds, it is reasonable to conclude that the sensitivity of marine and freshwater organisms is quite similar'*. It is therefore suggested in the WFD fact sheet to calculate the Quality Standard ($QS_{saltwater}$) from the same data set as used for the derivation of the $QS_{freshwater}$. To this end, the TGD assessment factor method as proposed for the marine assessment is used.

However, the quality standard for secondary poisoning in water is 0.003 µg/l (see 4.2.2.1). The MPC for water derived from secondary poisoning is much lower than the MPC derived from the aquatic toxicity dataset. Therefore the MPC for water is 0.003 µg/l.

For calculating the SRC_{eco} chronic data are available for crustaceans and fish and the geometric mean is 6.1 mg/l. The geometric mean of the acute values/10 is 24 mg/l and therefore the SRC_{eco} is 6.1 mg/l.

4.2 Bioconcentration and secondary poisoning

4.2.1 Bioconcentration

In Table 4.1 the log BCF (Bioconcentration Factor) is given calculated on bases of the log K_{ow}. The log K_{ow} on its turn is the selected experimental value or calculated using ClogP (BioByte, 2004). The results show that for four substances the BCF > 100: pentachloroethane, hexachloroethane, tetrachloroethylene and hexachlorobutadiene.

For the four compounds mentioned the literature was searched for experimentally obtained BCF data. For hexachlorobutadiene no further data search has been done because a datasheet from the Water Framework Directive (WFD) was present (Environmental Quality Standards (EQS), 2005c). The data discussed here clearly show that the BCF for hexachlorobutadiene > 100, as is concluded in the WFD datasheet, where the value of 17000 is used for risk assessment. For tetrachloroethylene an EU-RAR is available (European Commission, 2001), and in this RAR it is concluded (based on experimental data and calculations) that the BCF < 100, for the EU-RAR a value of 28.2 is used for risk assessment.

The data found and judged as reliable are presented in Table 4.1. Lien et al. (1994) describe the bioaccumulation for 1,1,2,2-tetrachloroethane, pentachloroethane and hexachloroethane in short term experiments (15 min – 1hour). From the results it is not possible to derive a reliable BCF value, but from the results it is clear that the BCF for hexachloroethane > 100, while the BCF for the other two compounds < 100.

Table 4.1: Calculated BCF values for whole fish.

	Log K_{ow}	BCF calculated	BCF experimental
acrylonitrile	0.25	0.3	
ethylene	1.13	2	
ethylene oxide	-0.3	0.1	
dichloromethane	1.25	2	
trichloromethane	1.97	9	
tetrachloromethane	2.83	51	
1,1-dichloroethane	1.79	7	
1,2-dichloroethane	1.47	4	
1,1,1-trichloroethane	2.49	26	
1,1,2-trichloroethane	2.07	11	
1,1,2,2-tetrachloroethane	2.62	34	
pentachloroethane	3.22	109	67[b]
hexachloroethane	4.14	659	139[b]
1,2-dichloropropane	1.99	10	
1,3-dichloropropane	2	10	
chloroethylene	1.52[a]	4	
1,1-dichloroethylene	2.13	13	
trans-1,2-dichloroethylene	1.86	8	
cis-1,2-dichloroethylene	2.09	12	
trichloroethylene	2.61	33	
tetrachloroethylene	3.4	155	49[b]
3-chloropropene	1.51[a]	4	
1,3-dichloropropene	1.82	7	
2,3-dichloropropene	2.34	19	
2-chlorobutadiene	2.15[a]	13	
hexachlorobutadiene	4.78	2307	Up to 19000[c]

Notes:
a: derived from ClogP calculations (BioByte, 2004).
b: (Barrows et al., 1980)
c: Datasheet of the WFD (Environmental Quality Standards (EQS), 2005c)

As a conclusion, two volatile compounds (hexachloroethane and hexachlorobutadiene) have a BCF value > 100, and secondary poisoning is assessed.

4.2.2 Secondary poisoning

4.2.2.1 Hexachlorobutadiene

For hexachlorobutadiene (HCBD) an ERL is derived in the WFD datasheet (Environmental Quality Standards (EQS), 2005c). Here the lowest $NOAEL_{oral}$ (No Observed Adverse Effect Level) found is 0.2 mg/kg bw/d. This value is used to calculate the $NOEC_{food}$ using a conversion factor (CONV).

The $NOEC_{food,rat} = NOAEL_{rat} * CONV\ 20 = 4$ mg HCBD / kg food

and the $NOEC_{food,mouse} = NOAEL_{mouse} * CONV\ 8.3 = 1.66$ mg HCBD / kg food

The lowest value (1.66) for mice is than used to derive the quality standard, and an assessment factor of 30 is used to derive a $PNEC_{food}$ from a chronic $NOEC_{food.}$

The $PNEC_{food}$ from the NOEC for mice thus is 1.66 / 30 = 0.0553 mg/kg food and the

$QS_{secpois,biota}$ = 55.3 µg HCBD / kg biota tissue (wet wt).

Than the quality standard for secondary poisoning in water is calculated using the formula:

$QS_{secpois,water} = QS_{secpois,biota}$ (55.3)/BCF*BMF.

For the BCF the value of 17000 is used (see above). For the BMF (Biomagnification Factor) TDG defaults of 10 (freshwater) and 100 (saltwater) could be used, but in the best case (no biomagnification) a factor 1 can be used for both water types. Since – based on the information available – no evidence is found for biomagnification the latter values have been used and the

$QS_{secpois,water}$ = 0.0033 µg hexachlorobutadiene / L

is taken as protective for secondary poisoning. From this value the $QS_{SPM,water}$ is derived using a partitioning coefficient and
the $QS_{SPM,water}$ (freshwater and saltwater) = 3.3 µg/kg SPM (dry weight).

A comparison is made with the quality standard for food uptake by humans. A TDI of 0.2 µg/kg bw is used. As a starting point it is assumed that not more than 10% of the TDI should originate form aquatic food sources, resulting for a 70 kg person in a TDI of 1.4 µg HCBD per day (from aquatic food sources). Since the average fish consumption in Europe is 115 g/d, the $QS_{hh,food}$ = 1.4 µg/115 g * 1000 g = 12.2 µg HCBD/kg food.

Since no indications for biomagnification have been found,
the $QS_{hh,water} = QS_{hh,food}$ (12.2 µg/kg)/BCF.

For the BCF different values has been used (since humans normally do not eat whole fish), resulting in different QS values (see Table 4.2).

Table 4.2: Scenario's for quality standards for human uptake of seafood (source: (Environmental Quality Standards (EQS), 2005c).

Scenario	BCF	$QS_{hh,water}$ (µg/l)
BCF_{fish} (whole body)	17,000	0.0007
BCF Blue mussel	2,000	0.0061
BCF in Plaice fillet	700	0.0174

From the above in the WFD datasheet it is concluded that the $QS_{secpois,water}$ can be considered as protective for humans and consumption of sea food.

4.2.2.2 Hexachloroethane

The NOEALs found are summarized in Table 4.3. Here the lowest $NOAEL_{oral}$ found is 1 $mg/kg_{bw}/d$. This value is used to calculate the $NOEC_{food}$ using a conversion factor.

Table 4.3: Mammal and bird oral toxicity data relevant for the assessment of secondary poisoning (lowest endpoints reported): source ATSDR (1997).

Species	Type of study	NOAEL $mg/kg_{bw}/d$
Rat	2 y, several endpoints	160
Rat	16 w, hepatic and renal systemic effects	1
Mouse	2 y, body weight	590

The $NOEC_{food,rat}$ = $NOAEL_{rat}$ * CONV 20 = 20 mg HCBD / kg food.
The $NOEC_{food,mouse}$ = $NOAEL_{mouse}$ * CONV 8.3 = 4897 mg HCBD / kg food.

The lowest value (20) for rat is than used to derive the quality standard, and an assessment factor of 30 is used to derive a $PNEC_{food}$ from a chronic $NOEC_{food.}$

The $MPC_{oral,min}$ ($PNEC_{food}$) thus is 20/30 = 0.666 mg/kg food and the

$MPC_{secpois,biota}$ = 666 µg Hexachloroethane / kg biota tissue (wet wt).

Then the quality standard for secondary poisoning in water is calculated using the formula:

$MPC_{secpois,water}$ = $MPC_{secpois,biota}$ (666)/(BCF*BMF)

For the BCF the value of 139 is used (see above). For the BMF the TGD (European Commission, 2003) defaults a value of 1 (freshwater) for compounds with a log K_{ow}< 4.5 and the

$MPC_{secpois,freshwater}$ = 4.79 µg hexachloroethane / L

is taken as protective for secondary poisoning. From this value the $QS_{SPM,water}$ is derived using a partitioning coefficient and the $QS_{SPM,water}$ (freshwater) = 3171 µg/kg SPM (dry weight). Since the MPC derived for freshwater species is 0.67 µg/l this value is assumed to be protective for secondary poisoning.

4.3 Derivation of ERLs for soil and sediment

The terrestrial and benthic toxicity data that are found for the volatile aliphatic hydrocarbons considered in this report are presented in Appendix 4. The selected toxicity data, used to derive the ERLs are shown in Appendix 2.

4.3.1 Acrylonitrile (2-propenenitrile)

Data for soil organisms are lacking. In the EU-RAR (European Commission, 2004a) the PNEC has been derived using the equilibrium partitioning method (0.00268 mg/kg). However, the partition coefficients that have been used in the EU-RAR could not be reproduced using the formulas presented in the TGD (European Commission, 2003). Recalculation of the equilibrium partitioning and normalising to Dutch standard soil and sediment yielded 0.021 mg/kg for the MPC for soil and the MPC for sediment is 0.050 mg/kg. The SRC_{eco} has been derived from the aquatic data too, and the $SRC_{eco,soil}$ is 1.5 mg/kg and the $SRC_{eco,sediment}$ is 3.7 mg/kg.

4.3.2 Ethylene

Only data for exposure of terrestrial organisms via air were found (see 4.4.1). Since an MPC for aquatic organisms could not be derived, it is also not possible to derive an MPC for the soil compartment by equilibrium partitioning. The $SRC_{eco,soil}$ has been derived from aquatic data and is 12 mg/kg and the $SRC_{eco,sediment}$ is 11 mg/kg.

4.3.3 Ethylene oxide (oxirane)

Data for soil organisms are lacking. Therefore the terrestrial MPC has been derived from the aquatic data and the MPC for soil is 0.039 mg/kg and the MPC for sediment is 0.18 mg/kg. The SRC_{eco} has been derived from the aquatic data too, and the $SRC_{eco,soil}$ is 8.7 mg/kg and the $SRC_{eco,sediment}$ is 41 mg/kg.

4.3.4 Dichloromethane (methylene dichloride)

The only available terrestrial data concern the inhibition of the respiration of soil micro-organisms (see Table A2.3) for which an IC_{50} (Inhibition Concentration) of 13429 mg/kg_{dw} standard soil has been found. Applying an assessment factor of 1000 results in an MPC of 13 mg/kg soil. The value derived from aquatic data results in an MPC for soil of 4.8 mg/kg. Since this value is lower, 4.8 mg/kg is taken as the MPC for soil. Since data for sediment organisms are lacking, the MPC for sediment is derived from the aquatic data and is 7.5 mg/kg. The SRC_{eco} derived from aquatic data is lower than the acute terrestrial value with an assessment factor of 10. Therefore, the SRC_{eco} has been derived from the aquatic data, and the $SRC_{eco,soil}$ is 130 mg/kg and the $SRC_{eco,sediment}$ is 200 mg/kg.

4.3.5 Trichloromethane (chloroform)

Data for soil organisms are lacking. Therefore, the terrestrial MPC has been derived from the aquatic data and the MPC for soil is 1.7 mg/kg. In the WFD data sheet (Environmental Quality Standards (EQS), 2004) one long term test is available for sediment organisms Table A2.4). Applying an assessment factor of 100 on this NOEC results in an MPC for sediment of 81 $\mu g/kg_{dw}$ (standard soil). The SRC_{eco} has been derived from the aquatic data and the $SRC_{eco,soil}$ is 260 mg/kg. For the $SRC_{eco,sediment}$ an assessment factor of 10 has been used on the only LC_{50} value available, resulting in an $SRC_{eco, sediment}$ of 1.0 mg/kg.

4.3.6 Tetrachloromethane (carbon tetrachloride)

For soil organisms, a study was found for soil micro-organisms (Table A2.5). Besides that value, a value is available for exposure through a medium solution (Table A2.1), but such data can not be used for calculating an MPC for soil. The MPC based on the value of exposure through soil would be 6.4 mg/kg. The MPC derived from aquatic data is 0.069 mg/kg soil. Since toxicity data are available for one group of organisms only, the lower of the two is taken as the MPC and the MPC for soil for tetrachloromethane is 0.069 mg/kg. For sediment no toxicity data are available. The MPC is derived from aquatic data and is 0.084 mg/kg . For the SRC_{eco} the value for soil micro-organisms with a safety factor of 10 (642.9) is compared with the value derived from aquatic data and the latter value of 29 mg/kg is taken as the SRC_{eco} for soil. The $SRC_{eco,sediment}$ has been derived from aquatic data and is 35 mg/kg.

4.3.7 1,1-Dichloroethane

For soil organisms, data are available for exposure of a medium (see Table A2.7 for the unspecified isomer and Table A2.8 for 1,1-dichloroethane). These data can not be used for calculating an MPC for soil. Data for soil organisms exposed via soil are lacking. Since also aquatic data are too scarce to derive a PNEC, it is also not possible to use the aquatic data for deriving a PNEC for soil. The SRC_{eco} has been derived from the aquatic SRC_{eco}, and the $SRC_{eco,soil}$ is 20 mg/kg and the $SRC_{eco,sediment}$ is 36 mg/kg.

4.3.8 1,2-Dichloroethane

The only available data concern the inhibition of the respiration of soil micro-organisms (see Table A2.9) for which an IC_{50} of 7286 mg/kg_{dw} (standard soil) has been found. Applying an assessment factor of 1000 results in an MPC of 7.3 mg/kg soil. The value derived from aquatic data results in an MPC for soil of 3.0 mg/kg. Since this value is lower, 3.0 mg/kg is taken as the MPC for soil. The MPC for sediment has been derived from the aquatic data and is 4.8 mg/kg. Since the SRC_{eco} derived from aquatic data is lower than the acute terrestrial value with an assessment factor of 10, the $SRC_{eco,soil}$ has been derived from the aquatic data. The $SRC_{eco,soil}$ is 180 mg/kg and the $SRC_{eco,sediment}$ is 290 mg/kg.

4.3.9 1,1,1-Trichloroethane

For soil organisms, data are available for exposure through a medium (see Table A2.10). These data can not be used for calculating an MPC for soil. The only available data for exposure through soil concern the inhibition of the respiration of soil micro-organisms (see Table A2.12) for which an IC_{50} of 8429 mg/kg_{dw} (standard soil) has been found. Applying an assessment factor of 1000 results in an MPC of 8.4 mg/kg soil. The value derived from aquatic data results in an MPC for soil of 0.15 mg/kg. Since this value is lower, 0.15 mg/kg is taken as the MPC for soil. The MPC for sediment has been derived from the aquatic data and the MPC for sediment is 0.18 mg/kg. The $SRC_{eco,soil}$ derived from aquatic data using equilibrium partitioning is 10 mg/kg. Since this value is lower than the acute terrestrial value with an assessment factor of 10, 10 mg/kg is taken as the $SRC_{eco,soil}$. The $SRC_{eco,sediment}$ has been derived from the aquatic data and is 12 mg/kg.

4.3.10 1,1,2-Trichloroethane

For soil organisms, data are available for exposure through a medium (see Table A2.13). These data can not be used for calculating an MPC for soil. Since no terrestrial toxicity data with exposure through soil were found for 1,1,2-trichloroethane, the MPC for soil has been derived using the equilibrium partitioning method. This results in an MPC_{soil} of 1.7 mg/kg and an $MPC_{sediment}$ is 2.2 mg/kg. Also the SRC_{eco} has been derived from the aquatic data and the $SRC_{eco,soil}$ is 91 mg/kg and the $SRC_{eco,sediment}$ is 120 mg/kg.

4.3.11 1,1,2,2-Tetrachloroethane

The only available data concern the inhibition of the respiration of soil micro-organisms (see Table A2.14) for which an IC_{50} of 1714 mg/kg_{dw} (standard soil) has been found and a value for a macrophyt exposed trough a medium solution (see Table A2.15). Applying an assessment factor of 1000 results in an MPC of 1.7 mg/kg soil. The value derived from aquatic data results in an MPC for soil of 0.066 mg/kg. Since this value is lower 0.066 mg/kg is taken as the MPC for soil. The MPC for sediment has been derived from the aquatic data and the MPC for sediment is 0.079 mg/kg. Since the SRC_{eco} derived from aquatic data is lower than the acute terrestrial value with an assessment factor of 10, the SRC_{eco} has been derived from the aquatic data, and the $SRC_{eco,soil}$ is 14 mg/kg and the $SRC_{eco,sediment}$ is 17 mg/kg.

4.3.12 Pentachloroethane

Since no terrestrial toxicity data were found for pentachloroethane, the MPC for soil has been derived using the equilibrium partitioning method. The MPC_{soil} is 0.86 mg/kg and the $MPC_{sediment}$ is 0.90 mg/kg. The $SRC_{eco,soil}$ is 27 and the $SRC_{eco,sediment}$ is 29 mg/kg.

4.3.13 Hexachloroethane

No terrestrial toxicity data were found for hexachloroethane, so the MPC for soil has been estimated using the equilibrium partitioning method. The MPC_{soil} is 0.10 mg/kg and the $MPC_{sediment}$ is 0.10 mg/kg. The $SRC_{eco,soil}$ is 16 and the $SRC_{eco,sediment}$ is 16 mg/kg. The calculated MPC for secondary poisoning for soil of 0.22 mg/kg, calculated on basis of the $MPC_{oral,min}$ ($PNEC_{food}$), the K_{oc} and K_{ow} (Van Vlaardingen and Verbruggen, in prep.), are not more stringent than the value of 0.10 mg/kg derived by equilibrium partitioning.

4.3.14 1,2-Dichloropropane

For soil organisms a NOEC is available for *Eisenia fetida* (see Table A2.17). On this NOEC an assessment factor of 100 has been applied to obtain the MPC of 580 mg/kg_{dw}. However, the acute toxicity values for earthworms are lower than the chronic values, and therefore the MPC has been derived by applying an assessment factor of 1000 on the lowest acute value (*Perionyx excavatus*, LC_{50} 3880 mg/kg) resulting in an MPC_{soil} of 3.9 mg/kg. For soil micro-organisms an IC_{50} value of 4571 is found, which would result in an MPC of 4.6. Since data for two different taxonomic groups are found, with different functional properties, the MPC for soil is based on the soil data without comparison with equilibrium partitioning, and is 3.9 mg/kg. The value based aquatic toxicity data would be 0.85 mg/kg. Since these values are in the same order of magnitude, this underpins the choice for the value based on soil organisms. The $MPC_{sediment}$, derived on basis of equilibrium partitioning, is 1.3 mg/kg. For derivation of the $SRC_{eco,soil}$, the terrestrial data were considered first. Since the geometric mean of the LC_{50}s/10 is lower than the NOEC, this value of 440 mg/kg has been selected as $SRC_{eco,soil}$. Since this value is based on two EC_{50} values only, according to (Van Vlaardingen and Verbruggen, in prep.), this value has to be compared with the value based on aquatic data of 59 mg/kg. Since the latter value is lower, it has been taken as the $SRC_{eco,soil}$. The $SRC_{eco,sediment}$ has been derived by equilibrium partitioning from the aquatic data and is 92 mg/kg.

4.3.15 1,3-Dichloropropane

No terrestrial toxicity data were found for hexachloroethane, so the MPC for soil has been estimated using the equilibrium partitioning method. The MPC_{soil} is 0.11 mg/kg and the $MPC_{sediment}$ is 0.16 mg/kg. The $SRC_{eco,soil}$ is 21 and the $SRC_{eco,sediment}$ is 31 mg/kg.

4.3.16 Chloroethylene (vinylchloride)

For chloroethylene some data for exposure via air are available (see Table A4.20). These data, however are not suitable to derive an MPC for soil, so the MPC for soil has to be derived using the equilibrium partitioning method based on the aquatic toxicity data. Since the base set for aquatic organisms in incomplete, it is not possible to derive an MPC for soil for chloroethylene. The effect-level of the terrestrial data is not specified, and therefore also no MPC for air could be derived. The $SRC_{eco,soil}$ has been derived with the equilibrium partitioning method and is 180 mg/kg, and the $SRC_{eco,sediment}$ is 290 mg/kg.

4.3.17 1,1-Dichloroethylene

From the available toxicity data for terrestrial organisms (see Table A4.21) no reliable endpoint could be derived. Therefore the MPC for soil has been derived using the aquatic toxicity data. The MPC_{soil} is 0.044 mg/kg and the $MPC_{sediment}$ is 0.054 mg/kg. The $SRC_{eco,soil}$ is 53 and the $SRC_{eco,sediment}$ is 65 mg/kg.

4.3.18 1,2-Dichloroethylene

For 1,2-dichloroethylene no toxicity data for terrestrial organisms were found. Since the aquatic data for 1,2-dichloroethylene were combined with the data of the isomers, the MPC for soil is derived from these data and is 0.020 mg/kg, and the MPC for sediment is 0.030 mg/kg. The $SRC_{eco,soil}$ derived by equilibrium partitioning is 32 mg/kg and the $SRC_{eco,sediment}$ is 48 mg/kg.

4.3.19 *trans*-1,2-Dichloroethylene

The MPC_{soil} has been derived from the combined data for aquatic organisms and is 0.028 mg/kg, and the $MPC_{sediment}$ is 0.039 mg/kg. The $SRC_{eco,soil}$ has been derived based on aquatic data as well and is 44 mg/kg and the $SRC_{eco,sediment}$ is 61 mg/kg.

4.3.20 *cis*-1,2-Dichloroethylene

The only available data concern the inhibition of the respiration of soil micro-organisms (see Table A2.21) for which an IC_{50} of 6429 mg/kg_{dw} (standard soil) has been found. Applying an assessment factor of 1000 results in an MPC of 6.4 mg/kg soil. The MPC derived from the (combined) aquatic data is 0.019 mg/kg. Since the latter standard is much lower 0.019 mg/kg is taken as the MPC for soil. The MPC for sediment is 0.031 mg/kg. The $SRC_{eco,soil}$ derived from soil data is 640 mg/kg_{dw}. Since the $SRC_{eco,soil}$ value based on aquatic data is lower, this value of 31 mg/kg_{dw} is taken as the $SRC_{eco,soil}$. The $SRC_{eco,sediment}$ is derived from aquatic data and is 48 mg/kg.

4.3.21 Trichloroethylene

From the available toxicity data for terrestrial organisms (see Table A2.23 and Table A2.24) the only endpoint upon on which an MPC can be derived, concerns the inhibition of the respiration of soil micro-organisms for which an IC_{50} of 8000 mg/kg_{dw} has been found. Applying a safety factor of 1000 would result in an MPC of 8.0 mg/kg. In the EU-RAR (European Commission, 2004b) it is argued that the data for exposure via medium could be seen as representative for soil pore water. However the application of a safety factor of 1000 of this one chronic NOEC for plants would result in a value (0.118 mg/l) that is almost equal to aquatic PNEC (0.115 mg/l). Therefore in the EU-RAR, the PNEC for soil has been derived using equilibrium partitioning method with the PNEC for water. When this value is compared to the value derived from terrestrial organisms (see above) the value derived from aquatic organism is much lower. Therefore, the MPC_{soil} is 0.68 mg/kg. The $MPC_{sediment}$ is 0.86 mg/kg. The $SRC_{eco,soil}$ is 27 mg/kg and the $SRC_{eco,sediment}$ is 34 mg/kg.

4.3.22 Tetrachloroethylene

It is stated in the EU-RAR for tetrachloroethylene (European Commission, 2001) that enough terrestrial toxicity data are reported to allow the PNEC to be derived from actual data, although these are of questionable validity. Long-term studies have been conducted with three trophic levels/species; invertebrates (*Eisenia fetida*), plants (*Avena sativa*) and soil dwelling bacteria. The lowest NOEC reported is for nitrification (≤ 0.1 mg/kg wet weight). Applying an assessment factor of 10 results in an MPC_{soil} of 0.029 mg/kg wet weight (recalculated to an organic matter content of 10% assuming an organic matter content of the test soil of 3.4%, i.e. the standard soil from the TGD). The organic matter content of the soil was not reported. Recalculation of the MPC to dry weight results in an MPC of 0.033 mg/kg.

The MPC for terrestrial species can also be derived from the aquatic toxicity data using the equilibrium partitioning method. The value reported in the EU-RAR for tetrachloroethylene

(0.24 mg/kg wet weight) results in an MPC_{soil} of 0.71 mg/kg after recalculation to an organic matter content of 10%. Recalculation to dry weight results in an MPC soil of 0.80 mg/kg. The MPC derived from actual soil organism toxicity data is lower than the MPC derived from aquatic species data and so, it will be used as MPC. For sediment the value reported in the EU-RAR (277 mg/kg wet weight) is calculated with the equilibrium partitioning method and results in an $MPC_{sediment}$ of 0.86 mg/kg_{dw}, after subsequent correction for organic matter content and correction from wet weight to dry weight. For the derivation of $SRC_{eco,soil}$, three NOECs are available for three species and the geometric mean of all chronic toxicity data of 8.1 mg/kg is used as $SRC_{eco,soil}$. The $SRC_{eco,sediment}$ is calculated from the aquatic toxicity data and is 130 mg/kg.

4.3.23 3-Chloropropene

For 3-chloropropene no toxicity data for terrestrial organisms were found. Therefore the MPC for soil is derived using the aquatic toxicity data. The MPC_{soil} is 0.00065 mg/kg and the $MPC_{sediment}$ is 0.0011 mg/kg. The $SRC_{eco,soil}$ is 3.6 mg/kg and the $SRC_{eco,sediment}$ is 6.4 mg/kg.

4.3.24 1,3-Dichloropropene

The terrestrial toxicity data are shown in Table A4.35. From these data it is difficult to derive a NOEC and therefore an MPC. The only conclusion could be that the NOEC is in the order of magnitude of 100 mg/kg, and the MPC would be derived using an assessment factor of 100, resulting in an MPC in the order of magnitude of 1 mg/kg. However, when equilibrium partitioning is applied, the MPC_{soil} is 0.00056 mg/kg, and since this value is much lower, it is selected. The $MPC_{sediment}$ according to equilibrium partitioning is 0.00084 mg/kg. The $SRC_{eco,soil}$ is 0.087 mg/kg and the $SRC_{eco,sediment}$ is 0.13 mg/kg.

4.3.25 *trans*-1,3-Dichloropropene and *cis*-1,3-dichloropropene

For *trans*-1,3-dichloropropene and *cis*-1,3-dichloropropene no reliable toxicity data could be derived from the available data (see Table A4.36 and Table A4.37). The terrestrial data for *trans*- and *cis*-1,3-dichloropropene nevertheless confirm that the value of 1 mg/kg, derived on basis of terrestrial toxicity data for the unspecified isomer, is probably not protective for other trophic levels than microbes and fungi. Therefore the MPCs and SRCs are derived from the aquatic data. Since these data are the same for the different isomers, the values for soil are also the same as for 1,3-dichloropropene (see section 4.3.24).

4.3.26 2,3-Dichloropropene

For 2,3-dichloropropene no terrestrial toxicity data were found. Since also no MPC could be estimated for the aquatic environment, the MPC can not be derived from that data. The $SRC_{eco,soil}$ has been derived from the aquatic data and is 8.0 mg/kg and the $SRC_{eco,sediment}$ is 9.5 mg/kg.

4.3.27 2-Chlorobutadiene

No toxicity data were found for terrestrial organisms, so the MPC has been derived on basis of equilibrium partitioning. The MPC_{soil} is 0.10 mg/kg and the $MPC_{sediment}$ is 0.12 mg/kg. The $SRC_{eco,soil}$ is 10 mg/kg and the $SRC_{eco,sediment}$ is 12 mg/kg.

4.3.28 Hexachlorobutadiene

Data for soil organisms are lacking. The MPC could be derived from the aquatic data and the resulting MPC for soil is 0.29 mg/kg and the MPC for sediment is 0.29 mg/kg. However, the quality standard should also be protective for secondary poisoning. For water it was already observed that the quality standard calculated for secondary poisoning is more stringent (see section 4.2.2.1). Also for soil, the calculated MPC for secondary poisoning of 0.019 mg/kg, calculated on basis of the PNEC, the K_{oc} and K_{ow} (Van Vlaardingen and Verbruggen, in prep.), is more stringent than the value of 0.29 mg/kg derived by equilibrium partitioning.

Therefore the MPC for soil has been derived from secondary poisoning and is 19 µg/kg. The SRC_{eco} is derived from the aquatic data too, and the $SRC_{eco,soil}$ is 4000 mg/kg and the $SRC_{eco,sediment}$ is 4000 mg/kg.

4.3.29 Comparison of toxicity data for aquatic organisms with toxicity data for terrestrial organisms.

In the literature, for a number of compounds toxicity data have been found for terrestrial species in medium. These data have not been used for derivation of ERLs. In this report all ERLs for the terrestrial compartment have been derived from aquatic data or terrestrial exposed through soil. To underpin that the standards derived by the equilibrium partitioning method are protective for terrestrial species, the data for terrestrial species in medium are compared to the aquatic data below.

For dichloroethane toxicity data were found for *Rhizobium meliloti* in medium tested with unspecified isomer. In Table 4.4 and Table 4.5 this figure is compared to the aquatic toxicity data. From this comparison, it is obvious that most of the aquatic species show lower toxicity values than the data for the terrestrial bacteria. Also the MPC derived from the aquatic data for 1,2-dichloroethane is protective for terrestrial bacteria.

Table 4.4: Comparison of selected toxicity data for 1,1-dichloroethane to aquatic species with selected toxicity data for terrestrial species in medium.

Aquatic data		Data for soil organisms in medium (dichloroethane unspecified isomer)	
Taxonomic group	$E(L)C_{50}$ [mg/l]	Taxonomic group	$E(L)C_{50}$ [mg/l]
Freshwater			
Bacteria		**Bacteria**	
Nitrosomonas sp.	0.91	*Rhizobium meliloti*	240
Nitrobacter sp.	1653	**Macrophyta**	
Pisces		*Populus deltoides x nigra*	802
Poecilia reticulata	202		

Table 4.5 : Comparison of selected toxicity data for 1,2-dichloroethane to aquatic species with selected toxicity data for terrestrial species in medium.

Aquatic data		Data for soil organisms in medium	
Taxonomic group	$E(L)C_{50}$ [mg/l]	Taxonomic group	$E(L)C_{50}$ [mg/l]
Algae		**Bacteria**	
Scenedesmus subspicatus	189	*Rhizobium meliloti*	240
Crustacea			
Daphnia magna	148		
Gammarus fasciatus	100		
Pisces			
Lepomis macrochirus	94		
Micropterus salmoides	66		
Pimephales promelas	37		

In the case of 1,1,1-trichloroethane more data were found for terrestrial organisms in medium In Table 4.6 it can be seen that the terrestrial data are within the range of the aquatic data. The MPC derived for aquatic species (0.021 mg/l) is protective for the terrestrial species.

Table 4.6 : Comparison of selected toxicity data for 1,1,1-trichloroethane to aquatic species with selected toxicity data for terrestrial species in medium.

Aquatic data		Data for soil organisms in medium	
Taxonomic group	$E(L)C_{50}$ [mg/l]	Taxonomic group	$E(L)C_{50}$ [mg/l]
Bacteria		**Protozoa**	
Nitrosomonas sp.	8.5	*Colpoda sp.*	205
Escherichia coli	2028	**Bacteria**	
Spirochaeta aurantia	414	*Rhizobium meliloti*	46
Algae		**Oligochaeta**	
Chlamydomonas reinhardtii	0.536	*Aeolosoma hemprichi*	92
Chlamydomonas angulosa	280	**Rotifera**	
Chlorella vulgaris	153	*Philodina erytrophtalma*	162
Scenedesmus suspicatus	813	**Macrophyta**	
Crustacea		*Lactuca sativa*	58
Daphnia magna	30	*Populus deltoides x nigra*	160
Streptocephalus proboscideus	1314		
Pisces			
Lepomis macrochirus	66		
Pimephales promelas	47		
Poecilia reticulata	133		
Oncorhynchus mykiss	52		
Oryzias latipes	440		
Brachydanio rerio	55		
Leuciscus idus melanotus	123		

From Table 4.7 and Table A4.8 it can be seen that a mixed Protozoa culture, dominated by *Methylosinus trichosporium,* is more sensitive to 1,1-dichloroethylene and *trans*-1,2-dichloroethylene than the aquatic organisms. In the case of 1,1-dichloroethylene the MPC derived for aquatic species (0.009 mg/l) is however well below the toxicity value for *Methylosinus trichosporium*. For *trans*-1,2-dichloroethylene the MPC bases on aquatic data (0.022 mg/l) is also protective for the terrestrial species found.

Table 4.7: Comparison of selected toxicity data for 1,1-dichloroethylene to aquatic species with selected toxicity data for terrestrial species in medium.

Aquatic data		Data for soil organisms in medium	
Taxonomic group	$E(L)C_{50}$ [mg/l]	Taxonomic group	$E(L)C_{50}$ [mg/l]
Algae		**Protozoa**	
Chlamydomonas reinhardtii	9	*Methanotrophic mixed culture, 92% Methylosinus trichosporium*	0.098
Scenedesmus subspicatus	410	**Macrophyta**	
Crustacea		*Populus deltoides x nigra*	281
Daphnia magna	30		
Pisces			
Lepomis macrochirus	116		
Pimephales promelas	108		

Table 4.8: Comparison of selected toxicity data for trans-1,2-dichloroethylene to aquatic species with selected toxicity data for terrestrial species in medium.

Aquatic data		Data for soil organisms in medium	
Taxonomic group	$E(L)C_{50}$ [mg/l]	Taxonomic group	$E(L)C_{50}$ [mg/l]
Bacteria		**Protozoa**	
Nitrosomonas sp.	80	*Methanotrophic mixed culture, 92% Methylosinus trichosporium*	4.7
Nitrobacter sp.	1777	**Macrophyta**	
Crustacea		*Populus deltoides x nigra*	349
Daphnia magna	220		

For trichloroethylene (see Table 4.9) it is also clear that the toxicity for terrestrial organisms is within the range of the aquatic organisms, and the MPC of 0.015 mg/l is protective for terrestrial species as well.

Table 4.9: Comparison of selected toxicity data for trichloroethylene to aquatic species with selected toxicity data for terrestrial species in medium.

Aquatic data		Data for soil organisms in medium	
Taxonomic group	$E(L)C_{50}$ [mg/l]	Taxonomic group	$E(L)C_{50}$ [mg/l]
Algae		**Annelida**	
Chlamydomonas reinhardtii	36.5	*Aelosoma hemprichi*	47
Phaeodactylum tricornutum	8	**Protozoa**	
Scenedesmus subspicatus	450	*Colpoda sp.*	75
Crustacea		**Rotifera**	
Asellus aquaticus	30	*Philodina erythropthalma*	92
Daphnia cucullata	57	**Macrophyta**	
Daphnia magna	38.1[a]	*Populus deltoides x nigra*	131
Pisces			
Brachydanio rerio	60		
Jordanella floridae	28.28		
Leuciscus idus melanotus	136		
Oncorhynchus mykiss	42		
Pimephales promelas	43.8[b]		
Poecilia reticulata	54.8		
Insecta			
Aedes aegypti	48		
Chironomus thummi	64		
Cloeon dipterum	42		
Corix punctata	110		
Culex pipiens	55		
Ischnura elegano	49		
Nemona cinerea	70		
Amphibia			
Xenopus laevis	45		
Cnidaria			
Hydra oligactis	75		
Mollusca			
Lymnaea stagnalis	56		
Platyhelminthes			
Dugesia lugubris	42		
Erpobdella octoculata	75		
Protozoa			
Tetrahymena pyriformis	410		

For tetrachloroethylene, *cis*-1,2-dichloroethylene, 1,1,2,2-tetrachloroethane, and 1,1,2-trichloroethane data for *Populus deltoides x nigra* are available (see Table A2.26,

Table A2.22, Table A2.15 and Table A2.13). In all cases the data for terrestrial species are in the same range or less sensitive than the aquatic toxicity data.

From the comparison of the sensitivity of terrestrial species tested in medium with the sensitivity of aquatic species it is concluded that MPCs for soil derived from aquatic data are protective for terrestrial species.

4.4 Derivation of ERLs for air

Toxicity data for exposure via air are available for a limited number of compounds. For these compounds an environmental quality standard is proposed below.

4.4.1 Ethylene

In the history of standard setting for ethylene in air in the Netherlands three type of standards were used:

1. A standard for short term exposure (maximum average value for one hour). This value has been reviewed by Janus, (2002); in the latter report an MPC value for short term exposure of 300 μg/m^3 is proposed as 95-percentile of the average value for one hour. Since Janus reviewed the literature, no reason is seen to deviate from this proposal.
2. Furthermore an ERL for discontinuous exposure is proposed of 50 μg/m^3 as 95-percentile for the average values for 24 hour, for chronic, discontinuous exposure. Also for this value no reason is seen to deviate.
3. However, in line with the other ERLs as derived in this report, the MPC preferably should be based on effects resulting from chronic exposure. These type of data are available, but were not reviewed in Janus (2002). The present MPC value of 9 μg/m^3 is (maximum average value for 24 hour) based on the effect threshold line for ‘very sensitive species’ (Van der Eerden, 1987). In Table A4.1 the long-term toxicity data used in Janus (2002) are reviewed, and EC_{10} values were recalculated using the reported data. Table A2.1 shows the endpoints derived from these data. The lowest NOEC found is 7 μg/m^3. Given the fact that ethylene is a natural occurring substance and the availability of NOECs data for five plant species, it is proposed to apply a safety factor of 10 and the MPC for long term exposure in air is 0.7 μg/m^3.

Background concentrations reported in ‘natural areas’ in which no anthropogenic exposure is supposed, are less than 1 ppm (about 1 μg/l) (Archambault and Li, 2001). A measurement in a forest showed a level of 4.6 μg/m^3 with a peak value of 13.7 μg/m^3 (Reid and Watson, 1985).

4.4.2 Ethylene oxide (oxirane)

Some data for exposure via air are available, but they concern the effects at a high dose used for disinfection only. Only data for insects are available (see Table A2.2). The lowest value is found for *Rhyzopertha domenica* (LC_{50} = 1.2 mg/l). The EU/TGD does not provide guidance for deriving a PNEC. In analogy of other compartments an assessment factor of 1000 could be applied, which would result in an MPC for air of 0.0012 mg/l.

4.4.3 1,1,1-Trichloroethane

In the case of 1,1,1-trichloroethane also EC_{50} data for the concentration in air are available for vascular plants and insects (Table A2.11). On these data the same principles are applied as for the soil data, and a PNEC is derived by applying an assessment factor of 1000 on the lowest

EC_{50} value, in this case found for *Nicotiana tabacum*. From this value an MPC of 0.013 mg/l air is derived.

4.4.4 1,1,2,2-Tetrachloroethane

For 1,1,2,2-tetrachloroethane data are available for exposure via air only (see Table A2.16). Since only one EC_{50} value is found for *Nicotiana tabacum* (0.065 mg/l), the MPC is derived by applying an assessment factor of 1000 on this figure, and the MPC is 0.000065 mg/l air.

4.4.5 *Trans*-1,2-dichloroethylene

For *trans*-1,2-dichloroethylene for terrestrial organisms only data for exposure via air of *Nicotiana tabacum* are available (see Table A2.20). The (Effect Dose) ED_{50} for germination is 78 mg/l. In analogy to the terrestrial compartment an assessment factor of 1000 can be applied and an MPC of 0.078 mg/l could be derived for air.

4.4.6 Tetrachloroethylene

The toxicity data reported in the EU-RAR (European Commission, 2001) are presented in Table A2.27. For tetrachloroethylene data are available for exposure of plants via air. The lowest available NOEC was that of 46 $\mu g/m^3$ for *Phaseolus vulgaris*. The authors of the EU-RAR state that an assessment factor of 5 is used for derivation of the MPC since the range of species covered and the near-field exposure conditions cover at least some of the usual uncertainty in extrapolating from experiments to the environment. Applying the assessment factor of 5 to the lowest NOEC results in an MPC of 9.2 $\mu g/m^3$ (= 0.0000092 mg/l).

4.4.7 Comparison of ERLs for air derived from aquatic data with ERLs derived from air data

In Table 4.10 the above derived MPCs are compared with the MPCs derived from aquatic data using equilibrium partitioning. It should be noted that applying the equilibrium partitioning method in this case only gives a rough indication of the risks for organisms exposed via air. In the case of an extrapolation from water to soil organisms, it can be argued that exposure of soil organism will often ocurr via pore water. In the case of extrapolation from water to air, this argument is not valid.

Table 4.10: Comparison of MPCs for air derived from aquatic data and from air data for compounds for which data for exposure via air were available

	MPC derived from aquatic data mg/l	MPC derived from air data mg/l
Ethylene oxide	0.00028	0.0012
1,1,1-Trichloroethane	0.015	0.013
1,1,2,2-Tetrachloroethane	0.00011	0.000065
Trans-1,2-dichloroethylene	0.0028	0.078
Tetrachloroethylene	0.045	0.0000092

For ethene it was not possible to derive an MPC for air from aquatic data, because no MPC for freshwater is available. Table 4.10 clearly shows that results vary widely. The derivation of the MPC for air with terrestrial species however, is based on a very limited number of data, so that high assessment factors were used. Nevertheless, it is not a priori demonstrated that an MPC based on aquatic data will be protective for terrestrial species exposed via air.

4.5 Summary of derived ERLs

The derived ERLs for water, sediment, soil and air that were derived are summarised below. In Table 4.11 the derived risk limits for freshwater are reported. For six substances (ethylene, 1,1-dichloroethane, chloroethylene, 1,2-dichloroethylene, *cis*-1,2-dichloroethylene and 2,3-dichloropropene), toxicity data were insufficient for deriving a reliable MPC for water, sediment and soil. Given the compound properties it is not deemed useful to make a distinction between dissolved and total content, so in principle the dissolved content is presented.

Table 4.11: Environmental risk limits for several volatile aliphatic hydrocarbons in freshwater.

	SRC_{eco} [mg/l]	MPC [mg/l]	AF	NC [mg/l]
acrylonitrile[a]	1.3	0.017	10	0.00017
ethylene[c]				
ethylene oxide	19	0.084	1000	0.00084
dichloromethane[b]	44	1.7	50	0.017
trichloromethane[b]	23	0.15	10	0.0015
tetrachloromethane[b]	5.0	0.012		0.00012
1,1-dichloroethane[c]				
1,2-dichloroethane[b]	64	1.1	10	0.011
1,1,1-trichloroethane	1.5	0.021	10	0.00021
1,1,2-trichloroethane	16	0.30	10	0.0030
1,1,2,2-tetrachloroethane	1.7	0.0080	100	0.000080
pentachloroethane	0.89	0.028	10	0.00028
hexachloroethane	0.11	0.00067	100	0.0000067
1,2-dichloropropane	20	0.28	10	0.0028
1,3-dichloropropane	6.0	0.030	100	0.00030
chloroethylene[c]				
1,1-dichloroethylene	11	0.0090	1000	0.000090
1,2-dichloroethylene	11	0.0068	1000	0.000068
trans-1,2-dichloroethylene	11	0.0068	1000	0.000068
cis-1,2-dichloroethylene	11	0.0068	1000	0.000068
trichloroethylene[a]	4.6	0.12	50	0.0012
tetrachloroethylene[a]	7.8	0.051	10	0.00051
3-chloropropene	1.9	0.00034	1000	0.0000034
1,3-dichloropropene	0.028	0.00018	50	0.0000018
trans-1,3-dichloropropene	0.028	0.00018	50	0.0000018
cis-1,3-dichloropropene	0.028	0.00018	50	0.0000018
2,3-dichloropropene[c]				
2-chlorobutadiene	1.9	0.019	100	0.00019
hexachlorobutadiene[b]	6.1	0.0000033	sec. pois.	0.000000033

Notes:
a: MPCs set equal to PNEC from EU-RAR, SRC_{eco} based on presented data in EU-RAR
b: MPCs set equal to AA-EQS from EU-WFD, SRC_{eco} based on presented data in EU-WFD
c: data insufficient for deriving an MPC

The values for marine organisms are all 1/10th of the values for freshwater (see Table 4.12), with the exception of dichloromethane, trichloromethane and 1,2 dichloroethane were it is argued in the WFD datasheets ((Environmental Quality Standards (EQS), 2005a; Environmental Quality Standards (EQS), 2004; Environmental Quality Standards (EQS), 2005b) that given the compound properties no differences between the freshwater and marine environment are to be expected. In the case of hexachlorobutadiene the standard is based on secondary poisoning. Normally, the biomagnifaction factor is higher for the marine environment due to the longer food chain. However, in the factsheet the use of a higher biomagnification than one is deemed unnecessary. Therefore, the standards are the same for fresh- and marine water.

Table 4.12: Environmental risk limits for several volatile aliphatic hydrocarbons in the marine environment.

	SRC_{eco} [mg/l]	MPC [mg/l]	AF	NC [mg/l]
acrylonitrile[a]	1.3	0.0017	100	0.000017
ethylene[c]				
ethylene oxide	19	0.0084	10000	0.000084
dichloromethane[b]	44	1.7	50	0.017
trichloromethane[b]	23	0.15	10	0.0015
Tetrachloromethane[b]	5.0	0.012		0.00012
1,1-dichloroethane[c]				
1,2-dichloroethane[b]	64	1.1	10	0.011
1,1,1-trichloroethane	1.5	0.0021	100	0.000021
1,1,2-trichloroethane	16	0.030	100	0.00030
1,1,2,2-tetrachloroethane	1.7	0.00080	1000	0.000008
pentachloroethane	0.89	0.0028	100	0.000028
hexachloroethane	0.11	0.000067	1000	0.00000067
1,2-dichloropropane	20	0.028	100	0.00028
1,3-dichloropropane	6.0	0.0030	1000	0.000030
chloroethylene[c]				
1,1-dichloroethylene	11	0.00090	10000	0.0000090
1,2-dichloroethylene	11	0.00068	10000	0.0000068
trans-1,2-dichloroethylene	11	0.00068	10000	0.0000068
cis-1,2-dichloroethylene	11	0.00068	10000	0.0000068
trichloroethylene[a]	4.6	0.012	500	0.0012
tetrachloroethylene[a]	7.8	0.0051	100	0.000051
3-chloropropene	1.9	0.000034	10000	0.00000034
1,3-dichloropropene	0.028	0.000018	500	0.00000018
trans-1,3-dichloropropene	0.028	0.000018	500	0.00000018
cis-1,3-dichloropropene	0.028	0.000018	500	0.00000018
2,3-dichloropropene[c]				
2-chlorobutadiene	1.9	0.0019	1000	0.000019
hexachlorobutadiene[b]	6.1	0.0000033	sec. pois.	0.000000033

Notes:
a: MPCs set equal to PNEC from EU-RAR, if presented, SRC_{eco} based on presented data in EU-RAR
b: MPCs set equal to AA-EQS from EU-WFD, SRC_{eco} based on presented data in EU-WFD
c: data insufficient for deriving an MPC

In Table A4.13, the derived risk limits for soil and sediment are presented. The data are normalised to an organic matter content of 10%. This is the standard organic matter content for soil and sediment within the framework of INS (Van Vlaardingen and Verbruggen, in prep.). In most cases the data for soil and sediment are derived using the equilibrium partitioning method. Only in the case of tetrachloroethylene the MPC_{soil} and the $SRC_{eco,soil}$ are derived from terrestrial toxicity data, and in the case of trichloromethane the $MPC_{sediment}$ is derived from sediment data. In all other cases the sediment or soil data were lacking, or the MPC or SRC derived with equilibrium partitioning yielded lower results, and were selected as MPC or SRC. In Table 4.14 the preliminary risk limits for terrestrial organisms exposed via air are summarised.

Table 4.13: Environmental risk limits for several volatile aliphatic hydrocarbons in soil and sediment.

	$SRC_{eco, soil}$ [mg/kg_{dw}]	MPC_{soil} [mg/kg_{dw}]	NC_{soil} [mg/kg_{dw}]	$SRC_{eco, sediment}$ [mg/kg_{dw}]	$MPC_{sediment}$ [mg/kg_{dw}]	$NC_{sediment}$ [mg/kg_{dw}]
acrylonitrile[a]	1.5	0.021	0.00021	3.7	0.050	0.00050
ethylene[c]						
ethylene oxide	8.7	0.039	0.00039	41	0.18	0.0018
dichloromethane[b]	130	4.8	0.048	200	7.5	0.075
trichloromethane[b]	26	1.7	0.017	1.0	0.081	0.00081
tetrachloromethane[b]	29	0.069	0.00069	35	0.084	0.00084
1,1-dichloroethane[c]						
1,2-dichloroethane[b]	180	3.0	0.030	290	4.8	0.048
1,1,1-trichloroethane	10	0.15	0.0015	12	0.18	0.0018
1,1,2-trichloroethane	91	1.7	0.017	120	2.2	0.022
1,1,2,2-tetrachloroethane	14	0.066	0.00066	17	0.079	0.00079
pentachloroethane	27	0.86	0.0086	29	0.90	0.0090
hexachloroethane	16	0.10	0.0010	16	0.10	0.0010
1,2-dichloropropane	59	3.9	0.039	92	1.3	0.013
1,3-dichloropropane	21	0.11	0.0011	31	0.16	0.0016
chloroethylene[c]						
1,1-dichloroethylene	53	0.044	0.00044	65	0.054	0.00054
1,2-dichloroethylene	32	0.020	0.00020	48	0.031	0.00031
trans-1,2-dichloroethylene	44	0.028	0.00028	61	0.039	0.00039
cis-1,2-dichloroethylene	31	0.019	0.00019	48	0.031	0.00031
trichloroethylene[a]	27	0.68	0.0068	34	0.86	0.0086
tetrachloroethylene[a]	8.1	0.033	0.00033	130	0.86	0.0086
3-chloropropene	3.7	0.00065	0.0000065	6.4	0.0011	0.000011
1,3-dichloropropene	0.087	0.00056	0.0000056	0.13	0.00084	0.0000084
trans-1,3-dichloropropene	0.087	0.00056	0.0000056	0.13	0.00084	0.0000084
cis-1,3-dichloropropene	0.087	0.00056	0.0000056	0.13	0.00084	0.0000084
2,3-dichloropropene[c]						
2-chlorobutadiene	10	0.10	0.0010	12	0.12	0.0012
hexachlorobutadiene[b]	4000	0.019	0.00019	4000	0.29	0.0029

Notes:
a: standards derived from data presented in EU-RAR
b: standards derived from data presented in EU WFD
c: data insufficient for deriving an MPC

Table 4.14: Preliminary environmental risk limits for several volatile aliphatic hydrocarbons in air.

	MPC [mg/l]
ethylene	0.00000070
ethylene oxide	0.0012
1,1,1-trichloroethane	0.013
1,1,2,2-tetrachloroethane	0.000065
trans-1,2-dichloroethylene	0.078
tetrachloroethylene	0.0000092

5. Preliminary risk analysis

Monitoring data for fresh surface water in the Dutch environment were found for 18 of the 29 studied volatile aliphatic hydrocarbons. For the other compartments (soil, seawater, air) no data were found. Only monitoring data from 1999 to 2004 (most recent data) were considered. No monitoring data were found for acrylonitrile, ethylene, ethylene oxide, dichloromethane, trichloromethane, tetrachloromethane, pentachloroethane, 1,2-dichloroethylene, trichloroethylene, tetrachloroethylene and 2,3-dichloropropene. The monitoring data and references are summarised in Appendix 5. For calculation of average and 90-percentile values, the values below the Limit of Detection (LOD) are incorporated with the value LOD/2. Monitoring concentrations in surface water ranged from not detected to 3.7 µg/l for 1,2-dichloroethane. For hexachloroethane floating dust monitoring data were found ranging from < 1-10 µg/kg. Monitoring data and the derived MPC values are reported in Table 5.1. Note that the MPC values are reported in µg/l.

Table 5.1: Comparison of surface water monitoring data and MPC values.

Compound	Monitoring data		MPC [µg/l]	NC [µg/l]
	min. [µg/l]	max. [µg/l]		
acrylonitrile			17	0.17
ethylene			-	-
ethylene oxide			84	0.84
dichloromethane			1650	16.50
trichloromethane			146	1.46
tetrachloromethane			12	0.12
1,1-dichloroethane	<0.01	0.21	-	-
1,2-dichloroethane	0.005	3.7	1060	10.6
1,1,1-trichloroethane	0.005	0.48	21.3	0.213
1,1,2-trichloroethane	<0.01	0.07	300	3.00
1,1,2,2-tetrachloroethane	<0.01	<0.01	8	0.08
pentachloroethane			28	0.28
hexachloroethane	<0.001	0.012	0.67	0.0067
1,2-dichloropropane	<0.01	0.12	280	2.80
1,3-dichloropropane	<0.01	0.05	30	0.30
chloroethylene	<1	<1	-	-
1,1-dichloroethylene	<0.01	0.02	9	0.09
1,2-dichloroethylene			6.8	0.068
trans-1,2-dichloroethylene	<0.01	0.28	6.8	0.068
cis-1,2-dichloroethylene	<0.01	0.68	6.8	0.068
trichloroethylene			115	1.15
tetrachloroethylene			51	0.51
3-chloropropene	<0.01	<0.01	0.34	0.0034
1,3-dichloropropene	<0.02	<0.02	0.18	0.0018
trans-1,3-dichloropropene	<0.01	0.02	0.18	0.0018
cis-1,3-dichloropropene	<0.01	0.02	0.18	0.0018
2,3-dichloropropene			-	-
2-chlorobutadiene	<0.01	<0.01	19	0.19
hexachlorobutadiene	<0.001	0.007	0.003	0.00003

With the exception of hexachlorobutadiene, all maximum monitoring values are lower than the derived MPC value. The maximum measured values for 1,1,1-trichloroethane, hexachloroethane, *trans*-1,2-dichloroethylene, *cis*-1,2-dichloroethylene, *trans*-1,3-dichloropropene and *cis*-1,3-dichlororopene exceeded the NC. Details for the monitoring data for these compounds are specified in Table 5.2.

Table 5.2: Detailed information about the monitoring data exceeding the MPC or the NC in Dutch surfacewater.

Compound	N[a]	LOD[b] [µg/l]	N > LOD	MPC [µg/l]	N > MPC[c]	range > MPC	NC [µg/l]	N > NC[c]	range > NC
1,1,1-trichloroethane	624	0.01-0.1	236	21.3	0		0.213	1	0.48
hexachloroethane	927	0.001-0.012	30	0.67	0		0.0067	2	0.01-0.007
trans-1,2-dichloroethylene	407	0.01-0.1	34	6.8	0		0.068	1	0.28
cis-1,2-dichloroethylene	408	0.01	293	6.8	0		0.068	96	0.07-0.68
trans-1,3-dichloropropene	618	0.01-0.1	4	0.18	0		0.0018	4	0.01-0.02
cis-1,3-dichlororopene	618	0.01-0.1	7	0.18	0		0.0018	7	0.01-0.03
hexachlorobutadiene	914	0.001-0.009	63	0.003	1	0.004-0.007	0.00003	63	0.001-0.007

[a] N = total number of measurements
[b] LOD = limit of detection
[c] Number of measured values exceeding the EQL.

The measured values exceed the NC for seven out of 18 substances for which monitoring data are available (Table 5.2). For two other substances (3-chloropropene and 1,3-dichloropropene) the detection limit exceeds the NC and therefore, from these data no conclusions can be drawn concerning the actual exceedance of the NC.

As apparent from Table 5.2, for hexachlorobutadiene, the MPC is exceeded in one out of 914 monitoring data. For seven other measure points however, the LOD is higher than the MPC, which means that in this cases the MPC could be exceeded as well. From the available data this cannot be determined, however. For hexachlorobutadiene, since the detection limit is higher than the NC, all monitoring data above the LOD exceed the NC. However, for all 914 cases the NC could potentially be exceeded.

It should be noticed that the detection limit can vary between year and location. For 1,1,1-trichloroethane the NC is exceeded in one case (0.2%). In the case of hexachloroethane the actual measured values exceeded the NC in 2 cases. However, for 30% of the monitoring data the detection limit is above the NC, so for 30% of the cases exceeding of the NC can not be excluded. For *trans*-1,1-dichloroethylene, in one case the measured value is well above the NC. In this case, the NC is just in the range of the LOD, and in five cases the LOD is higher than the NC. For *cis*-1,2-dichloroethylene the measured values exceed the NC in 24% of the monitoring data (96 out of 408). For *trans*- and *cis*-1,3-dichloropropene the detection limit exceeds the NC in all cases. Therefore, the four values above the LOD (0.6%) exceed the NC for *trans*-1,3-dichloropropene and the seven values above the LOD (1.1%) exceed the NC for *cis*-1,3-dichloropropene.

6. Conclusions and recommendations

In this report ecotoxicological environmental risk limits were derived for several volatile aliphatic hydrocarbons. In general the number of aquatic toxicity data was sufficient to derive environmental risk limits. For four substances (ethylene, 1,1-dichloroethane, chloroethylene and 2,3-dichloropropene), toxicity data were insufficient for deriving a reliable MPC.

For eight substances enough chronic toxicity data were found, so that an assessment factor of 10 could be applied. For two other substances, an assessment factor of 50 was used for deriving an aquatic MPC, and for four substances an assessment factor of 100 was used. In the case of hexachlorobutadiene the MPC is based on secondary poisoning. For all other substances an assessment factor of 1,000 was used. Although in a number of cases data for marine organisms were found, these data did not differ significantly from the freshwater data. In all cases the MPC for marine organisms was derived by applying an assessment factor of 10 to the MPC for freshwater organisms.

Toxicity data for terrestrial organisms were found for some compounds, and in two cases (1,2-dichloropropane and tetrachloroethylene) the MPC_{soil} could be based on terrestrial toxicity data. In the case of trichloromethane the MPC for sediment could be derived based on sediment data. In all other cases the MPC_{soil} and $MPC_{sediment}$ were derived, using the aquatic toxicity data and applying the equilibrium partitioning method.

In former studies MPCs were derived for the same group of substances (Van der Plassche et al., 1993). The results are compared in Table 6.1. From Table 6.1 it is clear that the newly derived MPCs differ from the MPCs derived in 1993. In most cases the MPCs derived in 2005 are below the values derived in 1993. The main reason is that in the present report no QSAR data were included: the MPC was based on the available experimental data. The use of QSAR data in 1993 facilitated the application of the HC_5 method. In the present report data requirements for the HC_5 method were not fulfilled. In the case of 1,2-dichloropropane and 1,3-dichloropropane, the assessment factor could be lowered, and higher MPCs were derived than was the case in 1993. Furthermore, for 3-chloropropene and 1,3-dichloropropene, the assessment factor in 1993 was based on the EPA method (100), and the present factor is based on the EU/TGD (1000). For 1,1-dichloroethane and chloroethylene no MPC could be derived in 2005, while in 1993 the MPC was based on QSAR data. This method has not been applied in 2005, and it is proposed not to use the MPCs of 1993 anymore. For *trans*-1,2-dichloroethylene and *cis*-1,2-dichloroethylene the MPC was lacking in 1993. For 2,3-dichloropropene in 1993 the value for 1,3-dichloropropene was taken. In 2005 this value is not used, and no MPC is derived for this substance.

In the EU/TGD no guidance is given for deriving a PNEC for exposure of terrestrial species via air. It is assumed that standards for indirect exposure of humans will be protective for exposure of terrestrial organisms via air. Since in the case of volatile compounds, this route might be particularly relevant, an MPC for air was derived for terrestrial organisms. For six substances data for terrestrial species exposed via air were available, and the MPC for air was derived from these data. For five compounds a comparison could be made between the MPC for air based on aquatic data, using equilibrium partitioning and the MPC for air based on terrestrial data. From this comparison it is concluded that the MPC based on aquatic data is not in every case protective for exposure of terrestrial species via air. There it is recommended to develop a method for deriving ERLs for air.

Table 6.1: Comparison of the environmental risk limits for freshwater derived in this report with formerly derived MPC by Van der Plassche et al.(1993).

	SRC_{eco} [mg/l]	MPC_{2005} [mg/l]	AF 2005	MPC_{1993} [mg/l]	AF 1993
acrylonitrile[b]	1.25	0.017	10	0.0076	1000
ethylene oxide	18.6	0.084	1000	0.084	1000
dichloromethane[c]	43.6	1.65	50	20	QSAR/HC_5
trichloromethane[c]	23.1	0.146	10	5.9	QSAR/HC_5
tetrachloromethane[c]	4.98	0.012			
1,1-dichloroethane	a	a		0.700	QSAR/HC_5
1,2-dichloroethane[c]	64.0	1.06	10	-	
1,1,1-trichloroethane	1.47	0.0213	10	2.1	QSAR/HC_5
1,1,2-trichloroethane	16.1	0.3	10	7.9	QSAR/HC_5
1,1,2,2-tetrachloroethane	1.69	0.008	100	3.3	QSAR/HC_5
pentachloroethane	0.89	0.028	10	0.23	
hexachloroethane	0.11	0.00067	100	0.083	QSAR/HC_5
1,2-dichloropropane	19.9	0.28	10	0.076	QSAR/HC_5
1,3-dichloropropane	5.95	0.03	100	0.076	value of 1,2-dichloropropane
chloroethylene	a	a		0.82	QSAR/HC_5
1,1-dichloroethylene	10.9	0.009	1000	3.4	QSAR/HC_5
1,2-dichloroethylene	10.7	0.0068	1000	6.1	QSAR/HC_5
trans-1,2-dichloroethylene	10.7	0.0068	1000	-	
cis-1,2-dichloroethylene	10.7	0.0068	1000	-	
trichloroethylene[b]	4.60	0.115	50	2.4	QSAR/HC_5
tetrachlorothylene[b]	7.76	0.051	10	0.33	QSAR/HC_5
3-chloropropene	1.9	0.00034	1000	0.0034	100
1,3-dichloropropene	0.028	0.00018	50	0.008	100
trans-1,3-dichloropropene	0.028	0.00018	50	-	
cis-1,3-dichloropropene	0.028	0.00018	50	-	
2,3-dichloropropene	a	a		0.008	value of 1,3-dichloropropene
2-chlorobutadiene	1.9	0.019	100	a	
hexachlorobutadiene[c]	6.09	0.000003	secundary poisoning	-	

Notes:
a: data insufficient for deriving an MPC
b: standards derived from EU-RAR
c: standards derived from WFD datasheet

Numerous monitoring data were found for the volatile aliphatic compounds in Dutch surface waters. From all these data, the MPC is exceeded for one substance (hexachlorobutadiene) only. This might be expected, since the compounds studied are highly volatile, which on the one hand might cause a high risk for dispersal, for instance to surface water, but on the other hand the compounds may easily evaporate from the surface water. The NC is exceeded for eight compounds. A complicating factor is that in a number of cases the limit of detection is higher than the NC. In this case conclusions about exceeding of the NC can not be drawn.

It was decided not to include human toxicological data for deriving MPCs for the substances in this report. However the Risk Phrases indicate that potential risks may occur for a number of the substances for which environmental standards were derived in this report (see Table 6.2). Therefore it is recommended that in a follow up human toxicological standards are derived, and compared to the ecotoxicological standards. For the substances in bold this means that additional information has to be gathered from the literature.

Table 6.2: R-phrases for several volatile aliphatic hydrocarbons (source: ESIS (European chemical Substances Information System).

Substance	R-phrases	Human standard necessary	EU-RAR	EU-WFD
acrylonitrile	R45, R11, R23/24/25, R37,38, R41, R43, R51,53	+	*	
ethylene	R12, R67	-		
ethylene oxide	R45, R46, R12, R23, R36,37,38,	+		
dichloromethane	R10	-		*
trichloromethane	R32, R38, R40, R48,20,22	+	*	*
tetrachloromethane	R23/24/25, R40, R48,23, R59, R52,53	+		*
1,1-dichloroethane	R11, R22, R36/37, R52,53	-		
1,2-dichloroethane	R45, R11, R22, R36/37/38	+		*
1,1,1-trichloroethane	R20, R59	-		
1,1,2-trichloroethane	R20,21,22, R40, R66	+		
1,1,2,2-tetrachloroethane	R26,27, R51,53	-		
pentachloroethane	R40, R48,23, R51,53	+		
hexachloroethane	Not classified	+		
1,2-dichloropropane	R11, R20,22	-		
1,3-dichloropropane	Not classified			
chloroethylene	R45, R12	+		
1,1-dichloroethylene	R12, R20, R40	+		
1,2-dichloroethylene	R11, R20, R52/53	-		
trans-1,2-dichloroethylene	R11, R20, R52/53	-		
cis-1,2-dichloroethylene	R11, R20, R52/53	-		
trichloroethylene	R45, R36/38, R52,53, R67	+	*	*
tetrachloroethylene	R40, R51/53	+	*	*
3-chloropropene	R11, R20,21,22, R36,37,38, R40, R48,20, R68, R50	+		
1,3-dichloropropene	R10, R20/21, R25, R36,37,38, R43, R50/53	-		
trans-1,3-dichloropropene	Not in ESIS			
cis-1,3-dichloropropene	R10, R20,21, R25, R36,37,38, R43, R50,53	-		
2,3-dichloropropene	R11, R20,21,22, R37,38, R41, R52,53, R68	-		
2-chlorobutadiene	R45, R11, R20,22, R36,37,38, R48,20	+		
hexachlorobutadiene	Not classified	+[a]		*

Notes:
[a]: From the WFD factsheet it appears that human toxicological aspects are already covered by the standard for secondary poisoning.

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Appendix 1. Selected aquatic toxicity data used for derivation of ERLs

Legend

NOEC/EC_{10} refers to chronic toxicity data

E(L)C_{50} refers to acute toxicity data

Table A1.1: Selected toxicity data for acrylonitrile to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Crustacea		**Algae**	
Daphnia magna	0.78	*Scenedesmus subspicatus*	3.1
Pisces		**Mollusca**	
Lepomis macrochirus	10.0	*Radix peregra*	0.08
Pimephales promelas	0.17[f]	*Radix pliculata*	17.94[e]
		Annelida	
		Limnodrilus hoffmeisteri	16.9
		Crustacea	
		Daphnia magna	11.3[a]
		Insecta	
		Chironomus sp.	14.21
		Pisces	
		Brachydanio rerio	15.0
		Carrasius sp.	40.0
		Cyprinus carpio	21.7[b]
		Lebistes reticulatus	33.5
		Lepomis macrochirus	10.9[c]
		Leucaspius delineatus	22.7
		Leuciscus idus	21.2
		Oncorhynchus mykiss	13.0[d]
		Phoxinus phoxinus	17.6
		Pimephales promelas	10.1[e]
		Rhodeus sericeus	25.7

Notes:

a: geometric mean of 8.7, 7.6 and 22

b: geometric mean of 19.64 and 24

c: geometric mean of 10 and 11.8

d: geometric mean of 7 and 24

e: lowest value for this species

f: is LOEC/2

Table A1.2: Selected toxicity data for acrylonitrile to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Algae		**Bacteria**	
Skeletonema costatum	0.41[b]	*Photobacterium phosphoreum*	254
Pisces		**Algae**	
Cyprinodon variegatus	5.6	*Skeletonema costatum*	1.63
		Annelida	
		Ophryotrocha diadema	18.2
		Crustacea	
		Artemia salina	14.34
		Crangon crangon	10.4[a]
		Cyprinodon variegatus	8.6
		Gobius minutes	14.0
		Lagadon rhomboides	24.5

Notes:

a: geometric mean of 18.2 and 6

b: lowest value, parameter biomass

Table A1.3: Selected toxicity data for ethylene to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Algae		**Algae**	
Selenastrum capricornutum	13.9	*Selenastrum capricornutum.*	40

Table A1.4: Selected toxicity data for ethylene oxide to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Crustacea**	
		Daphnia magna.	212
		Pisces	
		Carassius auratus	90
		Pimephales promelas	84

Table A1.5: Selected toxicity data for ethylene oxide to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Crustacea**	
		Artemia salina	745

Table A1.6: Selected toxicity data for dichloromethane to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Pisces		**Algae**	
Pimephales promelas	82.5	*Selenastrum capricornutum*	500
Cyanobacteria		**Crustacea**	
Microcystis aeruginosa	550	*Daphnia magna*	416 [a]
		Pisces	
		Pimephales promelas	193
		Macrophyta	
		Lemna minor	20000

Note:
a: geometric mean of 194, 220 and 1682

Table A1.7: Selected toxicity data for dichloromethane to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Pisces		**Algae**	
Cyprinus variegatus	130	*Skeletonema costatum*	662
		Crustacea	
		Artemia salina	327 [a]
		Mysidopsis bahia	310
		Palaemonetes pugio	108.5
		Pisces	
		Fundulus heteroclitus	97

Note:
a: geometric mean of 122 and 876

Table A1.8: Selected toxicity data for trichloromethane to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Algae		**Algae**	
Chlamydomonas reinhardtii	3.61	*Chlamydomonas reinhardtii*	13.3
Scenedesmus quadricauda	110	*Scenedesmus subspicatus*	560
Scenedesmus subspicatus	225	**Pisces**	
Crustacea		*Brachydanio rerio*	121
Daphnia magna	6.3[c]	*Cyprinus carpio*	97
Pisces		*Ictalurus punctatus*	75
Oryzias latipes	1.463	*Micropterus salmoides*	51
Cyanobacteria		*Oncorhynchus mykiss*	18
Microcystis aeruginosa	185	*Pimephales promelas*	85.5[a]
		Poecilia reticulata	154
		Crustacea	
		Daphnia magna	56.6[b]

Notes:
a: geometric mean of 71 and 103
b: geometric mean of 29, 79 and 79
c: lowest value, parameters parent mortality, reproduction rate, appearance of first offspring

Table A1.9: Selected toxicity data for trichloromethane to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
		Crustacea	
		Artemia salina	31.1
		Crassostrea gigas	152.5

Table A1.10: Selected toxicity data for tetrachloromethane to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Algae		**Bacteria**	
Chlamydomonas reinhardtii	0.0717	*Escherichia coli*	8700
Selenastrum capricornutum	0.38	*Nitrosomonas sp.*	51
Bacteria		*Nitrobacter sp.*	527
Pseudomonas putida	30	**Protozoa**	
Cyanophyta		*Tetrahymna pyriformis*	830
Microcystis aeruginosa	105	**Algae**	
Protozoa		*Chlamydomonas reinhardtii*	0.246
Entosiphon sulcatum	770	*Scenedesmus subspicatus*	21
Crustacea		*Selenastrum capricornutum*	0.89
Daphnia magna[f]	1.13	**Platyhelminthes**	
		Dugesia japonica	1.6
		Rotifera	
		Brachionus calyciflorus	5799
		Crustacea	
		Daphnia magna	20[a]
		Moina macropoda	200
		Streptocephalus proboscideus	6429
		Pisces	
		Lepomis macrochirus	52.5[b]
		Leuciscus idus melanotus	72.3[c]
		Pimephales promelas	42.1[d]
		Poecilia reticulate	67
		Oryzias latipes	288.1[e]

Notes:
a: measured value
b: geometric mean of 27.3 and 101
c: geometric mean of 13, 47, 95 and 472
d: geometric mean of 41.4 and 42.9
e: geometric mean of 100 and 830
f: geometric mean of 0.41 and 3.1

Table A1.11: Selected toxicity data for tetrachloromethane to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Pisces		**Bacteria**	
Cyprinodon variegatus	4.5	*Vibrio fischeri*	5
		Crustacea	
		Artemia salina	30.4
		Pisces	
		Menidia beryllina	146
		Limanda limanda	50

Table A1.12: Selected toxicity data for 1,1-dichloroethane to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Bacteria**	
		Nitrosomonas sp.	0.91
		Nitrobacter sp.	1653
		Pisces	
		Poecilia reticulata	202

Table A1.13: Selected toxicity data for 1,1-dichloroethane to saltwater species.

Taxonomic group	NOEC/EC$_{10}$ [mg/l]	Taxonomic group	E(L)C$_{50}$ [mg/l]
-	-	**Bacteria**	
		Vibrio fischeri	270[a]

Note:
a: 5 minute value selected

Table A1.14: Selected toxicity data for 1,2-dichloroethane to freshwater species.

Taxonomic group	NOEC/EC$_{10}$ [mg/l]	Taxonomic group	E(L)C$_{50}$ [mg/l]
Algae		**Algae**	
Scenedesmus quadricauda	360	*Scenedesmus subspicatus*	189
Crustacea		**Crustacea**	
Daphnia magna	14.1[c]	*Daphnia magna*	148[a]
Pisces		*Gammarus fasciatus*	100
Pimephales promelas	20	**Pisces**	
Cyanobacteria		*Lepomis macrochirus*	94
Microcystis aeruginosa	53	*Micropterus salmoides*	66
		Pimephales promelas	37[b]

Notes:
a: geometric mean of 130 and 168.4
b: geometric mean of 11.8 and 116
c: geometric mean of 10.6, 10.6, 11, 11 and 41.6

Table A1.15: Selected toxicity data for 1,2-dichloroethane to saltwater species.

Taxonomic group	NOEC/EC$_{10}$ [mg/l]	Taxonomic group	E(L)C$_{50}$ [mg/l]
Annelida		**Crustacea**	
Ophryotrocha labronica	200	*Artemia salina*	36
		Eliminius modestus	186
		Pisces	
		Limanda limanda	115

Table A1.16: Selected toxicity data for 1,1,1-trichloroethane to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Algae		**Bacteria**	
Chlamydomonas reinhardtii	0.213	*Nitrosomonas sp.*	8.5
Crustacea		*Escherichia coli*	2028
Daphnia magna	0.837	*Spirochaeta aurantia*	414
Pisces		**Algae**	
Cyprinus carpio	7.7	*Chlamydomonas reinhardtii*	0.536
Brachydanio rerio	3.4	*Chlamydomonas angulosa*	280
		Chlorella vulgaris	153
		Scenedesmus suspicatus	813
		Crustacea	
		Daphnia magna	30[a]
		Streptocephalus proboscideus	1314
		Pisces	
		Lepomis macrochirus	66[b]
		Pimephales promelas	47[c]
		Poecilia reticulata	133
		Oncorhynchus mykiss	52
		Oryzias latipes	440
		Brachydanio rerio	55[d]
		Leuciscus idus melanotus	123

Notes:
a: geomean of 11.2, 40 and 58
b: geomean of 58, 69.7 and 72
c: geomean of 52.8, 52.9, 42.3, 43.4 and 47, measured values selected
d: 96 h value selected

Table A1.17: Selected toxicity data for 1,1,1-trichloroethane to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Bacteria**	
		Vibrio fischeri	5[a]
		Algae	
		Phaeodactylum tricornutum	5
		Crustacea	
		Artemia salina	128[b]
		Mysidopsis bahia	31.2
		Eliminius modestus	7.5
		Pisces	
		Cyprinodon variegatus	71
		Limanda limanda	33

Notes:
a: measured value selected
b: geometric mean of 4 and 4082

Table A1.18: Selected toxicity data for 1,1,2-trichloroethane to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Algae		**Bacteria**	
Chlamydomonas reinhardtii	26	*Nitrosomonas sp.*	1.9
Molluscs		*Nitrobacter sp.*	490
Lymnea stagnalis	10[g]	**Algae**	
Dreissena polymorpha	140[h]	*Chlamydomonas reinhardtii*	57
Crustacea		*Scenedesmus suspicatus*	200[a]
Daphnia magna	26[i]	*Chlorella pyrenoïdosa*	170
Pisces		**Molluscs**	
Jordanella floridae	19[j]	*Lymnea stagnalis*	170
Pimephales promelas	6	*Dreissena polymorpha*	320
Oncorhynchus mykiss	6	**Crustacea**	
		Daphnia magna	33[b]
		Ceriodaphnia cf. dubia	53[c]
		Insecta	
		Chironomus riparius	173
		Pisces	
		Lepomis macrochirus	40
		Pimephales promelas	82[d]
		Poecilia reticulata	79[e]
		Jordanella floridae	45[f]

Notes:
a: 72 h growth inhibition value selected
b: geometric mean of 18, 18, 43, 81 nominal and measured 48 h values
c: geometric mean of 151, 123, 38, 56, 30, 52, 32, 56, 32, nominal 48 h values
d: geometric mean of 82, 81.6, 82, 82, 81.7, 81.6, 81.8, measured and nominal 96 h values
e: geometric mean of 70, 75 and 94, measured and nominal 168 h values
f: measured flow through value selected
g: based on morphology and hatching
h: 14 d values selected
i: geometric mean of 24, 18, 26 and 41.8, 21 d values for reproduction selected
j: geometric mean of 17.1 and 21.5, 10 and 28 d values for 1 and 2 weeks old fish

Table A1.19: Selected toxicity data for 1,1,2-trichloroethane to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Annelida		**Bacteria**	
Ophryotrocha labronica	59[h]	*Vibrio fischeri*	57[a]
Crustacea		**Algae**	
Artemia salina	10	*Chlamydomonas sp.*	260
Pisces		*Phaeodactylum tricornutum*	60
Pleuronectus platessa	3	*Unaliella sp.*	200
		Chlorella ovalis	200
		Molluscs	
		Mytilus edulis	110
		Annelida	
		Ophryotrocha labronica	165[b]
		Crustacea	
		Artemia salina	46[c]
		Chaetogammarus marinus	77[d]
		Palaemonetes varians	43
		Crangon crangon	43
		Temora longicornis	43
		Pisces	
		Poecilia reticulata	55[e]
		Gobius minutus	43[f]
		Pleuronectus platessa	6[g]

Notes:
a: 15 min measured value selected
b: geometric mean of 143 and 190
c: geometric mean 40 and 52, 96 h values selected
d: geometric mean of 72 and 82
e: geometric mean of 43 and 70, 24 h values selected
f: 24 h value
g: most sensitive life stage, 7 d development from egg to metam larva selected
h: most sensitive endpoint, 15 d hatching selected

Table A1.20: Selected toxicity data for 1,1,2,2-tetrachloroethane to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Crustacea		**Bacteria**	
Daphnia magna	7	*Nitrosomonas sp.*	1.4
Pisces		*Nitrobacter sp.*	304
Jordanella floridae	5[g]	*Spirochaeta aurantia*	143
Pimephales promelas	1.4	**Algae**	
Oncorhynchus mykiss	1.4	*Scenedesmus suspicatus*	27[a]
		Selenastrum capricornutum	141[b]
		Crustacea	
		Daphnia magna	15[c]
		Pisces	
		Lepomis macrochirus	21[d]
		Pimephales promelas	20[e]
		Poecilia reticulata	37
		Jordanella floridae	22[f]

Notes:
a: 72 h value selected
b: geometric mean of 136 and 146, values for cell density and chlorophyll a.
c: geometric mean of 9.32 and 25, 48 h immobility unfed values selected
d: geometric mean of 21 and 21.3
e: geometric mean of 20, 20.3, 19.7, 18.0, 20, 20.3, 20.4, 20.3, 20
f: geometric mean of 26.8 and 18.5
g: geometric mean of 4.48 and 5.79

Table A1.21: Selected toxicity data for 1,1,2,2-tetrachloroethane to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Bacteria**	
		Vibrio fischeri	4[a]
		Algae	
		Skeletonema costatum	6.3[b]
		Crustacea	
		Artemia salina	0.84[c]
		Mysidopsis bahia	9.0
		Pisces	
		Cyprinodon variegatus	12

Notes:
a: measured 15 min value selected
b: geometric mean of 6.23 and 6.44, values for cell density and chlorophyll a
c: most sensitive life stage selected

Table A1.22: Selected toxicity data for pentachloroethane to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Pisces		**Bacteria**	
Pimephales promelas	0.9	*Nitrosomonas sp.*	7.9
Oncorhynchus mykiss	0.9	*Nitrobacter sp.*	235
		Spirochaeta aurantia	34
		Algae	
		Chlamydomonas angulosa	24
		Chlorella vulgaris	30
		Selenastrum capricornutum	127[a]
		Crustacea	
		Daphnia magna	17[b]
		Pisces	
		Lepomis macrochirus	7.2
		Pimephales promelas	7[c]
		Poecilia reticulata	15

Notes:
a: geometric mean of 121 and 134, values for chlorophyll a and cell density
b: geometric mean of 4.7 and 62.9, unfed 48 values for immobility
c: geometric mean of 7.3, 7.34 and 7.51

Table A1.23: Selected toxicity data for pentachloroethane to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Algae		**Bacteria**	
Champia parvula	2.8[d]	*Vibrio fischeri*	0.75[a]
Crustacea		**Algae**	
Mysidopsis bahia	0.28	*Skeletonema costatum*	58.2[b]
		Crustacea	
		Mysidopsis bahia	0.39[c]
		Pisces	
		Cyprinodon variegatus	116

Notes:
a: measured 5 min. value selected
b: same value found for chlorophyll a and cell density
c: measured flow through value selected
d: geometric mean of 2.4 and 3.2, values for reproduction parameters number of cystocarps and number of tetrasporangia

Table A1.24: Selected toxicity data for hexachloroethane to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Pisces		**Bacteria**	
Pimephales promelas	0.17[k]	*Nitrosomonas sp.*	32
Oncorhynchus mykiss	0.067	*Nitrobacter sp.*	328
		Algae	
		Selenastrum capricornutum	90[a]
		Mollusca	
		Aplexa hypnorum	2
		Crustacea	
		Daphnia magna	4.5[b]
		Ceriodaphnia reticulata	4.6[c]
		Simocephalus vetulus	5.8
		Insecta	
		Tanytarsus dissimilis	2.3[d]
		Pisces	
		Gambusia affinis	1.38
		Ictalurus punctatus	1.8[e]
		Lepomis macrochirus	0.9[f]
		Oncorhynchus mykiss	1.0[g]
		Pimephales promelas	1.3[h]
		Salmo gairdneri	1.0[i]
		Carassius auratus	1.42
		Amphibia	
		Rana catesbiana	2.8[j]

Notes:
a: geometric mean of 87 and 93.2, values for chlorophyll a and cell density
b: geometric mean of 2.1, 1.36, 8.07, 0.28, 10 and 13, 48 h unfed values selected
c: geometric mean of 3.3, 6.8 and 4.3, 48 h values selected
d: geometric mean of 1.23, 1.7 and 5.85, 48 h values selected
e: geometric mean of 2.36, 1.77. and 1.52
f: geometric mean of 0.98, 0.856 and 0.97
g: geometric mean of 1.18, 0.84, and 0.94, 96 h values selected
h: geometric mean of 1.52, 1.37, 1.5, 1.51, 1.23, 1.24, 1.39 and 1.1
i: geometric mean of 0.97, 0.98 and 1.18
j: geometric mean of 2.44 and 3.18
k: geometric mean of 0.069 and 0.41

Table A1.25: Selected toxicity data for hexachloroethane to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Bacteria**	
		Vibrio fischeri	0.14[a]
		Algae	
		Skeletonema costatum	8.1[b]
		Crustacea	
		Mysidopsis bahia	0.94
		Echinodermata	
		Arbacia punctulata	7.2[c]
		Pisces	
		Cyprinodon variegatus	2.4

Notes:
a: 5 min measured value selected
b: geometric mean of 7.75 and 8.57, values for cell density and chlorophyll a
c: geometric mean of 9.32, 8.51, 8.31, 6.05 and 4.97

Table A1.26: Selected toxicity data for 1,2-dichloropropane to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	$E(L)C_{50}$ [mg/l]
Protists		**Bacteria**	
Euglena gracilis	640	*Nitrosomonas sp.*	43
Algae		**Algae**	
Chlamydomonas reinhardtii	29[e]	*Scenedesmus subspicatus*	168[a]
Selenastrum apricornutum	11[g]	*Selenastrum capricornutum*	73g
Crustacea		**Crustacea**	
Daphnia magna	2.82[h]	*Daphnia magna*	45[b]
Pisces		*Ceriodaphnia reticulata*	13
Pimephales promelas	11[f]	*Daphnia carinata*	24
Oryzias latipes	10	**Pisces**	
		Lepomis macrochirus	300[c]
		Pimephales promelas	135[d]
		Poecilia reticulata	116
		Oryzias latipes	160

Notes:
a: 72 h value for growth inhibition selected
b: geometric mean of 30, 45, 52 and 55.9 mg/l, 48 h values selected
c: geometric mean of 280, 300 and 320 mg/l
d: geometric mean of 130, 136 and 140 mg/l
e: 10 d value selected
f: 28 d value for growth selected
g: 72 h value
h: geometric mean of 8.3 and 0.96

Table A1.27: Selected toxicity data for 1,2-dichloropropane to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	$E(L)C_{50}$ [mg/l]
Crustacea		**Bacteria**	
Mysidopsis bahia	4.1	*Vibrio fischeri*	73[a]
Pisces		**Algae**	
Cyprinodon variegatus	82	*Phaeodactylum tricornutum*	50
		Crustacea	
		Mysidopsis bahia	25[b]
		Eliminius modestus	53
		Pisces	
		Menidia beryllina	223[c]
		Limanda limanda	61

Notes:
a: 15 min. measured value selected
b: 96 h value selected
c: recalculated value selected

Table A1.28: Selected toxicity data for 1,3-dichloropropane to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Pisces		**Bacteria**	
Pimephales promelas	28	*Nitrosomonas* sp.	4.8
		Algae	
		Scenedesmus subspicatus	221
		Scenedesmus capricornutum	59[a]
		Crustacea	
		Daphnia magna	39[b]
		Pisces	
		Carassius auratus	160
		Pimephales promelas	114[c]
		Poecilia reticulata	84
		Amphibians	
		Xenopus laevis	63

Notes:
a: geometric mean of 72 and 48, values for cell density and chlorophyll a
b: measured 24 h value selected (lower than 48 h nominal)
c: geometric mean of 94.2, 110, 125 and 131.1

Table A1.29: Selected toxicity data for 1,3-dichloropropane to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Crustacea		**Bacteria**	
Mysidopsis bahia	3	*Vibrio fischeri*	119[a]
		Algae	
		Skeletonema costatum	78[b]
		Crustacea	
		Mysidopsis bahia	10.3
		Pisces	
		Cyprinodon variegatus	87

Notes:
a: 5 min. measured value selected
b: geometric mean of 65.8 and 93.6, values for cell density and chlorophyll a

Table A1.30: Selected toxicity data for chloroethylene to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Protozoa**	
		Tetrahymena pyriformis	405[a]
		Pisces	
		Micropterus salmoides	1100
		Lepomis macrochirus	1200

Note:
a: Most relevant and sensitive endpoint (9 h value for proliferation rate) selected

Table A1.31: Selected toxicity data for 1,1-dichloroethylene to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Algae**	
		Chlamydomonas reinhardtii	9
		Scenedesmus subspicatus	410
		Crustacea	
		Daphnia magna	30[a]
		Pisces	
		Lepomis macrochirus	116[b]
		Pimephales promelas	108[c]

Notes:
a: geometric mean of 11.6 and 79 mg/l, 48 h values selected
b: geometric mean of 74 and 183 mg/l
c: measured flow through value selected

Table A1.32: Selected toxicity data for 1,1-dichloroethylene to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Crustacea**	
		Mysidopsis bahia	224
		Pisces	
		Cyprinodon variegatus	250
		Menidia beryllina	259

Table A1.33: Selected toxicity data for 1,2-dichloroethylene to freshwater species

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Pisces**	
		Lepomis macrochirus	140

Table A1.34: Selected toxicity data for 1,2-dichloroethylene to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Crustacea**	
		Artemia salina	6.8[a]

Note:
a: most sensitive life stage (72 h) selected

Table A1.35: Selected toxicity data for trans-1,2-dichloroethylene to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Bacteria**	
		Nitrosomonas sp.	80
		Nitrobacter sp.	1777
		Crustacea	
		Daphnia magna	220

Table A1.36: Selected toxicity data for trans-1,2-dichloroethylene to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Bacteria**	
		Vibrio fischeri	1300[a]

Note:
a: geometric mean of 1100 and 1536 mg/l, 5 and 30 min. values

Table A1.37: Selected toxicity data for cis-1,2-dichloroethylene to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Pisces**	
		Pimephales promelas	207

Table A1.38: Selected toxicity data for cis-1,2-dichloroethylene to saltwater species

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Bacteria**	
		Vibrio fischeri	608[a]

Note:
a: measured 5 min. value selected

Table A1.39: Selected toxicity data for trichloroethylene to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Cyanobacteria		**Algae**	
Microcystis aeruginosa	63	*Chlamydomonas reinhardtii*	36.5
Algae		*Phaeodactylum tricornutum*	8
Chlamydomonas reinhardtii	12.3	*Scenedesmus subspicatus*	450
Pisces		**Crustacea**	
Jordanella floridae	5.76	*Asellus aquaticus*	30
		Daphnia cucullata	57
		Daphnia magna	38.1[a]
		Pisces	
		Brachydanio rerio	60
		Jordanella floridae	28.28
		Leuciscus idus melanotus	136
		Oncorhynchus mykiss	42
		Pimephales promelas	43.8[b]
		Poecilia reticulata	54.8
		Insecta	
		Aedes aegypti	48
		Chironomus thummi	64
		Cloeon dipterum	42
		Corix punctata	110
		Culex pipiens	55
		Ischnura elegano	49
		Nemona cinerea	70
		Amphibia	
		Xenopus laevis	45
		Cnidaria	
		Hydra oligactis	75
		Mollusca	
		Lymnaea stagnalis	56
		Platyhelminthes	
		Dugesia lugubris	42
		Erpobdella octoculata	75
		Protozoa	
		Tetrahymena pyriformis	410

Notes:
a: geometric mean of 76, 18, 20.8, 63.8, 85.2, 27, 44.6 and 24
b: geometric mean of 40.7, 44 and 47

Table A1.40: Selected toxicity data for trichloroethylene to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Algae		**Algae**	
Dunaliella tertiolecta	0.1	*Phaeodactylum tricornutum*	8
		Bacteria	
		Photobacterium phosphoreum	335.2[a]
		Crustacea	
		Mysidopsis bahia	14
		Pisces	
		Cyprinodon variegatus	52
		Limanda limanda	16
		Amphibia	
		Ambystoma mexicanum	48

Note:
[a]geometric mean of 960, 602, 115 and 190

Table A1.41: Selected toxicity data for tetrachloroethylene to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Algae		**Algae**	
Chlamydomonas reinhardii	1.77	*Chlamydomonas reinhardii*	3.64
Selenastrum capricornutum	816	**Crustacea**	
Crustacea		*Daphnia magna*	28.0[a]
Daphnia magna	0.8[c]	*Tanytarsus dissimilis*	30.8
Pisces		**Pisces**	
Jordanella floridae	1.99[d]	*Jordanella floridae*	8.4
Pimephales promelas	1.4[e]	*Lepomis macrochirus*	13
		Leuciscus idus	130
		Oncorhynchus mykiss	5
		Pimephales promelas	18.6[b]
		Bacteria	
		Nitrosomonas sp.	112
		Tetrahymena pyriformis	100

Notes:
a: geometric mean of 22, 184.2, 8.5 and 18
b: geometric mean of 18.4, 21.4, 13.4, 23.8 and 17.8
c: geometric mean f 0.51 and 1.11
d: lowest value
e: lowest value of MATC range, used as NOEC

Table A1.42: Selected toxicity data for tetrachloroethylene to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Bacteria		**Algae**	
Photobacterium phosphoreum	68	*Phaeodactylum tricornutum*	10.5
		Skeletonema costatum	500
		Crustacea	
		Mysidopsis bahia	10.2
		Pisces	
		Cyprinodon variegatus	38.8
		Limanda limanda	5

Table A1.43: Selected toxicity data for 3-chloropropene to freshwater species.

Taxonomic group	NOEC/EC$_{10}$ [mg/l]	Taxonomic group	E(L)C$_{50}$ [mg/l]
Bacteria		**Crustacea**	
Pseudomonas putida	115	*Daphnia magna*	250
Cyanophyta		**Pisces**	
Microcystis aeruginosa	8.2	*Carassius auratus*	21
Protozoa		*Lepomis macrochirus*	42
Chilomonas paramaecium	8.6	*Leuciscus idus melanotus*	70[a]
Entosiphon sulcatum	8.4	*Pimephales promelas*	20
Algae		*Poecilia reticulata*	8[b]
Scenedesmus quadricauda	6.3	**Amphibians**	
		Xenopus laevis	0.34

Notes:
a: 48 h value
b: geometric mean of 48 and 1.2 mg/l, 96 h and 14 d values

Table A1.44: Selected toxicity data for 3-chloropropene to saltwater species.

Taxonomic group	NOEC/EC$_{10}$ [mg/l]	Taxonomic group	E(L)C$_{50}$ [mg/l]
-	-	**Bacteria**	
		Vibrio fischeri	24

Table A1.45: Selected toxicity data for 1,3-dichloropropene to freshwater species.

Taxonomic group	NOEC/EC$_{10}$ [mg/l]	Taxonomic group	E(L)C$_{50}$ [mg/l]
Algae		**Bacteria**	
Selenastrum capricornutum	0.009[h]	*Nitrosomonas sp.*	0.7
Crustacea		*Nitrobacter sp.*	150
Daphnia magna	0.09	**Algae**	
		Scenedesmus capricornutum	1.4[a]
		Mollusca	
		Helosima trivolvis	8
		Crustacea	
		Daphnia magna	0.9[b]
		Gammarus minus	2
		Insecta	
		Chironomus thummi	1.3
		Tallaperla maria	5.4
		Pisces	
		Lepomis macrochirus	6.6[c]
		Pimephales promelas	1.3[d]
		Oncorhynchus mykiss	4.6[e]
		Micropterus salmoides	3.6
		Stizostedion vitreum	1.1
		Carasius auratus	12.8
		Idus idus melanotus	9
		Salmo gairdneri	2.8[f]
		Poecilia reticulata	0.51[g]
		Oryzias latipes	1.5

Notes:
a: 72 h values selected, mean of 7.2 and 0.24
b: geometric mean of 0.09, 1.2 and 6.2 mg/l
c: geometric mean of 6.1, 6.7 and 7.1 mg/l
d: geometric mean of 0.24, 2.3 and 4.1 mg/l
e: geometric mean of 3.9 and 5.4 mg/l
f: geometric mean of 2 and 3.9 mg/l
g: 14 d value
h: 72 h values selected

Table A1.46: Selected toxicity data for 1,3-dichloropropene to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Bacteria**	
		Vibrio fischeri	89[a]
		Algae	
		Skeletonema costatum	1
		Crustacea	
		Mysidopsis bahia	0.79
		Pisces	
		Cyprinodon variegatus	1.8

Note:
a: geometric mean of 72 and 110 mg/l, 30 and 5 min. values

Table A1.47: Selected toxicity data for trans-1,3-dichloropropene to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Algae**	
		Scenedesmus capricornutum	11[a]
		Crustacea	
		Daphnia magna	3.1
		Pisces	
		Salmo gairdneri	4.5

Note:
a: 72 h value selected

Table A1.48: Selected toxicity data for cis-1,3-dichloropropene to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Algae**	
		Scenedesmus capricornutum	2.8[a]
		Crustacea	
		Daphnia magna	1.4
		Pisces	
		Salmo gairdneri	1.6

Note:
a: 72 h value selected

Table A1.49: Selected toxicity data for 2,3-dichloropropene to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Protozoa		**Protozoa**	
Tetrahymena thermophila	58[a]	*Tetrahymena thermophila*	119
Fungi		**Pisces**	
Saccharomyces cerevisiae	250[b]	*Poecilia reticulata*	1.2

Notes:
a: geometric mean of 40, 25, 123, 70 and 74, NOEC and EC_{10} values.
b: EC_{20} value.

Table A1.50: Selected toxicity data for 2-chlorobutadiene to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Crustacea		**Algae**	
Daphnia magna	1.9	*Navicula seminulum*	380
		Pisces	
		Lepomis macrochirus	245

Table A1.51: Selected toxicity data for hexachlorobutadiene to freshwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Crustacea		**Crustacea**	
Daphnia magna	0.0044	*Asellus aquaticus*	0.130
Pisces		*Daphnia magna*	0.030
Pimephales promelas	0.0065	**Mollusca**	
Carassius auratus	0.0096	*Lymnaea stagnalis*	0.210
Brachydanio rerio	0.005	**Pisces**	
		Carassius auratus	0.090
		Oncorhynchus mykiss	0.320
		Pimephales promelas	0.090

Table A1.52: Selected toxicity data for hexachlorobutadiene to saltwater species.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
no data		**Crustacea**	
		Eliminius modestus (nauplii)	0.870
		Pisces	
		Cyprinodon variegatus	3.60
		Limanda limanda	0.450

Appendix 2. Selected terrestrial toxicity data used for derivation of ERLs

Legend

NOEC/EC_{10} refers to chronic toxicity data
E(L)C_{50} refers to acute toxicity data

Table A2.1: Selected toxicity data for ethylene to terrestrial species, exposure via air.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Macrophyta			
Hordeum vulgare	0.000014[a]		
Pisum sativum	0.00013		
Brassica napus	0.00025		
Brassica campestris	0.000007		
Avena sativa	0.000012		

Notes:
a: geometric mean of 0.000009 and 0.000023

Table A2.2: Selected toxicity data for ethylene oxide to terrestrial species, exposure via air.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Insecta**	
		Trogoderma granarium	1.9
		Rhyzopertha domenica	1.2

Table A2.3: Selected toxicity data for dichloromethane to terrestrial species; exposure via soil.

Taxonomic group	NOEC/EC_{10} [mg/kg_{dw}]	Taxonomic group	E(L)C_{50} [mg/kg_{dw}]
		Bacteria	
		Respiration	13429

Table A2.4: Selected toxicity data for trichloromethane to sediment species, exposure via sediment.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Bacteria		**Bacteria**	
Methanogenic bacteria	8.1	Methanogenic bacteria	10.1

Table A2.5: Selected toxicity data for tetrachloromethane to terrestrial species; exposure via soil.

Taxonomic group	NOEC/EC_{10} [mg/kg_{dw}]	Taxonomic group	E(L)C_{50} [mg/kg_{dw}]
		Bacteria	
		Respiration	6429

Table A2.6: Selected toxicity data for tetrachloromethane to terrestrial species; exposure via medium

Taxonomic group	NOEC/EC$_{10}$ [mg/l]	Taxonomic group	E(L)C$_{50}$ [mg/l]
-	-	**Bacteria**	
		Rhizobium meliloti	1790

Table A2.7: Selected toxicity data for dichloroethane (unspecified) to terrestrial species; exposure via medium

Taxonomic group	NOEC/EC$_{10}$ [mg/l]	Taxonomic group	E(L)C$_{50}$ [mg/l]
-	-	**Bacteria**	
		Rhizobium meliloti	240

Table A2.8: Selected toxicity data for 1,1-dichloroethane to terrestrial species; exposure via medium.

Taxonomic group	NOEC/EC$_{10}$ [mg/l]	Taxonomic group	E(L)C$_{50}$ [mg/l]
		Macrophyta	
		Populus deltoides x nigra	802

Table A2.9: Selected toxicity data for 1,2-dichloroethane to terrestrial species; exposure via soil.

Taxonomic group	NOEC/EC$_{10}$ [mg/kg$_{dw}$]	Taxonomic group	E(L)C$_{50}$ [mg/kg$_{dw}$]
		Bacteria	
		Respiration	7286

Table A2.10: Selected toxicity data for 1,1,1-trichloroethane to terrestrial species; exposure via medium.

Taxonomic group	NOEC/EC$_{10}$ [mg/l]	Taxonomic group	E(L)C$_{50}$ [mg/l]
-	-	**Protozoa**	
		Colpoda sp.	205
		Bacteria	
		Rhizobium meliloti	46
		Oligochaeta	
		Aeolosoma hemprichi	92
		Rotifera	
		Philodina erytrophtalma	162
		Macrophyta	
		Lactuca sativa	58[a]
		Populus deltoides x nigra	160

Note:
a: geometric mean of 104 and 32

Table A2.11: Selected toxicity data for 1,1,1-trichloroethane to terrestrial species exposure via air.

Taxonomic group	NOEC/EC_{10} [mg/kg_{dw}]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Macrophyta**	
		Nicotiana tabacum	13
		Sorghum bicolor	50
		Brassica napus	26
		Insecta	
		Tribolium castaneum	208

Table A2.12: Selected toxicity data for 1,1,1-trichloroethane to terrestrial species; exposure via soil.

Taxonomic group	NOEC/EC_{10} [mg/kg_{dw}]	Taxonomic group	E(L)C_{50} [mg/kg_{dw}]
		Bacteria	
		Respiration	8429

Table A2.13: Selected toxicity data for 1,1,2-trichloroethane to terrestrial species; exposure via medium.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
		Macrophyta	
		Populus deltoides x nigra	253

Table A2.14: Selected toxicity data for 1,1,2,2-tetrachloroethane to terrestrial species; exposure via soil.

Taxonomic group	NOEC/EC_{10} [mg/kg_{dw}]	Taxonomic group	E(L)C_{50} [mg/kg_{dw}]
		Bacteria	
		Respiration	1714

Table A2.15: Selected toxicity data for 1,1,2,2-tetrachloroethane to terrestrial species exposure via medium.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
		Macrophyta	
		Populus deltoides x nigra	151

Table A2.16: Selected toxicity data for 1,1,2,2-tetrachloroethane to terrestrial species exposure via air.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Macrophyta**	
		Nicotiana tabacum	0.065

Table A2.17: Selected toxicity data for 1,2-dichloropropane to terrestrial species; exposure via soil.

Taxonomic group	NOEC/EC_{10} [mg/kg_{dw}]	Taxonomic group	E(L)C_{50} [mg/kg_{dw}]
Annelida		**Bacteria**	
Eisenia fetida	57714	*Respiration*	4571
		Annelida	
		Allolobophora tuberculata	4272
		Eisenia fetida	4240
		Eudrilus eugeniae	5300
		Perionyx excavatus	3880

Table A2.18: Selected toxicity data for 1,1-dichloroethylene to terrestrial species; exposure via medium.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
	-	**Protozoa**	
		Methanotrophic mixed culture, 92% Methylosinus trichosporium	0.098[a]
		Macrophyta	
		Populus deltoides x nigra	281

Table A2.19: Selected toxicity data for trans-1,2-dichloroethylene to terrestrial species; exposure via medium.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
	-	**Protozoa**	
		Methanotrophic mixed culture, 92% Methylosinus trichosporium	4.7[a]
		Macrophyta	
		Populus deltoides x nigra	349

Notes:
a: EC_{54} value

Table A2.20: Selected toxicity data for trans-1,2-dichloroethylene to terrestrial species exposure via air.

Taxonomic group	NOEC/EC_{10} [mg/kg_{dw}]	Taxonomic group	E(L)C_{50} [mg/l]
-	-	**Macrophyta**	
		Nicotiana tabacum	78

Table A2.21: Selected toxicity data for cis-1,2-dichloroethylene to terrestrial species; exposure via soil.

Taxonomic group	NOEC/EC_{10} [mg/kg_{dw}]	Taxonomic group	E(L)C_{50} [mg/kg_{dw}]
		Bacteria	
		Respiration	6429

Table A2.22: Selected toxicity data for cis-1,2-dichloroethylene to terrestrial species; exposure via medium.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
		Macrophyta	
		Populus deltoides x nigra	494

Table A2.23: Selected toxicity data for trichloroethylene to terrestrial species; exposure via soil.

Taxonomic group	NOEC/EC_{10} [mg/kg_{dw}]	Taxonomic group	E(L)C_{50} [mg/kg_{dw}]
		Bacteria	
		Respiration	8000

Table A2.24: Selected toxicity data for trichloroethylene to terrestrial species; exposure via medium.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Macrophyta		**Annelida**	
Populus deltoides x nigra	118 [a]	*Aelosoma hemprichi*	47
		Protozoa	
		Colpoda sp.	75
		Rotifera	
		Philodina erythropthalma	92

Note:
a: reported as NOEC in EU RAR; however from the original source it is clear that this value is a 100% effect value

Table A2.25: Selected toxicity data for tetrachloroethylene to terrestrial species; exposure via soil.

Taxonomic group	NOEC/EC_{10} [mg/kg_{dw}]	Taxonomic group	E(L)C_{50} [mg/kg_{dw}]
		Bacteria	
		Respiration	4857

Table A2.26: Selected toxicity data for tetrachloroethylene to terrestrial species; exposure via medium.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
		Macrophyta	
		Populus deltoides x nigra	38

Table A2.27: Selected toxicity data for tetrachloroethylene to terrestrial species; exposure via air.

Taxonomic group	NOEC/EC_{10} [mg/l]	Taxonomic group	E(L)C_{50} [mg/l]
Macrophyta			
Brassica oleracea	0.000758	-	-
Fagus sylvatia	0.000750		
Molinia caerulea	0.000109		
Phaseolus vulgaris	0.000046		
Picea abies	0.000109		
Pinus silverstris	0.000109		
Pleurozium schreberi	0.000984		
Polytrichum formosum	0.002101		
Rhytidiadelphus squarrosus	0.002101		
Trifolium repens	0.000543		
Triticum aestivum	0.000747		
Vaccinium myrtillus	0.000109		

Appendix 3. Aquatic toxicity data

Legend

L(E)Cx	test result showing x% mortality (LCx) of effect (ECx). LC_{50}s and EC_{50}s are usually determined for acute effects, EC_{10}s are for chronic effects
NOEC	no observed effect concentration, statistically determined
Organism	species used in the test, if available followed by age, size, weight or life stage
A (Analysed)	Y = test substance analysed in test solution, test result is consequently based on actual concentrations N = test substance not analysed in test solution or no data
Test type	S = static, Sc = static with closed test vessels, R = static with renewal, F = flow-through
Test water	am = artificial medium, dtw = dechlorinated tap water, dw = dechlorinated water, nw = natural water, rw = reconstituted water (+additional salts), tw = tap water
Test substance purity	percentage active ingredient, or chemical grade of purity.
Exposure time	h = hours, d = days, w = weeks, m = months, min. = minutes

Table A3.1: Acute toxicity data for ethylene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Algae														
Selenastrum capricornutum		Y							72 h	EC_{50}	biomass	40		(OECD, 1998)
Selenastrum capricornutum		Y							72 h	EC_{50}	growth rate	72		(OECD, 1998)
Pisces														
Lepomis humilis			S					16-17		EC_{100}	mortality	22-25		(OECD, 1998)

Table A3.2: Chronic toxicity data for ethylene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Algae														
Selenastrum capricornutum		Y							72 h	NOEC		13.9		(OECD, 1998)

Table A3.3: Acute toxicity data for ethylene oxide to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria			S											
Activated sludge			S					22	16 h	EC_{50}	growth	10-100		(Conway et al., 1983)
Crustacea														
Daphnia magna			S			7		17	24 h	LC_{50}	mortality	260->300		(Conway et al., 1983)
Daphnia magna			S			7		17	48 h	LC_{50}	mortality	212		(Conway et al., 1983)
Pisces														
Carassius auratus	6.2±0.7 cm, 3.3±1.0 g	Y	S		tw	7.8	283	20±1	24 h	LC_{50}	mortality	90	a	(Bridié et al., 1979)
Pimephales promelas			S			7		22	96 h	LC_{50}	mortality	84		(Conway et al., 1983)

Note:
a: Tlm is used as LC_{50}; calculated by graphical interpolation; method recommended by American Public Health Association (1971)

Table A3.4: Acute toxicity data for ethylene oxide to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Crustacea														
Artemia salina			S			7		24	24 h	LC_{50}	mortality	350->500		(Conway et al., 1983)
Artemia salina			S			7		24	48 h	LC_{50}	mortality	745		(Conway et al., 1983)

Table A3.5: Acute toxicity data for tetrachloromethane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Escherichia coli	B B12-, ATCC 29682	N	S		am			37	1 h	EC_{50}	growth	8700	a	(Yamamoto et al., 1988)
Escherichia coli	B B12-, ATCC 29682	N	S		am			37	1 h	EC_{10}	growth	3700	a	(Yamamoto et al., 1988)
Escherichia coli	B B12-, ATCC 29682	N	S		am		100	37	40 min	LC_{50}	mortality	9200	b	(Yamamoto et al., 1988)
Escherichia coli	B B12-, ATCC 29682	N	S		am		100	37	40 min	LC_{10}	mortality	8000	b	(Yamamoto et al., 1988)
Nitrosomonas sp.		N	Sc			6.5-8		25	24 h	EC_{50}	ammonia use	51		(Blum and Speece, 1991)
Nitrobacter sp.		N	Sc		am	8.9		25	24 h	EC_{50}	nitrite use	527	c	(Tang et al., 1992)
Protozoa														
Tetrahymna pyriformis		N	S	ag	am			30	24 h	EC_{50}	proliferation	830	d	(Yoshioka et al., 1985)
Algae														
Chlamydomonas reinhardtii	11-32a SAG	Y	Sc	p.a.	am	6.5-7.5	110	20±1	72 h	EC_{50}	biomass	0.246	e	(Brack and Rottler, 1994)
Haematococcus pluvialis	Flotow	N	S		am				4 h	EC_{10}	oxygen production	>136	f	(Knie et al., 1983)
Scenedesmus subspicatus		Y	Sc		am				72 h	EC_{50}	growth inhibition	21	g	(Freitag et al., 1994)
Selenastrum capricornutum									48	EC_{50}	growth inhibition	1.5		(Nite, 2007),
Selenastrum capricornutum									72	EC_{50}	biomass	0.89		(Nite, 2007)
Platyhelminthes (Turbellaria)														
Dugesia japonica		N	S		am	~7		20±1	7d	EC^{50}	regeneration	32		(Yoshioka et al., 1986)
Dugesia japonica		N	S		am	~7		20±1	7d	LC_{50}	mortality	1.6	h	(Yoshioka et al., 1986)
Rotifera														
Brachionus calyciflorus		N	S	>97%	am			25	24 h	LC_{50}	mortality	5799	i	(Calleja et al., 1994)
Crustacea														
Daphnia magna	<24 h, 0.315-0.630 mm	N	S		tw	7.6-7.7	286	20-22	24 h	EC_{50}	immobility	>770		(Bringmann and Kühn, 1977b) b
Daphnia magna	<24 h, Strauss,	N	S		am	8.0±0.2	250.2	20	24 h	EC_{50}	immobility	721		(Bringmann and Kühn, 1982)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
	IRCHA													
Daphnia magna		N	S	>97%					24 h	EC_{50}	immobility	20766	j	(Calleja et al., 1994)
Daphnia magna	6-24 h	Y	S						24 h	EC_{50}	immobility	20	k	(Freitag et al., 1994)
Daphnia magna	Straus	N	S		am		250	20	24 h	EC_{50}	immobility	28	n	(Knie et al., 1983)
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	LC_{50}	mortality	35		(LeBlanc, 1980)
Daphnia magna	<24 h; neonate	N	S	reagent grade	am	7.6	200	21±1	24 h	EC_{50}	immobility	74.4		(Lilius et al., 1994)
Daphnia magna									48 h	LC_{50}	mortality	28	l	(Zhao et al., 1993)
Daphnia magna		N	S						48 h	EC_{50}	immobility	35.2	l, m	(U.S. EPA, 1980a)
Daphnia magna	<24 h, Strauss, IRCHA	N	S		am	8.0±0.2	250.2	20	24 h	EC_0	immobility	579		(Bringmann and Kühn, 1982)
Daphnia magna	Straus	N	S		am		250	20	24 h	EC_0	immobility	9	n	(Knie et al., 1983)
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	NOEC	mortality	7.7		(LeBlanc, 1980)
Daphnia magna	Straus <24 h	N	S		am			24	4-5 h	LOEC	immobility		20-30% effect	(Tumanov et al., 1995)
Daphnia magna									48 h	EC_{50}	immobility	8.1		(Nite, 2007)
Daphnia magna									48 h	EC_{50}	immobility	28	r	(Knie et al., 1983)
Daphnia magna									48 h	EC_0	immobility	9	r	(Knie et al., 1983)
Moina macropoda	5 d	N	S		am	~7		20±1	3h	LC_{50}	mortality	200		(Yoshioka et al., 1986)
Streptocephalus proboscideus		N	S	>97%	am				24 h	LC_{50}	mortality	6429	Streptox kit F test	(Calleja et al., 1994)
Pisces														
Lepomis macrochirus	0.32-1.2 g	N	Sc	>80%	rw	6.5-7.9	32-48	21-23	96 h	LC_{50}	mortality	27	precipitate	(Buccafusco et al., 1981)
Lepomis macrochirus		N	S						96 h	LC_{50}	mortality	27.3	l., m, o	(U.S. EPA, 1980a)
Lepomis macrochirus	33-75 mm	N	S	-	nw	7.6-7.9	55	23	96 h	LC_{50}	mortality	125		(Dawson et al., 1975-1977)
Lepomis macrochirus	33-75 mm	N	S	-	nw	7.6-7.9	55	23	96 h	LC_{50}	mortality	101	p	(Dawson et al., 1975-1977)
Lepomis macrochirus	33-75 mm	N	S	-	nw	7.6-7.9	55	23	96 h	LC_{10}	mortality	63	q	(Dawson et al., 1975-1977)
Leuciscus idus	L.	N	S						48 h	LC_{50}	mortality	13	r	(Knie et al., 1983)
Leuciscus idus melanotus		N	S	-	tw	7--8	255	20±1	48 h	LC_{50}	mortality	95	s	(Juhnke and Lüdemann, 1978)
Leuciscus idus melanotus		N	S	-	tw	7--8	255	20±1	48 h	LC_{50}	mortality	472	s	(Juhnke and Lüdemann, 1978)
Leuciscus idus melanotus									24 h	LC_{50}	mortality	95	l	(Zhao et al., 1993)
Leuciscus idus	L.	N	S						48 h	LC_0	mortality	5	r	(Knie et al., 1983)
Leuciscus idus melanotus		N	S	-	tw	7--8	255	20±1	48 h	LC_0	mortality	16	s	(Juhnke and Lüdemann, 1978)
Leuciscus idus melanotus		N	S	-	tw	7--8	255	20±1	48 h	LC_0	mortality	272	s	(Juhnke and Lüdemann, 1978)
Leuciscus idus melanotus	N	S							48 h	LC_{50}	mortality	47	l	(Scheubel, 1980) in (Thompson et al., 2004)
Pimephales promelas	30 D, 17.4 MM, 0.098 G	Y	F	99%	-	6.8	49.2	21.7	96 h	LC_{50}	mortality	41.4		(Geiger et al., 1990)
Pimephales promelas	juvenile, 8 w,	Y	F	reagent	-	8.09		25.9	96 h	LC_{50}	mortality	42.9	Kimball	(U.S. EPA, 1980a)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
	12-16 mm			grade									in	
Pimephales promelas									96 h	LC_{50}	mortality	70	l	(Kaiser et al., 1995)
Poecilia reticulata	2-3 month old	N	R		am		25	22	14 d	LC_{50}	mortality	67	t	(Könemann, 1981)
Poecilia reticulata									7-14 d	LC_{50}	mortality	70	l	(Zhao et al., 1993)
Oryzias latipes			S					20	24 h	LC_{50}	mortality	830		(Tsuji et al., 1986)
Oryzias latipes			S					20	48 h	LC_{50}	mortality	830		(Tsuji et al., 1986)
Oryzias latipes	~3 cm, 0.3 g	N	S		dtw		20±1	80	48 h	LC_{50}	mortality	100	U	(Yoshioka et al., 1986)

Notes:

a: derived from data presented in figure, experiment was continued until 22 h, which was far beyond the phase of exponential growth; TSY medium used
b: derived from data presented in figure; 1 mM phosphate medium 0.5% glucose 1 mM $MgSO_4*5H_20$
c: corrected by author for liquid phase
d: Sealed for volatile compounds; <5000 mg/l DMSO (non-toxic) for slightly soluble substances
e: continuous light at 130 µE/m²s; 5*10^3 cell/mL; exponential phase
f: 8*10^4 cells/mL; according to von Tümpling, 1972 and Hedlich, 1966
g: according to OECD 201 except for the closed vessels enriched with CO_2; continuous light;
h: Value of 0.2 for log LC_{50} probably is a typing error and should be 2.0.
i: Streptoxkit F test
j: OECD guideline (1984)
k: according to OECD guideline 202; test performed in the dark
l: cited in reference
m: US EPA 1978
n: according to DIN 38412 Teil 11
o: same test as Buccafusco
p: LC_{50} recalculated with nonlinear regression
q: LC_{10} calculated from original data
r: according to DIN 38412 Teil 15
s: test according to Mann, 1976
t: covered with glass
u: 8 h dark, 16 h light

Table A3.6: Chronic toxicity data for tetrachloromethane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Algae														
Chlamydomonas reinhardtii	11-32a SAG	Y	Sc	p.a.	am	6.5-7.5	110	20±1	72 h	EC_{10}	biomass	0.0717	a	(Brack and Rottler, 1994)
Scenedesmus quadricauda		N	Sc		am	7.0	55	27	8 d	NOEC	growth	>600	b, c	(Bringmann and Kühn, 1977a), (Bringmann and Kühn, 1978a), (Bringmann and Kühn, 1978b), (Bringmann and Kühn, 1979) , (Bringmann and Kühn, 1980b)
Bacteria														
Pseudomonas putida		N	Sc		am	7.0	81.2	25	16 h	NOEC	growth	30	b	(Bringmann and Kühn, 1976), (Bringmann and Kühn, 1977a), (Bringmann and Kühn, 1979), (Bringmann and Kühn, 1980b)
Cyanophyta														
Microcystis aeruginosa		N	Sc		am	7.0	55	27	8 d	NOEC	growth	105	b, c	(Bringmann, 1975), (Bringmann and Kühn, 1976), (Bringmann and Kühn, 1978a), (Bringmann and Kühn, 1978b)
Protozoa														
Chilomonas paramaecium		N	Sc		am	6.9	74.6	20	48 h	NOEC	growth	>300	b, d	(Bringmann et al., 1980)
Entosiphon sulcatum	Stein	N	Sc		am	6.9	75.1	25	72 h	NOEC	growth	>770	b, d	(Bringmann, 1978)
Entosiphon sulcatum										NOEC	growth	770	b	(Bringmann and Kühn, 1979) (Bringmann and Kühn, 1980b)
Uronema parduczi	Chatton-Lwoff	N	Sc		am	6.9	75.1	25	20 h	NOEC	growth	>616	b, d	(Bringmann and Kühn, 1980a)
Crustacea														
Daphnia magna		Sc							21 d	NOEC		3.1	f	(Thompson et al., 1997) in (Thompson et al., 2004)
Daphnia magna									21 d	NOEC	reproduction	0.41		Nite database,
Pisces														
Pimephales promelas	ELS									NOEC		>3.4	e	(U.S. EPA, 1980a)

Notes:
a: continuous light at 130 µE/m^{2}s; 5*10^3 cell/mL; exponential phase
b: toxicity threshold is used as a NOEC
c: light intensity 2800 lm
d: 1.5*10^4 cells/ml
e: U.S. EPA 1978 cited in reference
f: fully filled vessel

Table A3.7: Acute toxicity data for tetrachloromethane to marine organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Vibrio fischeri		N	S	>97%	am				5-15 min	EC_{50}	bioluminescense	997		(Calleja et al., 1994)
Vibrio fischeri		Y	S						15 min	EC_{50}	bioluminescense	5	f	(Freitag et al., 1994)
Vibrio fischeri	LX-1	N	S		am			15	15 min	EC_{20}	bioluminescense	28	g	(Kafka et al., 1995b)
Vibrio fischeri									30 min	EC_{50}	growth	34	c	(Kaiser et al., 1995)
Vibrio fischeri		N	S					20	15 min	EC_{50}	bioluminescense	1222		(Zhao et al., 1993)
Vibrio fischeri		N	S		am	5-6	20	15	5 min	EC_{50}	bioluminescenc e	563	h	(Kahru et al., 1996)
Vibrio fischeri		N	S		am	5-6	20	15	5 min	EC_{20}	bioluminescenc e	190	h	(Kahru et al., 1996)
Crustacea														
Artemia salina		N	S	>97%	am			25	24 h	LC_{50}	mortality	2153	a	(Calleja et al., 1994)
Artemia salina	30 h after hatching, 2nd instar	Y	Sc	>98%	am	8.5-8.7	32	19	24 h	EC_{50}	immobility	30.4	b	(Foster and Tullis, 1984)
Artemia spp									24 h	LC_{50}	mortality	31	c	(Zhao et al., 1993)
Pisces														
Menidia beryllina	40-100 mm	N	S	-	rw	-	-	20	96 h	LC_{50}	mortality	150		(Dawson et al., 1975-1977)
Menidia beryllina	40-100 mm	N	S	-	rw	-	-	20	96 h	LC_{50}	mortality	146	d	(Dawson et al., 1975-1977)
Menidia beryllina	40-100 mm	N	S	-	rw	-	-	20	96 h	LC_{10}	mortality	61	E	(Dawson et al., 1975-1977)
Limanda limanda	15-20 cm	Y	F		nw				96 h	LC_{50}	mortality	ca 50		(Pearson and McConnell, 1975)

Notes:
a: Artoxkit M
b: artificial sea water
c: cited in reference
d: LC50 recalculated with nonlinear regression
e: LC10 calculated from original data
f: Microtox test; German standard DIN 38412 L 34
g: test with 2% v/v 2-propanol
h: Biotox test. Correlation with Microtox is poor. 1.5% methanol added

Table A3.8: Chronic toxicity data for tetrachloromethane to marine organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pisces														
Cyprinodon variegatus	-	Y	F	-	-	-	-		-	NOEC	mortality	4.5		(Mayer et al., 1994)

Table A3.9: Acute toxicity data for 1,1-dichloroethane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Nitrosomonas sp.		N	Sc			6.5-8		25	24 h	EC_{50}	ammonia use	0.91		(Blum and Speece, 1991)
Nitrobacter sp.		N	Sc		am	8.2		25	24 h	EC_{50}	nitrite use	1653	a	(Tang et al., 1992)
Pisces														
Poecilia reticulata	2-3 month old	N	Rc		am		25	22	7 d	LC_{50}	mortality	202		(Könemann, 1981)

Note:

a: Corrected by author for liquid phase.

Table A3.10: Acute toxicity data for 1,1-dichloroethane to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Vibrio fischeri		N							30 min	EC_{50}	bioluminescense	351	a	(Sixt et al., 1995)
Vibrio fischeri		N	S			6.5-7.5		15	5 min	EC_{50}	bioluminescense	270		(Blum and Speece, 1991)

Note:

a: Original reference: (Anonymous1994)

Table A3.11: Acute toxicity data for 1,1,1-trichloroethane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Nitrosomonas sp.		N	Sc			6.5-8		25	24 h	EC_{50}	ammonia use	8.5		(Blum and Speece, 1991)
Escherichia coli			S	-	am			37	12-16 h	EC_{50}	growth inhibition	2028		(Nendza and Seydel, 1988)
Spirochaeta aurantia	ATCC 25082	N	S	-	am	7	-	30	30 min	EC_{50}	growth inhibition	414		(Pill et al., 1991)
Algae														
Chlamydomonas reinhardtii	11-32a SAG	Y	Sc	>99%	am	6.5-7.5	110	20±1	72 h	EC_{50}	biomass	0.536	a	(Brack and Rottler, 1994)
Chlamydomonas angulosa		N	Sc	-	am	6.5	-	19	3 h	EC_{50}	photosynthesis	280	b	(Hutchinson et al., 1980)
Chlorella vulgaris		N	Sc	-	am	6.5	-	19	3 h	EC_{50}	photosynthesis	153	c	(Hutchinson et al., 1980)
Scenedesmus subspicatus		Y	Sc		am				72 h	EC_{50}	growth inhibition	813	d	(Freitag et al., 1994)
Selenastrum capricornutum									96 h	EC_{50}	cell density	>669	e	(U.S. EPA, 1980b)
Selenastrum capricornutum									96 h	EC_{50}	chlorophyll *a*	>669	e	(U.S. EPA, 1980b)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Fungi														
Saccharomyces cerevisiae		N	Sc		am			30	24 h	EC_{20}	growth	5336	e,f	(Weber et al., 2000)
Saccharomyces cerevisiae		N	Sc		am			28	16-18 h	EC_{20}	fermentation inhibition	77	e	(Weber et al., 2000)
Rotifera														
Brachionus calyciflorus		N	S	>97%	am			25	24 h	LC_{50}	mortality	6417	g	(Calleja et al., 1994)
Crustacea														
Daphnia magna	4-6 days	N	Sc	>97%	Distilled water			23±2	48 h	LC_{50}	mortality	58		(Abernethy et al., 1986)
Daphnia magna	<24 h, 0.315-0.630 mm	N	S		tw	7.6-7.7	286	20-22	24 h	EC_{50}	immobility	>1300		(Bringmann and Kühn, 1977a)
Daphnia magna		N	S	>97%					24 h	EC_{50}	immobility	915	h	(Calleja et al., 1994)
Daphnia magna	6-24 h	Y	S						24 h	EC_{50}	immobility	40	i	(Freitag et al., 1994)
Daphnia magna	< 24 h	N	Sc	-	rw	6.7-8.1	72±6	22±1	48 h	LC_{50}	mortality	>530		(LeBlanc, 1980)
Daphnia magna		N	S						48 h	EC_{50}	immobility	>530	e	(U.S. EPA, 1980b)
Daphnia magna	4-6 days	N	S						48 h	LC_{50}	mortality	57.6	e	(IPCS, 1992)
Daphnia magna			S	96.40%					48 h	EC_{50}	immobility	11.2	j	EPA, 2000
Streptocephalus proboscideus		N	S	>97%	am				24 h	LC_{50}	mortality	1314	k	(Calleja et al., 1994)
Pisces														
Lepomis macrochirus	0.32-1.2 g	N	S	>80%	rw	6.5-7.9	32-48	21-23	96 h	LC_{50}	mortality	72	l	(Buccafusco et al., 1981)
Lepomis macrochirus		N	S						96 h	LC_{50}	mortality	69.7	e	(U.S. EPA, 1980b)
Lepomis macrochirus			S	96.40%					96 h	LC_{50}	mortality	58	j	EPA, 2000
Pimephales promelas	Avg 1.04 g, 49 mm	Y	F		rw				96 h	LC_{50}	mortality	52.8		(Alexander et al., 1978)
Pimephales promelas	Avg 1.04 g, 49 mm	Y	F		rw				96 h	LC_{10}	mortality	30.8		(Alexander et al., 1978)
Pimephales promelas	Avg 1.04 g, 49 mm	N	S		rw				96 h	LC_{50}	mortality	105		(Alexander et al., 1978)
Pimephales promelas	31 d	Y	F	99%	nw/dtw	7.69±0.09	43.8±3.23	25.5±0.40	96 h	LC_{50}	mortality	52.9		(Geiger et al., 1986)
Pimephales promelas	31 d	Y	F	99%	nw/dtw	7.99±0.16	46.4±0.63	25.6±0.52	96 h	LC_{50}	mortality	42.3		(Geiger et al., 1986)
Pimephales promelas	31 d	Y	F	99%	nw/dtw	7.99±0.16	46.4±0.63	25.6±0.52	96 h	LC_{50}	mortality	43.4	m	(Geiger et al., 1986)
Pimephales promelas	31 d	Y	F	99%	nw/dtw	7.99±0.16	46.4±0.63	25.6±0.52	96 h	LC_{10}	mortality	31.3	m	(Geiger et al., 1986)
Pimephales promelas									96 h	LC_{50}	mortality	47	e	(Kaiser et al., 1995)
Pimephales promelas										LC_{50}	mortality	42	e	(Nendza and Russom, 1991)
Pimephales promelas										LC_{50}	mortality	52	e	(Nendza and Russom, 1991)
Poecilia reticulata	2-3 month old	N	Rc		am		25	22	7 d	LC_{50}	mortality	133		(Könemann, 1981)
Oncorhynchus mykiss			S	96.40%					96 h	LC_{50}	mortality	52	m	EPA, 2000
Oryzias latipes			S					20	24 h	LC_{50}	mortality	440		(Tsuji et al., 1986)
Oryzias latipes			S					20	48 h	LC_{50}	mortality	440		(Tsuji et al., 1986)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Brachydanio rerio		N	F		am	8.15		23±1	48 h	LC_{50}	mortality	79	e	(GDCh, 1996)
Brachydanio rerio		N	F		am	8.15		23±1	48 h	LC_0	mortality	35	e	(GDCh, 1996)
Brachydanio rerio		N	F		am	8.15		23±1	96 h	LC_{50}	mortality	55	e	(GDCh, 1996)
Brachydanio rerio		N	F		am	8.15		23±1	96 h	LC_0	mortality	35	e	(GDCh, 1996)
Leuciscus idus melanotus		N	S	-	tw	7--8	255	20±1	48 h	LC_{50}	mortality	123	n	(Juhnke and Lüdemann, 1978)
Leuciscus idus melanotus		N	S	-	tw	7--8	255	20±1	48 h	LC_0	mortality	94	n	(Juhnke and Lüdemann, 1978)

Notes:

a: continuous light at 130 µE/ m^2s; 5*10^3 cell/mL; exponential phase

b: light intensity 400 foot candles; 12 h light:dark; 5*10^4 cells/mL

c: light intensity 400 foot candles; 12 h light:dark; 20*10^4 cells/mL

d: according to OECD 201 except for the closed vessels enriched with CO_2; continuous light

e: cited in reference

f: YPD medium

g: Rotoxkit F test

h: OECD guideline (1984)

i: according to OECD guideline 202; test performed in the dark

j: data from RIVM E-tox Database

g: Streptoxkit F test

l: undissolved chemical

m: determined from tabulated data with log-logistic model

n: test according to Mann, 1976

Table A3.12: Chronic toxicity data for 1,1,1-trichloroethane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Algae														
Chlamydomonas reinhardtii	11-32a SAG	Y	Sc	>99%	am	6.5-7.5	110	20±1	72 h	EC_{10}	Biomass	0.213	a	(Brack and Rottler, 1994)
Crustacea														
Daphnia magna	< 24 h	Y	R	96%	rw	7.6-8.8	187	20±1	17 d	LC_{50}	mortality	5.56	b	(Thompson and Carmichael, 1989)
Daphnia magna	< 24 h	Y	R	96%	rw	7.6-8.8	187	20±1	17 d	LC_{10}	mortality	1.401	b	(Thompson and Carmichael, 1989)
Daphnia magna	< 24 h	Y	R	96%	rw	7.6-8.8	187	20±1	17 d	LC_{50}	reproduction	4.352	b,c	(Thompson and Carmichael, 1989)
Daphnia magna	< 24 h	Y	R	96%	rw	7.6-8.8	187	20±1	17 d	LC_{10}	reproduction	0.837	b,c	(Thompson and Carmichael, 1989)
Pisces														
Cyprinus carpio	Avg 0.79 g	Y	Fc	96%	am	7.6-8.1	64-74	22±1	14 d	NOEC	growth inhibition	7.7		(Thompson and Carmichael, 1989)
Brachydanio rerio		N	F		am	8.15		23±1	14 d	NOEC		3.4	d	(GDCh, 1996)
Brachydanio rerio		N	F		am	8.15		23±1	14 d	LOEC		13.8	d	(GDCh, 1996)

Notes:

a: continuous light at 130 µE/ m^{2}s; 5*10^3 cell/mL; exponential phase

b: recalculated from original data

c: not corrected for mortality

d: cited in reference

Table A3.13: Acute toxicity data for 1,1,1-trichloroethane to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Vibrio fischeri		N	S	>97%	am				5-15 min	EC_{50}	bioluminescense	46		(Calleja et al., 1994)
Vibrio fischeri		Y	S						15 min	EC_{50}	bioluminescense	5	a	(Freitag et al., 1994)
Vibrio fischeri		N	S		am				15 min	EC_{50}	bioluminescense	64		(Kafka et al., 1995a)
Vibrio fischeri		N	S		am				15 min	EC_{20}	bioluminescense	22		(Kafka et al., 1995a)
Vibrio fischeri		N	S		am			15	15 min	EC_{50}	bioluminescense	61	b	(Kafka et al., 1995b)
Vibrio fischeri		N	S		am			15	15 min	EC_{10}	bioluminescense	11	b	(Kafka et al., 1995b)
Vibrio fischeri									30 min	EC_{50}	bioluminescense	8	c	(Kaiser et al., 1995)
Vibrio fischeri									30 min	EC_{50}	bioluminescense	8	c	(Sixt and Altschuh, 1996)
Vibrio fischeri									5 min	EC_{50}	bioluminescense	18.2	c	(Sixt and Altschuh, 1996)
Vibrio fischeri		N	S		am			15	15 min	EC_{50}	bioluminescense	8.04		(Hermens et al., 1985)
Algae														

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Skeletonema costatum									96 h	EC_{50}	cell density	>669	c	(U.S. EPA, 1980b)
Skeletonema costatum									96 h	EC_{50}	Chlorophyll a	>669	c	(U.S. EPA, 1980b)
Phaeodactylum tricornutum		N	S							EC_{50}	carbon uptake	5		(Pearson and McConnell, 1975)
Crustacea														
Artemia salina	24 h	N	S		am	8.6		25	24 h	LC_{50}	mortality	113		(Sánchez-Fortún et al., 1997)
Artemia salina	48 h	N	S		am	8.6		25	24 h	LC_{50}	mortality	44		(Sánchez-Fortún et al., 1997)
Artemia salina	72 h	N	S		am	8.6		25	24 h	LC_{50}	mortality	8		(Sánchez-Fortún et al., 1997)
Artemia salina		N	S	>97%	am			25	24 h	LC_{50}	mortality	4082	d	(Calleja et al., 1994)
Mysidopsis bahia		N	S						24 h	LC_{50}	mortality	60.9	c	(GDCh, 1996)
Mysidopsis bahia		N	S						48 h	LC_{50}	mortality	56.6	c	(GDCh, 1996)
Mysidopsis bahia		N	S						72 h	LC_{50}	mortality	40.7	c	(GDCh, 1996)
Mysidopsis bahia		N	S						96 h	LC_{50}	mortality	31.2	c	(U.S. EPA, 1980b)
Mysidopsis bahia		N	S						96 (?) h	NOEC		< 7.5	c	(GDCh, 1996)
Eliminius modestus	15-20 cm	N	S		nw				48 h	LC_{50}	mortality	7.5		(Pearson and McConnell, 1975)
Pisces														
Cyprinodon variegatus	8-15 mm, 14-28 d	N	S	>80%	nw	-	10-31	25-31	96 h	LC_{50}	mortality	71		(Heitmuller et al., 1981)
Cyprinodon variegatus	8-15 mm, 14-28 d	N	S	>80%	nw	-	10-31	25-31	96 h	NOEC	mortality	43		(Heitmuller et al., 1981)
Limanda limanda	15-20 cm	Y	F		nw				96 h	LC_{50}	mortality	33		(Pearson and McConnell, 1975)

a: Microtox test; German standard DIN 38412 L 34

b: derived from figure

c: cited in reference

d: Artoxkit M

Table A3.14: Acute toxicity data for 1,1,2-trichloroethane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Nitrosomonas sp.		N	Sc			6.5-8		25	24 h	EC_{50}	ammonia use	1.9		(Blum and Speece, 1991)
Nitrobacter sp.		N	Sc		am	8.2		25	24 h	EC_{50}	nitrite use	490	a	(Tang et al., 1992)
Algae														
Chlamydomonas reinhardtii	11-32a SAG	Y	Sc	>99%	am	6.5-7.5	110	20±1	72 h	EC_{50}	biomass	57.0	b	(Brack and Rottler, 1994)
Scenedesmus subspicatus		Y	Sc	>98%	am				≤ 96 h	EC_{50}	cell density	167	c	(Behechti et al., 1995)
Scenedesmus subspicatus		Y	Sc	>98%	am				≤ 96 h	EC_{50}	cell density	198	d	(Behechti et al., 1995)
Scenedesmus subspicatus		Y	Sc		am				72 h	EC_{50}	growth	200	e	(Freitag et al., 1994)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
											inhibition			
Chlorella pyrenoïdosa		Y			enr nw	8			96 h	EC_{50}	growth	170.0		(Adema and Vink, 1981)
Molluscs														
Lymnea stagnalis	egg	Y			nw	8			96 h	LC_{50}	mortality	170		(Adema and Vink, 1981)
Dreissena polymorpha	adult 2 cm	Y			nw	8			96 h	LC_{50}	mortality	320		(Adema and Vink, 1981)
Crustacea														(Adema and Vink, 1981)
Daphnia magna	1 mm	Y			nw	8			24 h	LC_{50}	mortality	43		(Adema and Vink, 1981)
Daphnia magna	3 mm	Y			nw	8			24 h	LC_{50}	mortality	72		(Adema and Vink, 1981)
Daphnia magna	1 mm	Y			nw	8		20±1	24 h	LC_{50}	mortality	44		(Adema, 1978)
Daphnia magna	3 mm	Y			nw	8		20±1	24 h	LC_{50}	mortality	70		(Adema, 1978)
Daphnia magna	6-24 h	Y	S						24 h	EC_{50}	immobility	23	f	(Freitag et al., 1994)
Daphnia magna	3 mm	Y			nw	8			48 h	LC_{50}	mortality	43		(Adema and Vink, 1981)
Daphnia magna	1 mm	Y			nw	8		20±1	48 h	LC_{50}	mortality	43		(Adema, 1978)
Daphnia magna	3 mm	Y			nw	8		20±1	48 h	LC_{50}	mortality	43		(Adema, 1978)
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	LC_{50}	mortality	18		(LeBlanc, 1980)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.1-7.7	44.7 (43.5-47.5)	20±1	48 h	LC_{50}	mortality	190	g; i; j;	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.0-7.5	44.7 (43.5-47.5)	20±1	48 h	LC_{50}	mortality	170	g; i; k	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.1-7.7	44.7 (43.5-47.5)	20±1	48 h	EC_{50}	immobility	81	h; i; j	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.0-7.5	44.7 (43.5-47.5)	20±1	48 h	EC_{50}	immobility	78	h; i; k	(Richter et al., 1983)
Daphnia magna		N	S						48 h	EC_{50}	immobility	18		U.S. EPA 1978 in U.S. EPA 1980
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	NOEC	mortality	1		(LeBlanc, 1980)
Ceriodaphnia cf. dubia	< 24 h	N	S					15	48 h	EC_{50}	immobility	151	p	(Warne and Westbury, 1999)
Ceriodaphnia cf. dubia	< 24 h	N	S					20	48 h	EC_{50}	immobility	123	p	(Warne and Westbury, 1999)
Ceriodaphnia cf. dubia	< 24 h	N	S					25	48 h	EC_{50}	immobility	38	p	(Warne and Westbury, 1999)
Ceriodaphnia cf. dubia	< 24 h	N	S					25	48 h	EC_{50}	immobility	56	p	(Warne and Westbury, 1999)
Ceriodaphnia cf. dubia	< 24 h	N	S					25	48 h	EC_{50}	immobility	30	p	(Warne and Westbury, 1999)
Ceriodaphnia cf. dubia	< 24 h	N	S					25	48 h	EC_{50}	immobility	52	p	(Warne and Westbury, 1999)
Ceriodaphnia cf. dubia	< 24 h	N	S					25	48 h	EC_{50}	immobility	32	p	(Warne and Westbury, 1999)
Ceriodaphnia cf. dubia	< 24 h	N	S					25	48 h	EC_{50}	immobility	56	p	(Warne and Westbury, 1999)
Ceriodaphnia cf. dubia	< 24 h	N	S					30	48 h	EC_{50}	immobility	32	p	(Warne and Westbury, 1999)
Moina australiensis	< 24 h	N	S					25	48 h	EC_{50}	immobility	55	p	(Warne and Westbury, 1999)
Moinadaphnia macleayi	< 24 h	N	S					25	48 h	EC_{50}	immobility	55	p	(Warne and Westbury, 1999)
Simociphalus vetulus	< 24 h	N	S					25	48 h	EC_{50}	immobility	96	p	(Warne and Westbury, 1999)
Insecta														
Chironomus riparius	3th instar	N	S	>99%	aw	8.2±0.2	210	21±2	48 h	LC_{50}	mortality	173	m	(Roghair et al., 1994)
Chironomus riparius	3th instar	N	S	>99%	aw	8.2±0.2	210	21±2	48 h	LC_{10}	mortality	164	m	(Roghair et al., 1994)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pisces														
Lepomis macrochirus	0.32-1.2 g	N	Sc	>80%	rw	6.5-7.9	32-48	21-23	96 h	LC_{50}	mortality	40	n	(Buccafusco et al., 1981)
Pimephales promelas	-	-	F	-	-	-	-		96 h	LC_{50}	mortality	82	o	(Blum and Speece, 1991)
Pimephales promelas	31 d	Y	F	98%	nw/dtw	7.49±0.03	45.2±0.52	25.2±0.21	96 h	LC_{50}	mortality	81.6		(Geiger et al., 1985)
Pimephales promelas									96 h	LC_{50}	mortality	82	p	(Kaiser et al., 1995)
Pimephales promelas										LC_{50}	mortality	82	q	(Nendza and Russom, 1991)
Pimephales promelas	30 d, 0.12 g	Y	F		nw	7.5	45.5	25±1	96 h	LC_{50}	mortality	81.7		(Veith et al., 1983)
Pimephales promelas	30-35 d	Y	F		nw	6.7-7.6	45.1 (45.0-45.5)		96 h	LC_{50}	mortality	81.6		(Walbridge et al., 1983)
Pimephales promelas						7.6	44.6	25	96 h	LC_{50}	mortality	81.8	p	(GDCh, 1995).
Poecilia reticulata	2-3 month old	N	Rc		am		25	22	7 d	LC_{50}	mortality	94		(Könemann, 1981)
Poecilia reticulata	young	Y			nw	8			24 h	LC_{50}	mortality	72		(Adema and Vink, 1981)
Poecilia reticulata	young	Y			nw	8			7 d	LC_{50}	mortality	70		(Adema and Vink, 1981)
Poecilia reticulata	adult	Y			nw	8			24 h	LC_{50}	mortality	85		(Adema and Vink, 1981)
Poecilia reticulata	adult	Y			nw	8			7 d	LC_{50}	mortality	75		(Adema and Vink, 1981)
Jordanella floridae	2-4 month	N	R		nw	6.95±0.35	48±2.13	25±1	96 h	LC_{50}	mortality	89.1	r	(Smith et al., 1991)
Jordanella floridae	2-4 month	Y	F		nw	6.95±0.35	48±2.13	25±1	96 h	LC_{50}	mortality	45.1		(Smith et al., 1991)
Brachydanio rerio		Y	F					25	96 h	LOEC	mortality	60	p	(Warne and Westbury, 1999)
Gambudia affinis		Y	F					25	96 h	LOEC	mortality	34	p	(Warne and Westbury, 1999)
Macquaria ambigua		N	F					25	96 h	LOEC	mortality	57	p	(Warne and Westbury, 1999)
Melanotaenia duboulayi		Y	F					25	96 h	LOEC	mortality	47	p	(Warne and Westbury, 1999)
Melanotaenia duboulayi		Y	F					35	96 h	LOEC	mortality	31	p	(Warne and Westbury, 1999)
Melanotaenia duboulayi		Y	F					25	96 h	LOEC	mortality	59	p	(Warne and Westbury, 1999)
Melanotaenia duboulayi		Y	F					35	96 h	LOEC	mortality	47	p	(Warne and Westbury, 1999)
Melanotaenia duboulayi		Y	F					15	96 h	LOEC	mortality	66	p	(Warne and Westbury, 1999)

Notes:

a: corrected by author for liquid phase

b: continuous light at 130 µE/m^{2}s; 5*10^3 cell/mL; exponential phase

c: according to OECD 201 except from closed vessels aerated with 3% CO_2

d: according to OECD 201 except from closed vessels opened for measurements aerated with 3% CO_2

e: according to OECD 201 except for the closed vessels enriched with CO_2; continuous light

f: according to OECD guideline 202; test performed in the dark

g: probit

h: binomial

i: 16:8 h light:dark at 344 lm; based on mean concentrations

j: unfed
k: fed 20 mg/l dw trout chow and yeast
l: data from RIVM E-Tox database
m: recalculated from original data
n: soluble
o: cited in reference, source Center Lake Superior Environmental Studies
p: cited in reference
q: cited in reference, source EPA, according to ASTM guideline
r: renewel every 24 h

Table A3.15: Chronic toxicity data for 1,1,2-trichloroethane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Algae														
Chlamydomonas reinhardtii	11-32a SAG	Y	Sc	>99%	am	6.5-7.5	110	20±1	72 h	EC_{10}	biomass	26.3	a	(Brack and Rottler, 1994)
Molluscs														
Lymnea stagnalis	juvenile	Y			nw	8			16 d	LC_{50}	mortality	58		(Adema and Vink, 1981)
Lymnea stagnalis	juvenile	Y			nw	8			16 d	EC_{50}	morphology & hatching	36		(Adema and Vink, 1981)
Lymnea stagnalis	juvenile	Y			nw	8			16 d	NOEC	morphology & hatching	10		(Adema and Vink, 1981)
Dreissena polymorpha	adult 2 cm	Y			nw	8			7d	LC_{50}	mortality	190		(Adema and Vink, 1981)
Dreissena polymorpha	adult 2 cm	Y			nw	8			14d	LC_{50}	mortality	140		(Adema and Vink, 1981)
Crustacea														
Daphnia magna	< 24 h	Y	R	95-99%	nw	6.6-7.9	44.7 (43.5-47.5)	20±1	28 d	NOEC	reproduction (number of young per adult)	26	b	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	R	95-99%	nw	6.6-7.9	44.7 (43.5-47.5)	20±1	28 d	EC_{50}	reproduction (number of young per adult)	31	b, c	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	R	95-99%	nw	6.6-7.9	44.7 (43.5-47.5)	20±1	28 d	EC_{10}	reproduction (number of young per adult)	24	b, c	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	R	95-99%	nw	6.6-7.9	44.7 (43.5-47.5)	20±1	28 d	NOEC	growth	13	b	(Richter et al., 1983)
Daphnia magna	1 mm	Y			nw	8			21 d	LC_{50}	mortality	40		(Adema and Vink, 1981)
Daphnia magna	1 mm	Y			nw	8			21 d	EC_{50}	reproduction	32		(Adema and Vink, 1981)
Daphnia magna	1 mm	Y			nw	8			21 d	NOEC	reproduction and mortality	18		(Adema and Vink, 1981)
Daphnia magna	3 mm	Y			nw	8			7d	LC_{50}	mortality	43		(Adema and Vink, 1981)
Daphnia magna							44.7	20±1	28 d	NOEC	growth	13.2	d	(GDCh, 1995)
Daphnia magna							44.7	20±1	28 d	LOEC	growth	26	d	(GDCh, 1995)
Daphnia magna							44.7	20±1	28 d	NOEC	reproduction	26	d	(GDCh, 1995)
Daphnia magna							44.7	20±1	28 d	NOEC	reproduction	41.8	d	(GDCh, 1995)
Daphnia magna									16 d	EC_{50}	reproduction	2.9	d	(Anonymous, 1997)
Daphnia magna									16 d	LC_{50}	mortality	7.4	d	(Anonymous, 1997)
Pisces														
Jordanella floridae	eggs, < 24 h	Y	F		nw	6.95±0.35	48±2.13	25±1	4-6 d	NOEC	hatchability	>53.4		(Smith et al., 1991)
Jordanella floridae	2 weeks	Y	F		nw	6.95±0.35	48±2.13	25±1	10 d	EC_{50}	mortality	30.3	c	(Smith et al., 1991)
Jordanella floridae	2 weeks	Y	F		nw	6.95±0.35	48±2.13	25±1	10 d	EC_{10}	mortality	17.1	c	(Smith et al., 1991)
Jordanella floridae	1 week	Y	F		nw	6.95±0.35	48±2.13	25±1	28 d	EC_{50}	mortality	36.6	c	(Smith et al., 1991)
Jordanella floridae	1 week	Y	F		nw	6.95±0.35	48±2.13	25±1	28 d	EC_{10}	mortality	21.5	c	(Smith et al., 1991)
Pimephales promelas	embryo-									LOEC/NOEC		9.4		(U.S. EPA, 1980b)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
	larval													
Pimephales promelas	egs < 24 h		F			7.6	45		32 d	NOEC		6	d	(GDCh, 1995)
Pimephales promelas	ELS test Emryo larval									NOEC		6	d	(Walbridge et al., 1983)
Oncorhynchus mykiss		Y	F			7.4	45	25.0	32 d	NOEC	growth	6	e	(Ahmad et al., 1984)

Notes:
a: continuous light at 130 μE/m^{2}s; 5*10^3 cell/mL; exponential phase
b: based on mean concentrations; 16:8 h light:dark at 344 lm; Dunnett; control mortality <30%
c: determined from presented data with log-logistic model
d: cited in reference
e: data from RIVM E-Tox database

Table A3.16: Acute toxicity data for 1,1,2-trichloroethane to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Vibrio fischeri		N	S			6.5-7.5		15	5 min	EC_{50}	bioluminescense	110		(Blum and Speece, 1991)
Vibrio fischeri		Y	S						15 min	EC_{50}	bioluminescense	57	a	(Freitag et al., 1994)
Vibrio fischeri									30 min	EC_{50}	bioluminescense	176	b	(Kaiser et al., 1995)
Vibrio fischeri									30 min	EC_{50}	bioluminescense	176	b	(Sixt et al., 1995)
Algae										EC_{50}				
Chlamydomonas sp.		Y			enr nw	8			96 h	EC_{50}	growth	260.0		(Adema and Vink, 1981)
Phaeodactylum tricornutum		Y			enr nw	8			96 h	EC_{50}	growth	60.0		(Adema and Vink, 1981)
Unaliella sp.		Y			enr nw	8			96 h	EC_{50}	growth	200.0		(Adema and Vink, 1981)
Chlorella ovalis		Y			enr nw	8			96 h	EC_{50}	growth	200.0		(Adema and Vink, 1981)
Molluscs														
Mytilus edulis	adult 3 cm	Y			nw	8			96 h	LC_{50}	mortality	110		(Adema and Vink, 1981)
Annelida														
Ophryotrocha labronica	>2.5 mm	N	Rc		nw		33	23±2	96 h	LC_{50}	mortality	143	c; d	(Rosenberg et al., 1975)
Ophryotrocha labronica	>2.5 mm	N	Rc		nw		33	23±2	96 h	LC_{10}	mortality	143	c; d	(Rosenberg et al., 1975)
Ophryotrocha diadema	adult 4 w	Y			aw	8			96 h	LC_{50}	mortality	190		(Adema and Vink, 1981)
Crustacea														
Artemia salina	3 d, 1mm	Y			aw	8			48 h	LC_{50}	mortality	62		(Adema and Vink, 1981)
Artemia salina	3 d, 1mm	Y			aw	8			96 h	LC_{50}	mortality	40		(Adema and Vink, 1981)
Artemia salina	adult 1 cm	Y			aw	8			48 h	LC_{50}	mortality	72		(Adema and Vink, 1981)
Artemia salina	adult 1 cm	Y			aw	8			96 h	LC_{50}	mortality	52		(Adema and Vink, 1981)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Chaetogammarus marinus	larva, 5 mm	Y			nw	8			48 h	LC_{50}	mortality	72		(Adema and Vink, 1981)
Chaetogammarus marinus	adult 1 cm	Y			nw	8			48 h	LC_{50}	mortality	82		(Adema and Vink, 1981)
Palaemonetes varians	adult 4 cm	Y			nw	8			6 h	LC_{50}	mortality	43		(Adema and Vink, 1981)
Crangon crangon	adult 4 cm	Y			nw	8			6 h	LC_{50}	mortality	43		(Adema and Vink, 1981)
Temora longicornis	adult 1 mm	Y			nw	8			96 h	LC_{50}	mortality	43		(Adema and Vink, 1981)
Pisces														
Poecilia reticulata	young	Y			nw	8			24 h	LC_{50}	mortality	43		(Adema and Vink, 1981)
Poecilia reticulata	young	Y			nw	8			7 d	LC_{50}	mortality	40		(Adema and Vink, 1981)
Poecilia reticulata	adult	Y			nw	8			24 h	LC_{50}	mortality	70		(Adema and Vink, 1981)
Poecilia reticulata	adult	Y			nw	8			7 d	LC_{50}	mortality	45		(Adema and Vink, 1981)
Gobius minutus	adult	Y			nw	8			24 h	LC_{50}	mortality	43		(Adema and Vink, 1981)
Gobius minutus	adult	Y			nw	8			7 d	LC_{50}	mortality	43		(Adema and Vink, 1981)
Pleuronectus platessa	yolk sac larva	Y			aw	8			96 h	LC_{50}	mortality	55		(Adema and Vink, 1981)
Pleuronectus platessa	0-group 4-8 cm	Y			nw	8			48 h	LC_{50}	mortality	34		(Adema and Vink, 1981)
Pleuronectus platessa	0-group 4-8 cm	Y			nw	8			7 d	LC_{50}	mortality	27		(Adema and Vink, 1981)
Pleuronectus platessa	I-group -10 cm	Y			nw	8			48 h	LC_{50}	mortality	60		(Adema and Vink, 1981)
Pleuronectus platessa	I-group -10 cm	Y			nw	8			7 d	LC_{50}	mortality	55		(Adema and Vink, 1981)
Pleuronectus platessa	II-group -20 cm	Y			nw	8			48 h	LC_{50}	mortality	45		(Adema and Vink, 1981)
Pleuronectus platessa	II-group -20 cm	Y			nw	8			7 d	LC_{50}	mortality	36		(Adema and Vink, 1981)
Pleuronectus platessa	Egg to metam larva	Y			aw	8			48 h	LC_{50}	mortality	125		(Adema and Vink, 1981)
Pleuronectus platessa	Egg to metam larva	Y			aw	8			7 d	LC_{50}	mortality	6		(Adema and Vink, 1981)
Pleuronectus platessa	Egg to metam larva	Y			aw	8			28 d	LC_{50}	mortality	5.5		(Adema and Vink, 1981)
Pleuronectus platessa	Egg to metam larva	Y			aw	8			56 d	LC_{50}	mortality	5.5		(Adema and Vink, 1981)

Notes:
a: Microtox test; German standard DIN 38412 L 34
b: Cited in reference
c: determined from presented data with log-logistic model
d: renewed every second day

Table A3.17: Chronic toxicity data for 1,1,2-trichloroethane to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Molluscs														
Crepidula fornicata	veliger (larva)	Y			nw	8			7 d	LC_{50}	mortality	170		(Adema and Vink, 1981)
Mytilus edulis	adult 3 cm	Y			nw	8			7 d	LC_{50}	mortality	80		(Adema and Vink, 1981)
Mytilus edulis	adult 3 cm	Y			nw	8			14 d	LC_{50}	mortality	65		(Adema and Vink, 1981)
Annelida														
Ophryotrocha labronica	>2.5 mm	N	Rc		nw		33	23±2	216 h	LC_{50}	mortality	156	a;b	(Rosenberg et al., 1975)
Ophryotrocha labronica	>2.5 mm	N	Rc		nw		33	23±2	216 h	LC_{10}	mortality	109	a;b	(Rosenberg et al., 1975)
Ophryotrocha labronica	eggs	N	Rc		nw		33	23±2	15 d	EC_{50}	hatching	99	a;b	(Rosenberg et al., 1975)
Ophryotrocha labronica	eggs	N	Rc		nw		33	23±2	15 d	EC_{10}	hatching	59	a;b	(Rosenberg et al., 1975)
Crustacea														
Artemia salina	3 d, 1mm	Y			aw	8			7 d	LC_{50}	mortality	36		(Adema and Vink, 1981)
Artemia salina	3 d, 1mm	Y			aw	8			21 d	LC_{50}	mortality	36		(Adema and Vink, 1981)
Artemia salina	3 d, 1mm	Y			aw	8			21 d	EC_{50}	reproduction	15		(Adema and Vink, 1981)
Artemia salina	3 d, 1mm	Y			aw	8			21 d	NOEC	reproduction	10		(Adema and Vink, 1981)
Artemia salina	adult 1 cm	Y			aw	8			10 d	LC_{50}	mortality	43		(Adema and Vink, 1981)
Chaetogammarus marinus	larva, 5 mm	Y			nw	8			7 d	LC_{50}	mortality	48		(Adema and Vink, 1981)
Chaetogammarus marinus	larva, 5 mm	Y			nw	8			21 d	LC_{50}	mortality	41		(Adema and Vink, 1981)
Chaetogammarus marinus	adult, 1 cm	Y			nw	8			7 d	LC_{50}	mortality	62		(Adema and Vink, 1981)
Chaetogammarus marinus	adult, 1 cm	Y			nw	8			21 d	LC_{50}	mortality	50		(Adema and Vink, 1981)
Palaemonetes varians	adult 4 cm	Y			nw	8			7 d	LC_{50}	mortality	43		(Adema and Vink, 1981)
Crangon crangon	adult 4 cm	Y			nw	8			7 d	LC_{50}	mortality	42		(Adema and Vink, 1981)
Pisces														
Pleuronectus platessa	Egg to metam larva	Y			aw	8			56 d	NOEC	mort, growth, malf.	3		(Adema and Vink, 1981)

Notes:
a: Determined from presented data with log-logistic model
b: Renewed every second day

Table A3.18: Acute toxicity data for 1,1,2,2-tetrachloroethane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Nitrosomonas sp.		N	Sc			6.5-8		25	24 h	EC_{50}	ammonia use	1.4		(Blum and Speece, 1991)
Nitrobacter sp.		N	Sc		am	8		25	24 h	EC_{50}	nitrite use	304	a	(Tang et al., 1992)
Spirochaeta aurantia	ATCC 25082	N	S	-	am	7	-	30	30 min	EC_{50}	growth inhibition	143		(Pill et al., 1991)
Algae										EC_{50}				
Scenedesmus subspicatus		Y	Sc	>98%	am				≤96 h	EC_{50}	cell density	47	b	(Behechti et al., 1995)
Scenedesmus subspicatus		Y	Sc	>98%	am				≤96 h	EC_{50}	cell density	50	c	(Behechti et al., 1995)
Scenedesmus subspicatus		Y	Sc		am				72 h	EC_{50}	growth inhibition	26	d	(Freitag et al., 1994)
Selenastrum capricornutum									96 h	EC_{50}	cell density	146	m	(U.S. EPA, 1980b)
Selenastrum capricornutum									96 h	EC_{50}	Chlorophyll a	136	m	(U.S. EPA, 1980b)
Crustacea										EC_{50}				
Daphnia magna	6-24 h	Y	S						24 h	EC_{50}	immobility	11	e	(Freitag et al., 1994)
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	LC_{50}	mortality	9.3		(LeBlanc, 1980)
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	24 h	LC_{50}	mortality	18		(LeBlanc, 1980)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.1-7.7	44.7 (43.5-47.5)	20±1	48 h	LC_{50}	mortality	62	f,g, h,i	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.0-7.5	44.7 (43.5-47.5)	20±1	48 h	LC_{50}	mortality	57	g, h, j, k	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.1-7.7	44.7 (43.5-47.5)	20±1	48 h	EC_{50}	immobility	23	f,g,h,l	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.0-7.5	44.7 (43.5-47.5)	20±1	48 h	EC_{50}	immobility	25	j,k	(Richter et al., 1983)
Daphnia magna		N	S						48 h	EC_{50}	immobility	9.32	m	(U.S. EPA, 1980b)
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	NOEC	mortality	<1.7		(LeBlanc, 1980)
Daphnia magna									48 h	LC_{50}	mortality	16	m	(Pawlisz and Peters, 1995)
Daphnia magna		M	S			6.7-7.6	43-57	20	48 h	LC_{50}	mortality	62.1	m	(Moore et al., 1991)
Pisces														
Lepomis macrochirus	0.32-1.2 g	N	Sc	>80%	rw	6.5-7.9	32-48	21-23	96 h	LC_{50}	mortality	21	n	(Buccafusco et al., 1981)
Lepomis macrochirus		N	S						96 h	LC_{50}	mortality	21.3	m	(Moore et al., 1991)
Pimephales promelas	-	-	F	-	-	-	-		96 h	LC_{50}	mortality	20	m	(Blum and Speece, 1991)
Pimephales promelas	32 d	Y	F	98%	nw/dtw	7.28±0.06	45.2±0.44	25.6±0.41	96 h	LC_{50}	mortality	20.3		(Geiger et al., 1985)
Pimephales promelas	32 d	Y	F	98%	nw/dtw	7.28±0.06	45.2±0.44	25.6±0.41	96 h	LC_{50}	mortality	19.7	o	(Geiger et al., 1985)
Pimephales promelas	32 d	Y	F	98%	nw/dtw	7.28±0.06	45.2±0.44	25.6±0.41	96 h	LC_{10}	mortality	18.0	o	(Geiger et al., 1985)
Pimephales promelas										LC_{50}	mortality	20	m	(Nendza and Russom, 1991)
Pimephales promelas	30 d, 0.12 g	Y	F		nw	7.5	45.5	25±1	96 h	LC_{50}	mortality	20.3		(Veith et al., 1983)
Pimephales promelas	30-35 d	Y	F		nw	6.7-7.6	45.1 (45.0-45.5)		96 h	LC_{50}	mortality	20.4		(Walbridge et al., 1983)
Pimephales promelas		Y	F		nw	6.7-7.6	43-57	25	96 h	LC_{50}	mortality	20.3	m	(Moore et al., 1991)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pimephales promelas									96 h	LC_{50}	mortality	20	m	(Zhao et al., 1993)
Poecilia reticulata	2-3 month	N	Rc		am		25	22	7 d	LC_{50}	mortality	37		(Könemann, 1981)
Poecilia reticulata									7-14 d	LC_{50}	mortality	37	m	(Zhao et al., 1993)
Jordanella floridae	2-4 month	N	R 24 h		nw	6.95±0.35	48±2.13	25±1	96 h	LC_{50}	mortality	26.8		(Smith et al., 1991)
Jordanella floridae	2-4 month	Y	F		nw	6.95±0.35	48±2.13	25±1	96 h	LC_{50}	mortality	18.5		(Smith et al., 1991)

Notes:
a: corrected by author for liquid phase
b: according to OECD 201 except from closed vessels aerated with 3% CO_2
c: according to OECD 201 except from closed vessels opened for measurements aerated with 3% CO_2
d: according to OECD 201 except for the closed vessels enriched with CO_2; continuous light
e: according to OECD guideline 202; test performed in the dark
f: unfed
g: based on mean concentrations;
h: 16:8 h light:dark at 344 lm;
i: moving average
j: fed 20 mg/l dw trout chow and yeast
k: probit
l: binomial
m: cited in reference
n: soluble
o: determined from tabulated data with log-logistic model

Table A3.19: Chronic toxicity data for 1,1,2,2-tetrachloroethane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Crustacea														
Daphnia magna	< 24 h	Y	R	95-99%	nw	6.6-7.9	44.7 (43.5-47.5)	20±1	28 d	NOEC	reproduction (number of young per adult)	6.9	a	(Richter et al., 1983)
Pisces														
Jordanella floridae	eggs, < 24 h	Y	F		nw	6.95±0.35	48±2.13	25±1	4-6 d	NOEC	hatchability	>22		(Smith et al., 1991)
Jordanella floridae	2 weeks	Y	F		nw	6.95±0.35	48±2.13	25±1	10 d	EC_{50}	mortality	12.6	b	(Smith et al., 1991)
Jordanella floridae	2 weeks	Y	F		nw	6.95±0.35	48±2.13	25±1	10 d	EC_{10}	mortality	4.48	b	(Smith et al., 1991)
Jordanella floridae	1 week	Y	F		nw	6.95±0.35	48±2.13	25±1	28 d	EC_{50}	mortality	8.75	b	(Smith et al., 1991)
Jordanella floridae	1 week	Y	F		nw	6.95±0.35	48±2.13	25±1	28 d	EC_{10}	mortality	5.79	b	(Smith et al., 1991)
Pimephales promelas	Embryo-larval									NOEC		1.4		(Call et al., 1985)
Pimephales promelas	embryo-larval									LOEC		4		(Call et al., 1985)
Oncorhynchus mykiss		Y	F			7.4	45	25.0	32 d	NOEC	growth	1.4	e-tox	(Ahmad et al., 1984)

Notes:
a: based on mean concentrations; 16:8 h light:dark at 344 lm; Dunnett; control mortality <30%
b: determined from presented data with log-logistic model
c: data from RIVM E-tox database

Table A3.20: Acute toxicity data for 1,1,2,2-tetrachloroethane to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Vibrio fischeri		N	S			6.5-7.5		15	5 min	EC_{50}	bioluminescense	5.4		(Blum and Speece, 1991)
Vibrio fischeri		Y	S						15 min	EC_{50}	bioluminescense	4	a	(Freitag et al., 1994)
Vibrio fischeri									30 min	EC_{50}	bioluminescense	7.9	b	(Sixt et al., 1995)
Vibrio fischeri		N	S					20	15 min	EC_{50}	bioluminescense	33		(Zhao et al., 1993)
Algae														
Skeletonema costatum									96 h	EC_{50}	cell density	6.23	b	(U.S. EPA, 1980b)
Skeletonema costatum									96 h	EC_{50}	Chlorophyll a	6.44	b	(U.S. EPA, 1980b)
Crustacea														
Artemia salina	24 h	N	S		am	8.6		25	24 h	LC_{50}	mortality	12		(Sánchez-Fortún et al., 1997)
Artemia salina	48 h	N	S		am	8.6		25	24 h	LC_{50}	mortality	5		(Sánchez-Fortún et al., 1997)
Artemia salina	72 h	N	S		am	8.6		25	24 h	LC_{50}	mortality	0.84		(Sánchez-Fortún et al., 1997)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Mysidopsis bahia		N	S						96 h	LC_{50}	mortality	9.02	b	(U.S. EPA, 1980b)
Pisces														
Cyprinodon variegatus	8-15 mm, 14-28 d	N	S	>80%	nw	-	10-31	25-31	96 h	LC_{50}	mortality	12		(Heitmuller et al., 1981)
Cyprinodon variegatus	8-15 mm, 14-28 d	N	S	>80%	nw	-	10-31	25-31	96 h	NOEC	mortality	<8.8		(Heitmuller et al., 1981)

Notes:
a: Microtox test; German standard DIN 38412 L 34
b: cited in reference

Table A3.21: Acute toxicity data for pentachloroethane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Nitrosomonas sp.		N	Sc			6.5-8		25	24 h	EC_{50}	ammonia use	7.9		(Blum and Speece, 1991)
Nitrobacter sp.		N	Sc		am	8.3		25	24 h	EC_{50}	nitrite use	235	a	(Tang et al., 1992)
Spirochaeta aurantia	ATCC 25082	N	S	-	am	7	-	30	30 min	EC_{50}	growth inhibition	34		(Pill et al., 1991)
Algae														
Chlamydomonas angulosa		N	Sc	-	am	6.5	-	19	3 h	EC_{50}	photosynthesis	24	b,c	(Hutchinson et al., 1980)
Chlorella vulgaris		N	Sc	-	am	6.5	-	19	3 h	EC_{50}	photosynthesis	30	b,d	(Hutchinson et al., 1980)
Selenastrum capricornutum									96 h	EC_{50}	cell density	134	k	(U.S. EPA, 1980b)
Selenastrum capricornutum									96 h	EC_{50}	Chlorophyll *a*	121	k	(U.S. EPA, 1980b)
Crustacea														
Daphnia magna	< 24 h	N	Sc	-	rw	6.7-8.1	72±6	22±1	48 h	LC_{50}	mortality	63		(LeBlanc, 1980)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.0-7.5	44.7 (43.5-47.5)	20±1	48 h	LC_{50}	mortality	8	e,g, h	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.1-7.7	44.7 (43.5-47.5)	20±1	48 h	LC_{50}	mortality	7.3	e,f,h	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.1-7.7	44.7 (43.5-47.5)	20±1	48 h	EC_{50}	immobility	4.7	e,f,i	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.0-7.5	44.7 (43.5-47.5)	20±1	48 h	EC_{50}	immobility	6.9	e,g,i	(Richter et al., 1983)
Daphnia magna		N	S						48 h	EC_{50}	immobility	62.9	k	(U.S. EPA, 1980b)
Daphnia magna	< 24 h	N	Sc	-	rw	6.7-8.1	72±6	22±1	48 h	NOEC	mortality	46		(LeBlanc, 1980)
Pisces														
Lepomis macrochirus	0.32-1.2 g	N	S	>80%	rw	6.5-7.9	32-48	21-23	96 h	LC_{50}	mortality	7.2	j	(Buccafusco et al., 1981)
Pimephales promelas	-	-	F	-	-	-	-		96 h	LC_{50}	mortality	7.5	k	(Blum and Speece, 1991)
Pimephales promelas	32 d	Y	F	96%	nw/dtw	7.45±0.13	45.5	25.3±0.51	96 h	LC_{50}	mortality	7.53		(Geiger et al., 1985)
Pimephales promelas	32 d	Y	F	96%	nw/dtw	7.45±0.13	45.5	25.3±0.51	96 h	LC_{50}	mortality	7.51	l	(Geiger et al., 1985)
Pimephales promelas	32 d	Y	F	96%	nw/dtw	7.45±0.13	45.5	25.3±0.51	96 h	LC_{10}	mortality	5.88	l	(Geiger et al., 1985)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pimephales promelas										LC_{50}	mortality	7.5	k	(Nendza and Russom, 1991)
Pimephales promelas	30 d, 0.12 g	Y	F		nw	7.5	45.5	25±1	96 h	LC_{50}	mortality	7.3		(Veith et al., 1983)
Pimephales promelas	30-35 d	Y	F		nw	6.7-7.6	45.1 (45.0-45.5)		96 h	LC_{50}	mortality	7.34		(Walbridge et al., 1983)
Poecilia reticulata	2-3 month old	N	Rc		am		25	22	7 d	LC_{50}	mortality	15		(Könemann, 1981)

Notes:
a: corrected by author for liquid phase
b: light intensity 400 foot candles; 12 h light:dark
c: 5*10^4 cells/mL
d: 20*10^4 cells/mL
e: 16:8 h light:dark at 344 lm; based on mean concentrations
f: unfed
g: fed 20 mg/l dw trout chow and yeast
h: binomial
i: probit
j: undissolved chemical
k: cited in reference
l: determined from tabulated data with log-logistic model

Table A3.22: Chronic toxicity data for pentachloroethane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pisces														
Pimephales promelas	embryo-larval									NOEC		0.9	a	(Call et al., 1985)
Pimephales promelas	embryo-larval									LOEC		1.4	a	(Call et al., 1985)
Oncorhynchus mykiss		Y	F			7.4	45	25.0	32 d	NOEC	growth	0.9	b	(Ahmad et al., 1984)

Notes:
a: cited in reference
b: data from RIVM E-tox database

Table A3.23: Acute toxicity data for pentachloroethane to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Vibrio fischeri									30 min	EC_{50}	bioluminescense	0.904	a	(Sixt et al., 1995)
Vibrio fischeri		N	S			6.5-7.5		15	5 min	EC_{50}	bioluminescense	0.63		(Blum and Speece, 1991)
Vibrio fischeri		Y	S		am				5 min	EC_{50}	bioluminescense	0.75		(Curtis et al., 1982)
Algae														
Skeletonema costatum									96 h	EC_{50}	cell density	58.2	a	(U.S. EPA, 1980b)
Skeletonema costatum									96 h	EC_{50}	Chlorophyll *a*	58.2	a	(U.S. EPA, 1980b)
Crustacea														
Mysidopsis bahia		N	S						96 h	LC_{50}	mortality	5.06	a	(U.S. EPA, 1980b)
Mysidopsis bahia		M	F						96 h	LC_{50}	mortality	0.39	a	(U.S. EPA, 1980b)
Pisces										LC_{50}				
Cyprinodon variegatus	8-15 mm, 14-28 d	N	S	>80%	nw	-	10-31	25-31	96 h	LC_{50}	mortality	116		(Heitmuller et al., 1981)
Cyprinodon variegatus	8-15 mm, 14-28 d	N	S	>80%	nw	-	10-31	25-31	96 h	NOEC	mortality	30		(Heitmuller et al., 1981)

Note:
a: cited in reference

Table A3.24: Chronic toxicity data for pentachloroethane to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Algae														
Champia parvula		N	R		nw		30	22-24	14 d	EC_{50}	growth	10	a,b,c	(Thursby et al., 1985)
Champia parvula		N	R		nw		30	22-24	14 d	EC_{10}	growth	5.7	a,c	(Thursby et al., 1985)
Champia parvula		N	R		nw		30	22-24	11 d	EC_{50}	growth	4.8	a,c	(Thursby et al., 1985)
Champia parvula		N	R		nw		30	22-24	11 d	EC_{10}	growth	2	a,c	(Thursby et al., 1985)
Champia parvula		N	R		nw		30	22-24	14 d	EC_{50}	growth	5.4	a,d	(Thursby et al., 1985)
Champia parvula		N	R		nw		30	22-24	14 d	EC_{10}	growth	1.6	a,d	(Thursby et al., 1985)
Champia parvula		N	R		nw		30	22-24	11 d	EC_{50}	growth	7.9	a,d	(Thursby et al., 1985)
Champia parvula		N	R		nw		30	22-24	11 d	EC_{10}	growth	3.2	a,d	(Thursby et al., 1985)
Champia parvula		N	R		nw		30	22-24	11 d	EC_{50}	reproduction	6.4	a,,e	(Thursby et al., 1985)
Champia parvula		N	R		nw		30	22-24	11 d	EC_{10}	reproduction	2.4	a,e	(Thursby et al., 1985)
Champia parvula		N	R		nw		30	22-24	11 d	EC_{50}	reproduction	6.5	a,f	(Thursby et al., 1985)
Champia parvula		N	R		nw		30	22-24	11 d	EC_{10}	reproduction	3.2	a,f	(Thursby et al., 1985)
Crustacea														

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Mysidopsis bahia	Life cycle									LOEC/NOEC		0.281	g	(U.S. EPA, 1980b)

Notes:
a: determined from reported data with log-logistic model
b: zero included
c: growth (dw) of females
d: growth (dw) of tetrasporophyte
e: number of cystocarps
f: number of tretrasporangia
g: cited in reference

Table A3.25: Acute toxicity data for hexachloroethane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Nitrosomonas sp.		N	Sc			6.5-8		25	24 h	EC_{50}	ammonia use	32		(Blum and Speece, 1991)
Nitrobacter sp.		N	Sc		am	7.9		25	24 h	EC_{50}	nitrite use	328	a	(Tang et al., 1992)
Algae														
Selenastrum capricornutum									96 h	EC_{50}	cell density	93.2	i	(U.S. EPA, 1980b)
Selenastrum capricornutum									96 h	EC_{50}	Chlorophyll *a*	87	i	(U.S. EPA, 1980b)
Mollusca														
Aplexa hypnorum	adult	Y	F		nw	7.1-7.8	44.4 (40.7-46.6)	17.3±0.6	96 h	LC_{50}	mortality	>2.1		(Phipps and Holcombe, 1985)
Crustacea										LC_{50}				
Daphnia magna	< 24 h	N	Sc	-	rw	6.7-8.1	72±6	22±1	48 h	LC_{50}	mortality	8.1		(LeBlanc, 1980)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.1-7.7	44.7 (43.5-47.5)	20±1	48 h	LC_{50}	mortality	2.9	b,c,d	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.0-7.5	44.7 (43.5-47.5)	20±1	48 h	LC_{50}	mortality	2.4	c,e,f	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.1-7.7	44.7 (43.5-47.5)	20±1	48 h	EC_{50}	immobility	2.1	b,c,d	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	Sc	95-99%	nw	7.0-7.5	44.7 (43.5-47.5)	20±1	48 h	EC_{50}	immobility	1.8	c,e,g	(Richter et al., 1983)
Daphnia magna	< 24 h	Y	Sc	98%	gw	8.23 (8.16-8.29)	155	22.0	48 h	LC_{50}	mortality	1.36		(Thurston et al., 1985)
Daphnia magna		N	S						48 h	EC_{50}	immobility	8.07	i	(U.S. EPA, 1980b)
Daphnia magna	< 24 h	N	Sc	-	rw	6.7-8.1	72±6	22±1	48 h	NOEC	mortality	0.28		(LeBlanc, 1980)
Daphnia magna	< 24 h	N	S		gw	8±0.3	240±10	23±1	48 h	EC_{50}	immobility	10		(Elnabarawy et al., 1986)
Daphnia magna	< 24 h	N	S		nw	7.2-7.4	45		48 h	LC_{50}	mortality	2.7		(Mount and Norberg, 1984)
Daphnia pulex	< 24 h	N	S		nw	7.2-7.4	45		48 h	LC_{50}	mortality	>10		(Mount and Norberg, 1984)
Daphnia pulex	< 24 h	N	S		gw	8±0.3	240±10	23±1	48 h	EC_{50}	immobility	13		(Elnabarawy et al., 1986)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Ceriodaphnia reticulata	< 4 h	N	S		nw	7.2-7.4	45		48 h	LC_{50}	mortality	3.3		(Mount and Norberg, 1984)
Ceriodaphnia reticulata	< 24 h	N	S		gw	8±0.3	240±10	23±1	48 h	EC_{50}	immobility	6.8		(Elnabarawy et al., 1986)
Ceriodaphnia reticulata	< 24 h	N	S					22	1 h	EC_{50}	feeding behaviour	1.1		(Bitton et al., 1996)
Ceriodaphnia reticulata	< 24 h	N	S					22	48 h	EC_{50}	immobility	4.3		(Bitton et al., 1996)
Orconectes immunis	0.42 g	Y	F	98%	gw	7.92 (7.88-7.97)	155	13.5 (12.8-16.1)	96 h	LC_{50}	mortality	2.7		(Thurston et al., 1985)
Simocephalus vetulus	< 24 h	N	S		nw	7.2-7.4	45		48 h	LC_{50}	mortality	5.8		(Mount and Norberg, 1984)
Insecta										LC_{50}				
Tanytarsus dissimilis	3rd/4th instar larvae	Y	Sc	98%	gw	7.79 (7.76-7.81)	155	19.7 (19.7-19.8)	48 h	LC_{50}	mortality	1.23		(Thurston et al., 1985)
Tanytarsus dissimilis		Y	S						48 h	EC_{50}	mortality	1.7	i	(U.S. EPA, 1980b)
Tanytarsus Dissimilis	3-4 instars, 2-3.5 mm	Y	S			7.6	47	20	48	LC_{50}	mortality	5.85	h	(Call et al., 1983)
Tanytarsus Dissimilis	3-4 instars, 2-3.5 mm	Y	S			7.6	47	20	72	LC_{50}	mortality	1.68	h	(Call et al., 1983)
Pisces										LC_{50}				
Gambusia affinis	0.33 g	Y	F	98%	gw	7.92 (7.90-7.94)	155	18.9 (18.4-19.2)	96 h	LC_{50}	mortality	1.38		(Thurston et al., 1985)
Ictalurus punctatus	3.48 g	Y	F	98%	gw	7.90 (7.89-7.97)	155	16.7 (14.9-18.4)	96 h	LC_{50}	mortality	2.36		(Thurston et al., 1985)
Ictalurus punctatus	0.31 g	Y	F	98%	gw	8.06 (8.04-8.11)	155	19.5 (18.8-20.2)	96 h	LC_{50}	mortality	1.77		(Thurston et al., 1985)
Ictalurus punctatus	5.6 g	Y	F		nw	7.1-7.8	44.4 (40.7-46.6)	17.3±0.6	96 h	LC_{50}	mortality	1.52		(Phipps and Holcombe, 1985)
Lepomis macrochirus	0.32-1.2 g	N	Sc	>80%	rw	6.5-7.9	32-48	21-23	96 h	LC_{50}	mortality	0.98		(Buccafusco et al., 1981)
Lepomis macrochirus	0.68 g	Y	F	98%	gw	8.08 (8.05-8.10)	155	17.1 (16.5-17.8)	96 h	LC_{50}	mortality	0.856		(Thurston et al., 1985)
Lepomis macrochirus	0.7 g	Y	F		nw	7.1-7.8	44.4 (40.7-46.6)	17.3±0.6	96 h	LC_{50}	mortality	0.97		(Phipps and Holcombe, 1985)
Oncorhynchus mykiss	1.93 g	Y	F	98%	gw	7.93 (7.86-7.99)	155	13.9 (12.7-14.8)	96 h	LC_{50}	mortality	1.18		(Thurston et al., 1985)
Oncorhynchus mykiss	4.3 g	Y	F			6.8-7.5	51-56.8	11.6-12.7	96 h	LC_{50}	mortality	0.84	h	(Ahmad et al., 1984)
Oncorhynchus mykiss	6.6 cm, 4.3 g	Y	F			7.2	44	11.6	96 h	LC_{50}	mortality	0.94	h	(Call et al., 1983)
Oncorhynchus mykiss	6.6 cm, 4.3 g	Y	F			7.2	44	11.6	8 d	LC_{50}	mortality	0.77	h	(Call et al., 1983)
Pimephales promelas	-	-	F	-	-	-	-		96 h	LC_{50}	mortality	1.4	i	(Blum and Speece, 1991)
Pimephales promelas	32 d	Y	F	98%	nw/dtw	7.59±0.01	45.0	24.7±0.33	96 h	LC_{50}	mortality	1.53		(Geiger et al., 1985)
Pimephales promelas	32 d	Y	F	98%	nw/dtw	7.59±0.01	45.0	24.7±0.33	96 h	LC_{50}	mortality	1.52	j	(Geiger et al., 1985)
Pimephales promelas	32 d	Y	F	98%	nw/dtw	7.59±0.01	45.0	24.7±0.33	96 h	LC_{10}	mortality	1.18	j	(Geiger et al., 1985)
Pimephales promelas	44 d	Y	F	98%	nw/dtw	7.41±0.06	44.2±0.52	17.5±0.04	96 h	LC_{50}	mortality	1.32		(Geiger et al., 1985)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pimephales promelas	44 d	Y	F	98%	nw/dtw	7.41±0.06	44.2±0.52	17.5±0.04	96 h	LC_{50}	mortality	1.37	j	(Geiger et al., 1985)
Pimephales promelas	44 d	Y	F	98%	nw/dtw	7.41±0.06	44.2±0.52	17.5±0.04	96 h	LC_{10}	mortality	1.26	j	(Geiger et al., 1985)
Pimephales promelas										LC_{50}	mortality	1.5	i	(Nendza and Russom, 1991)
Pimephales promelas										LC_{50}	mortality	1.3	i	(Nendza and Russom, 1991)
Pimephales promelas	30 d, 0.12 g	Y	F		nw	7.5	45.5	25±1	96 h	LC_{50}	mortality	1.5		(Veith et al., 1983)
Pimephales promelas	30-35 d	Y	F		nw	6.7-7.6	45.1 (45.0-45.5)		96 h	LC_{50}	mortality	1.51		(Walbridge et al., 1983)
Pimephales promelas									96 h	LC_{50}	mortality	1.5	i	(Zhao et al., 1993)
Pimephales promelas	0.3 g	Y	F		nw	7.1-7.8	44.4 (40.7-46.6)	17.3±0.6	96 h	LC_{50}	mortality	1.23		(Phipps and Holcombe, 1985)
Pimephales promelas			F						96 h	LC_{50}	mortality	1.24	h	(Anonymous1988)
Pimephales promelas	0.56 g	Y	F	98%	gw	8.06 (8.04-8.11)	155	19.5 (18.8-20.2)	96 h	LC_{50}	mortality	1.39		(Thurston et al., 1985)
Pimephales promelas	0.44 g	Y	F	98%	gw	-	155	17.3 (16.6-18.0)	96 h	LC_{50}	mortality	1.1		(Thurston et al., 1985)
Salmo gairdneri		Y	F						96 h	EC_{50}	mortality	0.98	i	(U.S. EPA, 1980b)
Salmo gairdneri	1.8 g	Y	F		nw	7.1-7.8	44.4 (40.7-46.6)	17.3±0.6	96 h	LC_{50}	mortality	0.97		(Phipps and Holcombe, 1985)
Salmo gairdneri	1.93 g	Y	F	98%	gw	7.93 (7.86-7.99)	155	13.9 (12.7-14.8)	96 h	LC_{50}	mortality	1.18		(Thurston et al., 1985)
Carassius auratus	8.4 g	Y	F		nw	7.1-7.8	44.4 (40.7-46.6)	17.3±0.6	96 h	LC_{50}	mortality	>2.1		(Phipps and Holcombe, 1985)
Carassius auratus	1.74 g	Y	F	98%	gw	8.06 (8.04-8.11)	155	17.6 (15.7-19.2)	96 h	LC_{50}	mortality	1.42		(Thurston et al., 1985)
Orconectes immunis	2.2	Y	F		nw	7.1-7.8	44.4 (40.7-46.6)	17.3±0.6	96 h	LC_{50}	mortality	>2.1		(Phipps and Holcombe, 1985)
Amphibia														
Rana catesbiana	4.12 g	Y	F	98%	gw	8.06 (8.04-8.09)	155	18.5 (17.5-19.3)	96 h	LC_{50}	mortality	3.18		(Thurston et al., 1985)
Rana catesbiana	4.21 g	Y	F	98%	gw	8.05 (7.96-8.11)	155	17.2 (15.0-19.0)	96 h	LC_{50}	mortality	2.44		(Thurston et al., 1985)

Notes:
a: corrected by author for liquid phase
b: unfed
c: based on mean concentrations; 16:8 h light:dark at 344 lm;
d: probits
e: fed 20 mg/l dw trout chow and yeast
f: binomial
g: moving average
h: data from RIVM E-tox database
i: cited in reference
j: determined from tabulated data with log-logistic model

Table A3.26: Chronic toxicity data for hexachloroethane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pisces														
Pimephales promelas	embryo-larval									NOEC		0.41	a	(Call et al., 1985)
Pimephales promelas	embryo-larval									LOEC		0.7	a	(Call et al., 1985)
Pimephales promelas	embryo-larval									NOEC		0.069	a	(Walbridge et al., 1983)
Oncorhynchus mykiss		Y	F			7.4	45	25.0	32 d	NOEC	growth	0.067	b	(Ahmad et al., 1984)

Notes:
a: cited in reference
b: data from RIVM E-tox database

Table A3.27: Acute toxicity data for hexachloroethane to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Vibrio fischeri									30 min	EC_{50}	bioluminescense	0.342	a	(Sixt et al., 1995)
Vibrio fischeri		N	S			6.5-7.5		15	5 min	EC_{50}	bioluminescense	0.45		(Blum and Speece, 1991)
Vibrio fischeri		N	S					20	15 min	EC_{50}	bioluminescense	0.71		(Zhao et al., 1993)
Vibrio fischeri		Y	S		am				5 min	EC_{50}	bioluminescense	0.14		(Curtis et al., 1982)
Algae														
Skeletonema costatum									96 h	EC_{50}	cell density	7.75	a	(U.S. EPA, 1980b)
Skeletonema costatum									96 h	EC_{50}	Chlorophyll *a*	8.57	a	(U.S. EPA, 1980b)
Crustacea														
Mysidopsis bahia		N	S						96 h	LC_{50}	mortality	0.94	a	(U.S. EPA, 1980b)
Echinodermata														
Arbacia punctulata	1 h old embryos	N	S				30±1	20±1	3 h	EC_{50}	growth	9.32	b	(Jackim and Nacci, 1984)
Arbacia punctulata	1 h old embryos	N	S				30±1	20±1	3 h	EC_{50}	growth	8.51	b	(Jackim and Nacci, 1984)
Arbacia punctulata	1 h old embryos	N	S						3 h	EC_{50}	growth	8.31	b	(Nacci and Jackim,)
Arbacia punctulata	1 h old embryos	N	S						5 h	EC_{50}	growth	6.05	b,c	(Nacci and Jackim,)
Arbacia punctulata	1 h old embryos	N	S						4 h	EC_{50}	growth	4.97	b,c	(Nacci and Jackim,)
Pisces														
Cyprinodon variegatus	8-15 mm, 14-28 d	N	S	>80%	nw	-	10-31	25-31	96 h	LC_{50}	mortality	2.4		(Heitmuller et al., 1981)
Cyprinodon variegatus	8-15 mm, 14-	N	S	>80%	nw	-	10-31	25-31	96 h	NOEC	mortality	1.0		(Heitmuller et al., 1981)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
	28 d													

Notes:
a: cited in reference
b: measured as thymidine incorporation during 2 h
c: exposure one hour before fertilization

Table A3.28: Acute toxicity data for 1,2-dichloropropane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Nitrosomonas sp.		N	Sc			6.5-8		25	24 h	EC_{50}	ammonia use	43		(Blum and Speece, 1991)
Algae														
Scenedesmus subspicatus		Y	Sc	>98%	am				≤96 h	EC_{50}	cell density	123	a	(Behechti et al., 1995)
Scenedesmus subspicatus		Y	Sc	>98%	am				≤96 h	EC_{50}	cell density	194	b	(Behechti et al., 1995)
Scenedesmus subspicatus		Y	Sc		am				72 h	EC_{50}	growth inhibition	168	c	(Freitag et al., 1994)
Selenastrum capricornutum									48 h	EC_{50}	growth inhibition	130		(Nite, 2007)
Selenastrum capricornutum									72 h	EC_{50}	biomass	73		(Nite, 2007)
Crustacea														
Daphnia carinata	< 24 h	Y	S					20±1	48 h	EC_{50}	immobility	24.1	g	(Warne and Westbury, 1999)
Daphnia magna	6-24 h	Y	S						24 h	EC_{50}	immobility	58	d	(Freitag et al., 1994)
Daphnia magna	< 48 h	Y	S		am		100	22±1	48 h	LC_{50}	immobility	45	e	(Hermens et al., 1984)
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	LC_{50}	mortality	52		(LeBlanc, 1980)
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	NOEC	mortality	<22		(LeBlanc, 1980)
Daphnia magna		N	S						48 h	EC_{50}	immobility	52.5	f	(U.S. EPA, 1980c)
Daphnia magna		Y	F		dtw	8.0-8.3		21±1	24 h	LC_{50}	mortality	>72.9	f	(GDCh, 1994)
Daphnia magna		Y	F		dtw	8.0-8.3		21±1	48 h	LC_{50}	mortality	55.9	f	(GDCh, 1994)
Daphnia magna									48 h	EC_{50}	immobility	30		(Nite, 2007)
Ceriodaphnia cf. *dubia*	< 24 h	Y	S	>97%		7.7	65.2	23±1	48 h	EC_{50}	immobility	13.5		(Rose et al., 1998)
Pisces														
Lepomis macrochirus	0.32-1.2 g	N	S	>80%	rw	6.5-7.9	32-48	21-23	96 h	LC_{50}	mortality	280		(Buccafusco et al., 1981)
Lepomis macrochirus	33-75 mm	N	S	-	nw	7.6-7.9	55	23	96 h	LC_{50}	mortality	320		(Dawson et al., 1975-1977)
Lepomis macrochirus	33-75 mm	N	S	-	nw	7.6-7.9	55	23	96 h	LC_{50}	mortality	320	g	(Dawson et al., 1975-1977)
Lepomis macrochirus	33-75 mm	N	S	-	nw	7.6-7.9	55	23	96 h	LC_{10}	mortality	297	g	(Dawson et al., 1975-1977)
Lepomis macrochirus		N	S						96 h	LC_{50}	mortality	300	f	(U.S. EPA, 1980c)
Pimephales promelas	-	-	F	-	-	-	-		96 h	LC_{50}	mortality	130	f	(Blum and Speece, 1991)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pimephales promelas	31 d	Y	F	99%	nw/dtw	7.48±0.11	45.3±0.35	24.8±0.26	96 h	LC_{50}	mortality	127		(Geiger et al., 1985)
Pimephales promelas	31 d	Y	F	99%	nw/dtw	7.48±0.11	45.3±0.35	24.8±0.26	96 h	LC_{50}	mortality	136	g	(Geiger et al., 1985)
Pimephales promelas	31 d	Y	F	99%	nw/dtw	7.48±0.11	45.3±0.35	24.8±0.26	96 h	LC_{10}	mortality	93.1	g	(Geiger et al., 1985)
Pimephales promelas										LC_{50}	mortality	127	f	(Nendza and Russom, 1991)
Pimephales promelas	30-35 d	Y	F		nw	6.7-7.6	45.1 (45.0-45.5)		96 h	LC_{50}	mortality	140		(Walbridge et al., 1983)
Pimephales promelas		Y	F						96 h	LC_{50}	mortality	139.3	f	(U.S. EPA, 1980c)
Poecilia reticulata	2-3 month	N	Rc		am		25	22	7 d	LC_{50}	mortality	116		(Könemann, 1981)
Oryzias latipes									96 h	LC_{50}	mortality	160		(Nite, 2007)

Notes:
a: according to OECD 201 except from closed vessels aerated with 3% CO_2
b: according to OECD 201 except from closed vessels opened for measurements aerated with 3% CO_2
c: according to OECD 201 except for the closed vessels enriched with CO_2; continuous light
d: according to OECD guideline 202; test performed in the dark
e: test according to NEN 6501. 6502
f: cited in reference
g: determined from presented data with log-logistic model

Table A3.29: Chronic toxicity data for 1,2-dichloropropane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Protists														
Euglena gracilis			S						48 h	EC_{50}	reproduction	640	a	Atmos Environ, 1993 source unknown
Algae														
Chlamydomonas reinhardi		Y	F		am	6-7		24±2	10 d	EC_{50}	growth	50		(Schaefer et al., 1993)
Chlamydomonas reinhardi		Y	F		am	6-7		24±2	10 d	EC_{10}	growth	29		(Schaefer et al., 1993)
Chlamydomonas reinhardi		Y	F		am	6-7		24±2	7 d	EC_{50}	growth	62		(Schaefer et al., 1993)
Chlamydomonas reinhardi		Y	F		am	6-7		24±2	7 d	EC_{10}	growth	31.5		(Schaefer et al., 1993)
Chlamydomonas reinhardi		Y	F		am	6-7		24±2	4 d	EC_{50}	growth	83		(Schaefer et al., 1993)
Chlamydomonas reinhardi		Y	F		am	6-7		24±2	4 d	EC_{10}	growth	38		(Schaefer et al., 1993)
Selenastrum capricornutum									48 h	EC10	growth inhibition	81		(Nite, 2007)
Selenastrum capricornutum									72 h	EC10	biomass	11		(Nite, 2007)
Crustacea														
Daphnia magna		Y	F		dtw		160-180	20±2	21 d	NOEC		8.3	b	(GDCh, 1994)
Pisces														
Pimephales promelas	ELS test	Y	F	98-99%	nw	7.4		25±1	28 d	LC_{50}	mortality	34	c	(Benoit et al., 1982)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pimephales promelas	ELS test	Y	F	98-99%	nw	7.4		25±1	28 d	LC_{10}	mortality	12	c	(Benoit et al., 1982)
Pimephales promelas	ELS test	Y	F	98-99%	nw	7.4		25±1	28 d	EC_{50}	growth	27	c	(Benoit et al., 1982)
Pimephales promelas	ELS test	Y	F	98-99%	nw	7.4		25±1	28 d	EC_{10}	growth	11	c	(Benoit et al., 1982)
Pimephales promelas	ELS test	Y	F	98-99%	nw	7.4		25±1	4-5 d	NOEC	hatchability	>110		(Benoit et al., 1982)
Pimephales promelas	ELS test									LC_{50}	mortality	60	b	(U.S. EPA, 1980c)
Pimephales promelas	ELS test									LC_{50}	mortality	8.1	b	(U.S. EPA, 1980c)
Oryzias latipes									21 d	NOEC		10		(Nite, 2007)

Notes:
a: data from RIVM E-tox database
b: cited in reference
c: determined from presented data with log-logistic model

Table A3.30: Acute toxicity data for 1,2-dichloropropane to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Vibrio fischeri		N	S			6.5-7.5		15	5 min	EC_{50}	bioluminescense	59		(Blum and Speece, 1991)
Vibrio fischeri		Y	S						15 min	EC_{50}	bioluminescense	73		(Sixt et al., 1995)
Vibrio fischeri									30 min	EC_{50}	bioluminescense	94	a	(Sixt et al., 1995)
Algae														
Phaeodactylum tricornutum		N	S							EC_{50}	carbon uptake	50		(Pearson and McConnell, 1975)
Crustacea														
Crangon crangon	adult	N	R		nw			15	48 h	LC_{50}	mortality	>116		(Portmann and Wilson, 1971)
Mysidopsis bahia	<24	Y	Sc		nw		20-21	25±1	96 h	LC_{50}	mortality	24.79	a	(GDCh, 1994)
Mysidopsis bahia	<24	Y	Sc		nw		20-21	25±1	24 h	LC_{50}	mortality	> 26.65	a	(GDCh, 1994)
Mysidopsis bahia	3-4 d	Y	Sc		nw		20-21	21-24	24 h	LC_{50}	mortality	> 26.65	a	(GDCh, 1994)
Eliminius modestus	15-20 cm	N	S		nw				48 h	LC_{50}	mortality	53		(Pearson and McConnell, 1975)
Pisces														
Menidia beryllina	40-100 mm	N	S	-	rw	-	-	20	96 h	LC_{50}	mortality	240		(Dawson et al., 1975-1977)
Menidia beryllina	40-100 mm	N	S	-	rw	-	-	20	96 h	LC_{50}	mortality	223	b	(Dawson et al., 1975-1977)
Menidia beryllina	40-100 mm	N	S	-	rw	-	-	20	96 h	LC_{10}	mortality	151	b	(Dawson et al., 1975-1977)
Limanda limanda	15-20 cm	Y	F		nw			dec-18	96 h	LC_{50}	mortality	61		(Pearson and McConnell, 1975)

Notes:
a: cited in reference
b: determined from presented data with log-logistic model

Table A3.31: Chronic toxicity data for 1,2-dichloropropane to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Crustacea														
Mysidopsis bahia	<24	Y	F		nw	7.3-8.3	18-25	22.9-28	28 d	NOEC	reproduction, growth, mortality	4.09	a	(GDCh, 1994)
Pisces														
Cyprinodon variegatus	ELS test	N							33 d	NOEC	growth	82	a	(U.S. EPA, 1980c)
Cyprinodon variegatus	ELS test	N							33 d	LOEC	growth	164	a	(U.S. EPA, 1980c)

Note:
a: Cited in reference

Table A3.32: Acute toxicity data for 1,3-dichloropropane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Nitrosomonas sp.		N	Sc			6.5-8		25	24 h	EC_{50}	ammonia use	4.8		(Blum and Speece, 1991)
Algae														
Scenedesmus subspicatus		Y	Sc		am				72 h	EC_{50}	growth inhibition	221	a	(Freitag et al., 1994)
Scenedesmus capricornutum									96 h	EC_{50}	growth inhibition based on cell number	72	b	(U.S. EPA, 1980c)
Scenedesmus capricornutum									96 h	EC_{50}	growth inhibition based on chlorophyll a	48	b	(U.S. EPA, 1980c)
Crustacea														
Daphnia magna	6-24 h	Y	S						24 h	EC_{50}	immobility	39	c	(Freitag et al., 1994)
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	LC_{50}	mortality	280		(LeBlanc, 1980)
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	NOEC	mortality	68		(LeBlanc, 1980)
Daphnia magna		N	S						48 h	EC_{50}	immobility	282	b	(U.S. EPA, 1980c)
Pisces														
Carassius auratus	6.2±0.7 cm, 3.3±1.0 g	Y	S		tw	7.8	283	20±1	24 h	LC_{50}	mortality	160	d	(Bridié et al., 1979)
Lepomis macrochirus	0.32-1.2 g	N	S	>80%	rw	6.5-7.9	32-48	21-23	96 h	LC_{50}	mortality	>520		(Buccafusco et al., 1981)
Lepomis macrochirus		N	S						96 h	LC_{50}	mortality	>520	b	(U.S. EPA, 1980c)
Pimephales promelas	-	-	F	-	-	-	-		96 h	LC_{50}	mortality	110	b	(Blum and Speece, 1991)
Pimephales promelas	28 d, 21.4±2.134 mm, 0.184±0.050 3 g	Y	F	99%	nw/dtw	7.87±0.07	44.5	23.8±0.83	96 h	LC_{50}	mortality	94.2		(Brooke et al., 1984)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pimephales promelas	31 d	Y	F	99%	nw/dtw	7.03±0.29	44.8±0.58	24.1±1.23	96 h	LC_{50}	mortality	131		(Geiger et al., 1985)
Pimephales promelas	31 d	Y	F	99%	nw/dtw	7.03±0.29	44.8±0.58	24.1±1.23	96 h	LC_{50}	mortality	125	e	(Geiger et al., 1985)
Pimephales promelas	31 d	Y	F	99%	nw/dtw	7.03±0.29	44.8±0.58	24.1±1.23	96 h	LC_{10}	mortality	86.9	e	(Geiger et al., 1985)
Pimephales promelas										LC_{50}	mortality	131	b	(Walbridge et al., 1983)
Pimephales promelas	30-35 d	Y	F		nw	6.7-7.6	45.1 (45.0-45.5)		96 h	LC_{50}	mortality	131.1		(Walbridge et al., 1983)
Pimephales promelas		Y	F						96 h	LC_{50}	mortality	>520	b	(U.S. EPA, 1980c)
Pimephales promelas		Y	F						96 h	LC_{50}	mortality	131	b	(U.S. EPA, 1980c)
Poecilia reticulata	2-3 month	N	Rc		am		25	22	7 d	LC_{50}	mortality	84		(Könemann, 1981)
Amphibians														
Xenopus laevis	3-4 weeks		S		DSW			20±1	48 h	LC_{50}	mortality	63		(De Zwart and Slooff, 1987)

Notes:
a: according to OECD 201 except for the closed vessels enriched with CO_2; continuous light
b: cited in reference
c: according to OECD guideline 202; test performed in the dark
d: Tlm is used as LC_{50}; calculated by graphical interpolation;
e: determined from tabulated data with log-logistic model

Table A3.33:Chronic toxicity data for 1,3-dichloropropane to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pisces														
Pimephales promelas	ELS test	Y	F	98-99%	nw	7.4		25±1	28 d	LC_{50}	mortality	65	a	(Benoit et al., 1982)
Pimephales promelas	ELS test	Y	F	98-99%	nw	7.4		25±1	28 d	EC_{50}	growth	48	a	(Benoit et al., 1982)
Pimephales promelas	ELS test	Y	F	98-99%	nw	7.4		25±1	28 d	EC_{10}	growth	28	a	(Benoit et al., 1982)
Pimephales promelas	ELS test	Y	F	98-99%	nw	7.4		25±1	4-5 d	NOEC	hatchability	>65		(Benoit et al., 1982)
Pimephales promelas	ELS test									LC_{50}	mortality	5.7	b	(U.S. EPA, 1980c)

Notes:
a: determined from presented data with log-logistic model
b: cited in reference

Table A3.34: Acute toxicity data for 1,3-dichloropropane to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Vibrio fischeri		Y	S			6.13-7.15		15	5 min	EC_{50}	bioluminescense	119		(Bláha et al., 1998)
Vibrio fischeri		N	S			6.5-7.5		15	5 min	EC_{50}	bioluminescense	71		(Blum and Speece, 1991)
Vibrio fischeri		Y	S						15 min	EC_{50}	bioluminescense	152		(Freitag et al., 1994)
Vibrio fischeri									30 min	EC_{50}	bioluminescense	121	a	(Sixt et al., 1995)
Algae														
Skeletonema costatum									96 h	EC_{50}	growth inhibition based on cell number	93.6	a	(U.S. EPA, 1980c)
Skeletonema costatum									96 h	EC_{50}	growth inhibition based on chlorophyll a	65.8	a	(U.S. EPA, 1980c)
Crustacea														(U.S. EPA, 1980c)
Mysidopsis bahia		N	S						96 h	LC_{50}	mortality	10.3	a	(U.S. EPA, 1980c)
Pisces														
Cyprinodon variegatus	8-15 mm, 14-28 d	N	S	>80%	nw	-	10-31	25-31	96 h	LC_{50}	mortality	87		(Heitmuller et al., 1981)
Cyprinodon variegatus	8-15 mm, 14-28 d	N	S	>80%	nw	-	10-31	25-31	96 h	NOEC	mortality	38		(Heitmuller et al., 1981)
Cyprinodon variegatus		N	S						96 h	LC_{50}	mortality	87	a	(U.S. EPA, 1980c)

Note:
a: cited in reference

Table A3.35: Chronic toxicity data for 1,3-dichloropropane to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Crustacea														
Mysidopsis bahia	life cycle test									LC_{50}	mortality	3	a	(U.S. EPA, 1980c)

Note:
a: cited in reference

Table A3.36: Acute toxicity data for chloroethylene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Protozoa														
Tetrahymena pyriformis	GL (TP)	N	S	>98%	am			28	3 h	EC_{50}	proliferation rate	806	a	(Sauvant et al., 1995c)
Tetrahymena pyriformis	GL (TP)	N	S	>98%	am			28	6 h	EC_{50}	proliferation rate	430	a	(Sauvant et al., 1995c)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Tetrahymena pyriformis	GL (TP)	N	S	>98%	am			28	9 h	EC_{50}	proliferation rate	405	a	(Sauvant et al., 1995c)
Tetrahymena pyriformis	GL (TP)	N	Sc	>98%	am			28	9 h	EC_{50}	doubling time	540	a	(Sauvant et al., 1995b)
Tetrahymena pyriformis	GL (TP)	N	S	>98%	am			28	36 h	EC_{50}	doubling time	540	b	(Sauvant et al., 1995a)
Tetrahymena pyriformis	GL (TP)	N	S	>98%	am			28	36 h	EC_{50}	doubling time	520	c	(Sauvant et al., 1995a)
Pisces														
Esox lucius									10 d	LC_{100}	mortality	388	d,e	(GDCh, 1989b)
Micropterus salmoides									96 h	LC_{50}	mortality	1100	e	(GDCh, 1989b)
Lepomis macrochirus									96 h	LC_{50}	mortality	1200	e	(GDCh, 1989b)

Notes:
a: ~10^4 cells/ml
b: ~10^4 cells/ml flask
c: ~5*10^4 cells/ml microplate
d: continuous gas flow in the test aquarium
e: cited in reference

Table A3.37: Acute toxicity data for 1,1-dichloroethylene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Algae														
Chlamydomonas reinhardtii	11-32a SAG	Y	Sc	>99%	am	6.5-7.5	110	20±1	72 h	EC_{50}	Biomass	9.12	a	(Brack and Rottler, 1994)
Chlamydomonas reinhardtii	11-32a SAG	Y	Sc	>99%	am	6.5-7.5	110	20±1	72 h	EC_{10}	Biomass	3.94	a	(Brack and Rottler, 1994)
Scenedesmus capricornutum		N	S						96 h	EC_{50}	cell number/chlorophyll A content	>798	b	(U.S. EPA, 1983)
Scenedesmus capricornutum		N	S						96 h	NOEC	cell number/chlorophyll A content	<80	b	(U.S. EPA, 1983)
Scenedesmus subspicatus	Chodat	N	Sc	99%	am			22±2	96 h	EC_{50}	growth AUC	410	c	(Geyer et al., 1985)
Selenastrum capricornutum		N							96 h	EC_{50}	growth chlorophyll	>560	d	U.S. EPA, 1978
Selenastrum capricornutum		N							96 h	EC_{50}	growth population	>560	d	U.S. EPA, 1978
Scenedesmus subspicatus	Chodat	N	Sc	99%	am			22±2	96 h	EC_{10}	growth AUC	240	c	(Geyer et al., 1985)
Crustacea														
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	LC_{50}	mortality	79		(LeBlanc, 1980)
Daphnia magna		N	S			7.9	100	17	24 h	EC_{50}	immobility	11.6		(Dill et al., 1980)
Daphnia magna		N	S			7.9	100	17	48 h	EC_{50}	immobility	11.6		(Dill et al., 1980)
Daphnia magna		N	S			7.9	100	17	24 h	EC_{10}	immobility	3.8		(Dill et al., 1980)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Daphnia magna		N	S			7.9	100	17	48 h	EC_{10}	immobility	3.8		(Dill et al., 1980)
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	NOEC	mortality	<2.4		(LeBlanc, 1980)
Pisces														
Lepomis macrochirus	0.32-1.2 g	N	Sc	>80%	rw	6.5-7.9	32-48	21-23	96 h	LC_{50}	mortality	74		(Buccafusco et al., 1981)
Lepomis macrochirus		N	S						96 h	NOEC	mortality	32	b	(U.S. EPA, 1983)
Lepomis macrochirus	33-75 mm	N	S	-	nw	7.6-7.9	55	23	96 h	LC_{50}	mortality	220		(Dawson et al., 1975-1977)
Lepomis macrochirus	33-75 mm	N	S	-	nw	7.6-7.9	55	23	96 h	LC_{50}	mortality	183	e	(Dawson et al., 1975-1977)
Lepomis macrochirus	33-75 mm	N	S	-	nw	7.6-7.9	55	23	96 h	LC_{10}	mortality	175	e	(Dawson et al., 1975-1977)
Pimephales promelas		N	S						96 h	LC_{50}	mortality	169	b	(U.S. EPA, 1983)
Pimephales promelas		N	F						96 h	LC_{50}	mortality	108	b	(U.S. EPA, 1983)
Pimephales promelas	35 mm, 0.8 g	N	Sc			7.9	100	12±1	24 h	LC_{50}	mortality	175		(Dill et al., 1980)
Pimephales promelas	35 mm, 0.8 g	N	Sc			7.9	100	12±1	48 h	LC_{50}	mortality	169		(Dill et al., 1980)
Pimephales promelas	35 mm, 0.8 g	N	Sc			7.9	100	12±1	96 h	LC_{50}	mortality	169		(Dill et al., 1980)
Pimephales promelas	35 mm, 0.8 g	Y	F			7.9	100	12±1	96 h	LC_{50}	mortality	108		(Dill et al., 1980)
Pimephales promelas	35 mm, 0.8 g	Y	F			7.9	100	12±1	13 d	LC_{50}	mortality	29		(Dill et al., 1980)
Pimephales promelas	35 mm, 0.8 g	Y	F			7.9	100	12±1	96 h	LC_{10}	mortality	93		(Dill et al., 1980)
Pimephales promelas	35 mm, 0.8 g	Y	F			7.9	100	12±1	13 d	LC_{10}	mortality	20		(Dill et al., 1980)

Notes:
a: continuous light at 130 $\mu E/m^2 s$; 5*10^3 cell/mL; exponential phase
b: cited in reference
c: ~10^4 cells/ml; 120 $\mu E/m^2 s$ fluorescent light
d: data from RIVM E-tox database
e: determined from reported data with log-logistic model

Table A3.38: Chronic toxicity data for 1,1-dichloroethylene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Pseudomonas putida		N	Sc		am				16 h	EC_{10}	growth	>2000	a	(GDCh, 1988)
Methanotrophic mixed culture										EC_{80}	growth	0.05	a	(IPCS, 2003)
Pisces														
Pimephales promelas	embryo-larval	N	F						96 h	LC_{50}	mortality	≥2.8	a	(U.S. EPA, 1983)

Note:
a: cited in reference

Table A3.39: Acute toxicity data for 1,1-dichloroethylene to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Algae														
Skeletonema costatum		N							96 h	EC_{50}	cell number/chlorophyll A content	>712	a	(U.S. EPA, 1983)
Skeletonema costatum		N							96 h	NOEC	cell number/chlorophyll A content	712	a	(U.S. EPA, 1983)
Crustacea														
Mysidopsis bahia		N	S						96 h	LC_{50}	mortality	224	a	(U.S. EPA, 1983)
Mysidopsis bahia		N	S						96 h	NOEC	mortality	14.2	a	(U.S. EPA, 1983)
Pisces														
Cyprinodon variegatus	8-15 mm, 14-28 d	N	S	>80%	nw	-	10-31	25-31	96 h	LC_{50}	mortality	250		(Heitmuller et al., 1981)
Cyprinodon variegatus	8-15 mm, 14-28 d	N	S	>80%	nw	-	10-31	25-31	96 h	NOEC	mortality	80		(Heitmuller et al., 1981)
Menidia beryllina	40-100 mm	N	S	-	rw	-	-	20	96 h	LC_{50}	mortality	250		(Dawson et al., 1975-1977)
Menidia beryllina	40-100 mm	N	S	-	rw	-	-	20	96 h	LC_{50}	mortality	259	b	(Dawson et al., 1975-1977)
Menidia beryllina	40-100 mm	N	S	-	rw	-	-	20	96 h	LC_{10}	mortality	236	b	(Dawson et al., 1975-1977)

Notes:
a: cited in reference
b: determined from reported data with log-logistic model

Table A3.40: Chronic toxicity data for 1,1-dichloroethylene to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Algae														
Skeletonema costatum									96 h	NOEC	cell number/chlorophyll A content	≥712	a	(U.S. EPA, 1983)

Note:
a: cited in reference

Table A3.41: Acute toxicity data for 1,2-dichloroethylene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pisces														
Lepomis macrochirus	0.32-1.2 g	N	S	>80%	rw	6.5-7.9	32-48	21-23	96 h	LC_{50}	mortality	140		(Buccafusco et al., 1981)

Table A3.42: Acute toxicity data for 1,2-dichloroethylene to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Crustacea														
Artemia salina	24 h	N	S		am	8.6		25	24 h	LC_{50}	mortality	21		(Sánchez-Fortún et al., 1997)
Artemia salina	48 h	N	S		am	8.6		25	24 h	LC_{50}	mortality	9.7		(Sánchez-Fortún et al., 1997)
Artemia salina	72 h	N	S		am	8.6		25	24 h	LC_{50}	mortality	6.8		(Sánchez-Fortún et al., 1997)

Table A3.43: Acute toxicity data for trans-1,2-dichloroethylene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Nitrosomonas sp.		N	Sc			6.5-8		25	24 h	EC_{50}	ammonia use	80		(Blum and Speece, 1991)
Nitrobacter sp.		N	Sc		am	8.2		25	24 h	EC_{50}	nitrite use	1777	a	(Tang et al., 1992)
Crustacea														
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	LC_{50}	mortality	220		(LeBlanc, 1980)
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	NOEC	mortality	<110		(LeBlanc, 1980)

Note:
a: corrected by author for liquid phase

Table A3.44: Acute toxicity data for trans-1,2-dichloroethylene to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Vibrio fischeri									30 min	EC_{50}	bioluminescense	1536	a	(Sixt et al., 1995)
Vibrio fischeri		N	S			6.5-7.5		15	5 min	EC_{50}	bioluminescense	1100		(Blum and Speece, 1991)

Note:
a: cited in reference

Table A3.45: Acute toxicity data for trans-1,2-dichloroethylene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pisces														
Pimephales promelas									96 h	LC_{50}	mortality	207	a	(Kaiser et al., 1995)

Note:
a: cited in reference

Table A3.46: Acute toxicity data for trans-1,2-dichloroethylene to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Vibrio fischeri		N	S			6.5-7.5		15	5 min	EC_{50}	bioluminescense	720		(Blum and Speece, 1991)
Vibrio fischeri		N							30 min	EC_{50}	bioluminescense	905	a	(Kaiser et al., 1995)
Vibrio fischeri		N							30 min	EC_{50}	bioluminescense	905	a	(Sixt et al., 1995)
Vibrio fischeri									30 min	EC_{50}	bioluminescense	905	a	(Sixt and Altschuh, 1996)
Vibrio fischeri		Y	S			6.13-7.15		15	5 min	EC_{50}	bioluminescense	608		(Bláha et al., 1998)

Note:
a: cited in reference

Table A3.47: Acute toxicity data for 3-chloropropene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Crustacea														
Daphnia magna	<24 h, 0.315-0.630 mm	N	S		tw	7.6-7.7	286	20-22	24 h	EC_{50}	immobility	250		(Bringmann and Kühn, 1977a)
Daphnia magna	<24 h, 0.315-0.630 mm	N	S		tw	7.6-7.7	286	20-22	24 h	EC_0	immobility	125		(Bringmann and Kühn, 1977a)
Pisces														
Carassius auratus	6.2±0.7 cm, 3.3±1.0 g	Y	S		tw	7.8	283	20±1	24 h	LC_{50}	mortality	10	b,c	(Bridié et al., 1979)
Carassius auratus	3.8-6.4 cm, 1-2 g	N	S		nw diluted	7.5	~20	25	96 h	LC_{50}	mortality	20.87	b,d	(Pickering and Henderson, 1966)
Carassius auratus	3.8-6.4 cm, 1-2 g	N	S		nw diluted	7.5	~20	25	96 h	LC_{50}	mortality	22	b,c	(Pickering and Henderson, 1966)
Lepomis macrochirus	3.8-6.4 cm, 1-2 g	N	S		nw diluted	7.5	~20	25	96 h	LC_{50}	mortality	42.33	b,d	(Pickering and Henderson, 1966)
Lepomis macrochirus	3.8-6.4 cm, 1-2 g	N	S		nw diluted	7.5	~20	25	96 h	LC_{50}	mortality	42	b,c	(Pickering and Henderson, 1966)
Leuciscus idus melanotus		N	S	-	tw	7--8	255	20±1	48 h	LC_{50}	mortality	70	e	(Juhnke and Lüdemann, 1978)
Leuciscus idus melanotus		N	S	-	tw	7--8	255	20±1	48 h	LC_0	mortality	47	e	(Juhnke and Lüdemann, 1978)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Pimephales promelas	3.8-6.4 cm, 1-2 g	N	S		nw diluted	7.5	~20	25	96 h	LC_{50}	mortality	19.78	b,d	(Pickering and Henderson, 1966)
Pimephales promelas	3.8-6.4 cm, 1-2 g	N	S		nw diluted	7.5	~20	25	96 h	LC_{50}	mortality	24	b,c	(Pickering and Henderson, 1966)
Pimephales promelas	3.8-6.4 cm, 1-2 g	N	S		nw	8.2	~360	25	96 h	LC_{50}	mortality	24	b,d	(Pickering and Henderson, 1966)
Pimephales promelas	3.8-6.4 cm, 1-2 g	N	S		nw	8.2	~360	25	96 h	LC_{50}	mortality	22	b,c	(Pickering and Henderson, 1966)
Poecilia reticulata	6 m old, 1.9-2.5 cm, 0.1-0.2 g	N	S		nw diluted	7.5	~20	25	96 h	LC_{50}	mortality	51.08	b,d	(Pickering and Henderson, 1966)
Poecilia reticulata	6 m old, 1.9-2.5 cm, 0.1-0.2 g	N	S		nw diluted	7.5	~20	25	96 h	LC_{50}	mortality	48	b,c	(Pickering and Henderson, 1966)
Poecilia reticulata		N	SR						14 d	LC_{50}	mortality	1.2		(Hermens, 1983)
Amphibians														
Xenopus laevis	3-4 weeks		S		DSW			20±1	48 h	LC_{50}	mortality	0.34		(De Zwart and Slooff, 1987)

Notes:
a: cited in reference
b: Tlm is used as LC_{50};
c: calculated by graphical interpolation; method recommended by American Public Health Association (1971)
d: calculated by moving average-angle method; method recommended by American Public Health Association (1960)
e: test according to Mann, 1976

Table A3.48: Chronic toxicity data for 3-chloropropene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Pseudomonas putida		N	Sc		am	7.0	81.2	25	16 h	NOEC	growth	115	a	(Bringmann and Kühn, 1976), (Bringmann and Kühn, 1977b), (Bringmann and Kühn, 1979), (Bringmann and Kühn, 1980b)
Cyanophyta														
Microcystis aeruginosa		N	Sc		am	7.0	55	27	8 d	NOEC	growth	8.2	a; d	(Bringmann, 1975), (Bringmann and Kühn, 1976), (Bringmann and Kühn, 1978b), (Bringmann and Kühn, 1978a)
Protozoa														
Chilomonas paramaecium		N	Sc		am	6.9	74.6	20	48 h	NOEC	growth	8.6	a; e	(Bringmann et al., 1980)
Entosiphon sulcatum	Stein	N	Sc		am	6.9	75.1	25	72 h	NOEC	growth	8.4	a; e	(Bringmann, 1978), (Bringmann and Kühn, 1979; Bringmann and Kühn, 1980a)
Uronema parduczi	Chatton-Lwoff	N	Sc		am	6.9	75.1	25	20 h	NOEC	growth	>240	a; e	(Bringmann and Kühn, 1980b)
Algae														

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Scenedesmus quadricauda		N	Sc		am	7.0	55	27	8 d	NOEC	growth	6.3	a; d	(Bringmann and Kühn, 1977b), (Bringmann and Kühn, 1980b), (Bringmann and Kühn, 1979), (Bringmann and Kühn, 1978b), (Bringmann and Kühn, 1978a)

Notes:
a: toxicity threshold is used as a NOEC
b: cited in reference
c: soil bacterium tested in water, water solubility exceeded
d: light intensity 2800 lm
e: 1.5*10^4 cells/ml

Table A3.49:Acute toxicity data for 3-chloropropene to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Vibrio fischeri		Y	S			6.13-7.15		15	5 min	EC_{50}	bioluminescense	23.6		(Bláha et al., 1998)

Table A3.50: Acute toxicity data for 1,3-dichloropropene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Nitrosomonas sp.		N	Sc			6.5-8		25	24 h	EC_{50}	ammonia use	0.67		(Blum and Speece, 1991)
Nitrobacter sp.		N	Sc		am	8.2		25	24 h	EC_{50}	nitrite use	150	a	(Tang et al., 1992)
Algae														
Scenedesmus capricornutum									96 h	EC_{50}	growth inhibition based on cell number	4.96	b	(U.S. EPA, 1980c)
Scenedesmus capricornutum									96 h	EC_{50}	growth inhibition based on chlorophyll a	4.95	b	(U.S. EPA, 1980c)
Scenedesmus capricornutum			Sc						72 h	EC_{50}	growth inhibition based on chlorophyll a	8.2	b	(IPCS, 1993)
Scenedesmus capricornutum			Sc						72 h	EC_{50}	growth inhibition	8.2	b	(IPCS, 1993)
Scenedesmus capricornutum			Sc						24-48 h	EC_{50}	growth inhibition	11	b	(IPCS, 1993)
Scenedesmus capricornutum			Sc						24-72 h	EC_{50}	growth inhibition	3.6	b	(IPCS, 1993)
Selenastrum capricornutum									96 h	EC_{50}	population	4.07	c	U.S. EPA 1978

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Selenastrum capricornutum									96 h	EC_{50}	chlorophyll a	4.06	c	U.S. EPA 1978
Selenastrum capricornutum									96 h	NOEC	chlorophyll a	<0.6	c	U.S. EPA 1978
Selenastrum capricornutum									48 h	EC_{50}	growth inhibition	8.6		(Nite, 2007)
Selenastrum capricornutum									72h	EC_{50}	biomass	0.24		(Nite, 2007)
Mollusca														
Helosima trivolvis		N	S	92%		7.35-7.6	40-42	22.4	96 h	LC_{50}	mortality	8.1	c	(Horne and Oblad, 1983)
Crustacea														
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	LC_{50}	mortality	6.2		(LeBlanc, 1980)
Daphnia magna	< 24 h	N	Sc	-	rw	7.4-9.4	173±13	22±1	48 h	NOEC	mortality	0.41		(LeBlanc, 1980)
Daphnia magna		N	S						48 h	EC_{50}	immobility	6.2	b	(U.S. EPA, 1980c)
Daphnia magna	1st instar		S	100% technical material		7.4	44	21	48 h	EC_{50}	immobility	0.09		(Mayer.Jr. and Ellersieck, 1986)
Daphnia magna	24 h		S	51-52% cis+ 44% trans		7.9-8.3	179	18-23	48 h	EC_{50}	immobility	3.1		(IPCS, 1993)
Daphnia magna									48 h	EC_{50}	immobility	1.2		(Nite, 2007)
Gammarus minus		N	S	92%		7.3-7.6		11.4-11.52	96 h	LC_{50}	mortality	2	c	(Horne and Oblad, 1983)
Insecta														
Chironomus thummi		N	S	92%		7.6-7.7	44-46	17.2	48 h	LC_{50}	mortality	1.35	c	(Horne and Oblad, 1983)
Tallaperla maria		N	S	92%		7.2-7.4	46-49	11.6-11.8	96 h	LC_{50}	mortality	5.4	c	(Horne and Oblad, 1983)
Pisces														
Lepomis macrochirus	0.32-1.2 g	N	Sc	>80%	rw	6.5-7.9	32-48	21-23	96 h	LC_{50}	mortality	6.1		(U.S. EPA, 1980c)
Lepomis macrochirus		N	S						96 h	LC_{50}	mortality	6.1	b	(U.S. EPA, 1980c)
Lepomis macrochirus									96 h	LC_{50}	mortality	7.1		(Tomlin, 2002)
Lepomis macrochirus			S	92%					96 h	LC_{50}	mortality	6.7	c	EPA database, 2000
Pimephales promelas		Y	F			7.7	46	25.7	96 h	LC_{50}	mortality	0.24	b	(Kaiser et al., 1995)
Pimephales promelas		N	S	92%		6.92-7.33	35	16.7-16.9	96 h	LC_{50}	mortality	2.3	c	(Horne and Oblad, 1983)
Pimephales promelas	0.9 g		S	100% technical material		7.4	44	18	96 h	LC_{50}	mortality	4.1		(Mayer.Jr. and Ellersieck, 1986)
Oncorhynchus mykiss		N	S	92%		6.88-7.29	51	12.3-12.8	96 h	LC_{50}	mortality	5.4	c	(Horne and Oblad, 1983)
Oncorhynchus mykiss			S	92%					96 h	LC_{50}	mortality	3.9	c	EPA database, 2000
Micropterus salmoides	1.0 g		S	100% technical material		7.4	272	18	96 h	LC_{50}	mortality	3.65		(Mayer.Jr. and Ellersieck, 1986)
Stizostedion vitreum	1.3 g		S	100% technical material		7.4	272 (e-tox database: 40-50)	18	96 h	LC_{50}	mortality	1.08		(Mayer.Jr. and Ellersieck, 1986)
Carasius auratus	1.0 g		S	100% technical		7.4	44	18	96 h	LC_{50}	mortality	<7.5		(Mayer.Jr. and Ellersieck, 1986)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
				material										
Carasius auratus	1.0 g		S	100% technical material		7.4	44	18	24 h	LC_{50}	mortality	12.8		(Mayer.Jr. and Ellersieck, 1986)
Idus idus melanotus	2.8 g						260	18	96 h	LC_{50}	mortality	9	b	(IPCS, 1993)
Salmo gairdneri									96 h	LC_{50}	mortality	3.9		(Tomlin, 2002)
Salmo gairdneri	4.2 cm (0.68 g)		SS	51-52% cis+ 44% trans		7.5-8.3	251-284	13-17	96 h	LC_{50}	mortality	2	b	(IPCS, 1993)
Poecilia reticulata		N	SR					22	14 d	LC_{50}	mortality	0.51		(Hermens, 1983)
Oryzias latipes									96 h	LC_{50}	mortality	1.5		(Nite, 2007)

Notes:
a: corrected by author for liquid phase
b: cited in reference
c: data from RIVM E-tox database

Table A3.51: Chronic toxicity data for 1,3-dichloropropene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Algae														
Selenastrum capricornutum									48 h	NOEC	growth inhibition	0.97		(Nite, 2007)
Selenastrum capricornutum									72h	NOEC	biomass	0.009		(Nite, 2007)
Crustacea														
Daphnia magna									21 d	NOEC	reproduction	0.09		(Nite, 2007)
Pisces														
Pimephales promelas	ELS test									LC_{50}	mortality	0.244	a	(U.S. EPA, 1980c)

Note:
a: cited in reference

Table A3.52: Acute toxicity data for 1,3-dichloropropene to saltwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Vibrio phosphoreum		N							30 min	EC_{50}	bioluminescense	72	a	(Sixt et al., 1995)
Vibrio fischeri		N	S			6.5-7.5		15	5 min	EC_{50}	bioluminescense	110		(Blum and Speece, 1991)
Algae														

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Skeletonema costatum									96 h	EC_{50}	growth inhibition based on cell number	1.04	a	(U.S. EPA, 1980c)
Skeletonema costatum									96 h	EC_{50}	growth inhibition based on chlorophyll a	1	a	(U.S. EPA, 1980c)
Crustacea														
Mysidopsis bahia		N	S						96 h	LC_{50}	mortality	0.79	a	(U.S. EPA, 1980c)
Pisces														
Cyprinodon variegatus	8-15 mm, 14-28 d	N	S	>80%	nw	-	10-31	25-31	96 h	LC_{50}	mortality	1.8		(Heitmuller et al., 1981)
Cyprinodon variegatus	8-15 mm, 14-28 d	N	S	>80%	nw	-	10-31	25-31	96 h	NOEC	mortality	1.2		(Heitmuller et al., 1981)
Cyprinodon variegatus		N	S						96 h	LC_{50}	mortality	1.77	a	(U.S. EPA, 1980c)

Note:
a: cited in reference

Table A3.53: Acute toxicity data for trans-1,3-dichloropropene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Algae														
Scenedesmus capricornutum			Sc						72 h	EC_{50}	growth inhibition	11	a	(IPCS, 1993)
Scenedesmus capricornutum			Sc						24-48 h	EC_{50}	growth inhibition	6.6	a	(IPCS, 1993)
Scenedesmus capricornutum			Sc						24-72 h	EC_{50}	growth inhibition	7.5	a	(IPCS, 1993)
Crustacea														
Daphnia magna	24 h		S	95.4% (+0.3% cis)		7.8-8.3	170	18-22	48 h	EC_{50}	immobility	3.1	a	(IPCS, 1993)
Pisces														
Salmo gairdneri	4.0 cm (0.67 g)		SS	95.4% (+0.3% cis)		7.2-7.8	234-264	15-17	96 h	LC_{50}	mortality	4.5	a	(IPCS, 1993)

Note:
a: cited in reference

Table A3.54: Acute toxicity data for cis-1,3-dichloropropene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Algae														
Scenedesmus capricornutum			Sc						72 h	EC_{50}	growth inhibition	2.8	a	(IPCS, 1993)
Scenedesmus capricornutum			Sc						24-48 h	EC_{50}	growth inhibition	4.6	a	(IPCS, 1993)
Scenedesmus capricornutum			Sc						24-72 h	EC_{50}	growth inhibition	3.1	a	(IPCS, 1993)
Crustacea														
Daphnia magna	24 h		S	96%		7.6-8.4	176	18-22	48 h	EC_{50}	immobility	1.4	a	(IPCS, 1993)
Pisces														
Salmo gairdneri	4.7 cm (1.1 g)		SS	96%		7-7.8	226-258	13-17	96 h	LC_{50}	mortality	1.6	a	(IPCS, 1993)

Note:
a: cited in reference

Table A3.55: Acute toxicity data for 2,3-dichloropropene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Protozoa														
Tetrahymena thermophila			Sc					32	48 h	EC_{50}	growth inhibition, proliferation rate	119		(Pauli et al., 1993)
Pisces														
Poecilia reticulata	2-3 month old	N	Rc		am		25	22	7 d	LC_{50}	mortality	<11		(Könemann, 1981)
Poecilia reticulata	2-3 months	N	R		am		25	22	14 d	LC_{50}	mortality	1.2		(Hermens and Leeuwangh, 1982)

Table A3.56: Chronic toxicity data for 2,3-dichloropropene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Protozoa														
Tetrahymena thermophila			Sc					32	48 h	NOEC	growth inhibition, proliferation rate	40		(Pauli et al., 1993)
Tetrahymena thermophila									48 h	NOEC	growth	25	b	(Pauli et al., 1993)
Tetrahymena thermophila									48 h	NOEC	growth	123	b	(Pauli et al., 1993)

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Tetrahymena thermophila									48 h	EC_{10}	growth	70	b	(Pauli et al., 1993)
Tetrahymena thermophila									48 h	EC_{10}	growth	74	b	(Pauli et al., 1993)
Algae														
Scenedesmus subspicatus			Sc						7 d	EC_3	growth inhibition, proliferation	>20	b	(Trenel and Kuhn, 1982)
Fungi														
Saccharomyces cerevisiae	RXII	N	S		am				24 h	EC_{20}	growth rate	250	a	(Cascorbi et al., 1993)
Saccharomyces cerevisiae	RXII	N	S		am				24 h	EC_{20}	cell density	220	a	(Cascorbi et al., 1993)

Notes:
a: $EC_{10}>EC_{20}/2$
b: data from RIVM E-tox database

Table A3.57: Acute toxicity data for 2-chlorobutadiene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Bacteria														
Pseudomonas fluorescens		N								EC_{100}	growth inhibition	>1000	a	(GDCh, 1991)
Escherichia coli		N								EC_{100}	growth inhibition	>1000	a	(GDCh, 1991)
Algae														
Navicula seminulum var. Hustedtii Patr.		N	S						7 d	EC_{50}	growth inhibition	380	a	(GDCh, 1991)
Crustacea														
Daphnia magna		Y	S						24 h	EC_{50}	swimming ability	348	a	(GDCh, 1991)
Daphnia magna		Y	S						24 h	EC_0	swimming ability	100	a	(GDCh, 1991)
Pisces														
Lepomis macrochirus		N	F						96 h	LC_{50}	mortality	245	a	(GDCh, 1991)
Leuciscus idus			S						96 h	LC_0	mortality	200	a	(GDCh, 1991)
Leuciscus idus			S						4.5 h	LC_{100}	mortality	500	a	(GDCh, 1991)

Notes:
a: cited in reference

Table A3.58: Acute toxicity data for 2-chlorobutadiene to freshwater organisms.

Species	Species properties	Analyzed	Test type	Subst. purity	Test water	pH	Hardness [mg/l $CaCO_3$]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Value [mg/l]	Notes	Reference
Crustacea														
Daphnia magna		N	Sr						21 d	EC_{50}	reproduction	173	a; b	(GDCh, 1991)
Daphnia magna		N	Sr						21 d	EC_{10}	reproduction	1.9	a; b	(GDCh, 1991)

Notes:
a: cited in reference
b: determined from reported data with log-logistic model

Appendix 4. Terrestrial toxicity data

Table A4.1: Terrestrial toxicity data for ethylene: exposure via air.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test Air [mg/l air]	Notes	Reference
Macrophyta												
Hordeum vulgare	leaf emerging-early anthesis	artificial soil				23 day 15 night	26 d	EC_{10}	number of heads	0.000051	a	(Archambault and Li, 2001)
Hordeum vulgare	leaf emerging-early anthesis	artificial soil				23 day 15 night	26 d	EC_{10}	weight of heads	0.000015	a	(Archambault and Li, 2001)
Hordeum vulgare	leaf emerging-early anthesis	artificial soil				23 day 15 night	26 d	EC_{10}	number of seed	0.000023	a	(Archambault and Li, 2001)
Hordeum vulgare	leaf emerging-early anthesis	artificial soil				23 day 15 night	26 d	EC_{10}	weight per seed	0.000087	a	(Archambault and Li, 2001)
Hordeum vulgare	leaf emerging-early anthesis	artificial soil				23 day 15 night	26 d	EC_{10}	seed yield	0.000012	a	(Archambault and Li, 2001)
Hordeum vulgare	leaf emerging-early anthesis	artificial soil				14 day	26 d	EC_{10}	number of heads	0.000011	a	(Archambault and Li, 2001)
Hordeum vulgare	leaf emerging-early anthesis	artificial soil				14 day	26 d	EC_{10}	weight of heads	0.000015	a	(Archambault and Li, 2001)
Hordeum vulgare	leaf emerging-early anthesis	artificial soil				14 day	26 d	EC_{10}	number of seed	0.000009	a	(Archambault and Li, 2001)
Hordeum vulgare	leaf emerging-early anthesis	artificial soil				14 day	26 d	EC_{10}	weight per seed	0.000036	a	(Archambault and Li, 2001)
Pisum sativum	buts visible pods full	artificial soil				23 day 15 night	16 d	EC_{10}	number of pods	0.00021	a	(Archambault and Li, 2001)
Pisum sativum	buts visible pods full	artificial soil				23 day 15 night	16 d	EC_{10}	weight per pod	0.0001	a	(Archambault and Li, 2001)
Pisum sativum	buts visible pods full	artificial soil				23 day 15 night	16 d	EC_{10}	weight per seed	0.00018	a	(Archambault and Li, 2001)
Pisum sativum	buts visible pods full	artificial soil				23 day 15 night	16 d	EC_{10}	seed yield	0.00013	a	(Archambault and Li, 2001)
Brassica napus	flowers open pods full	artificial soil				23 day 15 night	31 d	EC_{10}	seed yield	0.000025	a	(Archambault and Li, 2001)
Brassica napus	flowers open pods full	artificial soil				23 day 15 night	31 d	EC_{10}	plant Height	0.000058	a	(Archambault and Li, 2001)
Brassica campestris	?	grit with nutrient solution				25 day 14 night	23 d	EC_{10}	shoot dry weight	0.000052	a	(Reid and Watson, 1985)
Brassica campestris	?	grit with nutrient				25 day 14 night	23 d	EC_{10}	leaf area	0.000053	a	(Reid and Watson, 1985)

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test Air [mg/l air]	Notes	Reference
		solution										
Brassica campestris	?	grit with nutrient solution				25 day 14 night	87 d	EC_{10}	seed + plant weight	0.000007	a	(Reid and Watson, 1985)
Brassica campestris	?	grit with nutrient solution				25 day 14 night	87 d	EC_{10}	no seeds/plant	0.000031	a	(Reid and Watson, 1985)
Avena sativa	?	grit with nutrient solution				25 day 14 night	23 d	EC_{10}	no leaves	0.000027	a	(Reid and Watson, 1985)
Avena sativa	?	grit with nutrient solution				25 day 14 night	23 d	EC_{10}	no tillers	0.000054	a	(Reid and Watson, 1985)
Avena sativa	?	grit with nutrient solution				25 day 14 night	100 d	EC_{10}	no florets	0.000012	a	(Reid and Watson, 1985)

Note:
a: Determined from presented data with log-logistic model

Table A4.2: Terrestrial toxicity data for ethylene oxide: exposure via air.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result Air [mg/l air]	Notes	Reference
Insecta												
Trogoderma granarium	8-10 d larvae					26-30	24 h eff 15 d	LC_{50}	mortality	1.89	a	(Rajendran, 1982)
Trogoderma granarium	8-10 d larvae					26-30	24 h eff 15 d	LC_{10}	mortality	1.12	a	(Rajendran, 1982)
Rhyzopertha domenica	5-8 d					26-29	24 h eff 10 d	LC_{50}	mortality	1.259	a	(Rajendran and Shivaramaiah, 1985)
Rhyzopertha domenica	5-8 d					26-29	24 h eff 10 d	LC_{10}	mortality	0.973	a	(Rajendran and Shivaramaiah, 1985)
Rhyzopertha domenica	5-8 d					26-29	24 h eff 35 d	EC_{50}	productivity	0.823	a	(Rajendran and Shivaramaiah, 1985)
Rhyzopertha domenica	5-8 d					26-29	24 h eff 35 d	EC_{10}	productivity	0.501	a	(Rajendran and Shivaramaiah, 1985)

Note:
a: recalculated from original data

Table A4.3: Terrestrial toxicity data for dichloromethane: exposure via soil.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg_{dw}]	Result stand. soil [mg/kg_{dw}]	Notes	Reference
Bacteria													
Mix of microbial organism, respiration		Sandy loam			7%	25	10 h	IC_{50}	Oxygen uptake	940	13429	a	(Regno et al., 1998)

Note:
a: determination of EC_{50} unclear

Table A4.4: Sediment acute toxicity data for trichloromethane: exposure via sediment.

Species	Species properties (age, sex)	Sediment type	A	Purity [%]	pH	o.m. [%]	Clay [%]	T [°C]	Exp. time	Criterion	Test endpoint	Result test sediment [mg/kg$_{dw}$]	Result stand. sediment [mg/kg$_{dw}$]	Notes	Reference
Bacteria															
Methanogenic bacteria		sediment from the estuary of the river Rhine	N			3-5% oc		20	10-11 d	methanogenesis	EC_{50}	6.9	10.1[c]	a, b	(Van Vlaardingen and Van Beelen, 1992)

Notes:
a: RI2
b: closed bottle, sterile incubation
c: assuming an average carbon content of 4%, corresponding to 6.8% o.m.

Table A4.5: Sediment chronic toxicity data for trichloromethane: exposure via sediment.

Species	Species properties (age, sex)	Sediment type	A	Purity [%]	pH	o.m. [%]	Clay [%]	T [°C]	Exp. time	Criterion	Test endpoint	Result test sediment [mg/kg$_{dw}$]	Result stand. sediment [mg/kg$_{dw}$]	Notes	Reference
Bacteria															
Methanogenic bacteria		sediment from the estuary of the river Rhine	N			3-5% oc		20	10-11 d	methanogenesis	EC_{10}	5.5	8.1[c]	a, b	(Van Vlaardingen and Van Beelen, 1992)

Notes:
a: RI2
b: closed bottle, sterile incubation
c: assuming an average carbon content of 4%, corresponding to 6.8% o.m.

Table A4.6: Terrestrial toxicity data for trichloromethane: exposure via medium.

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result medium [mg/l]	Notes	Reference
Bacteria													
Rhizobium meliloti		N	S		CDM with supplements	7.5	30	20 min	IC_{50}	inhibition of dye reduction	1786		(Botsford et al., 1997)

Table A4.7: Terrestrial toxicity data for tetrachloromethane: exposure via soil.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg$_{dw}$]	Result stand. soil [mg/kg$_{dw}$]	Notes	Reference
Bacteria													
Mix of microbial organism, respiration		sandy loam			7%	25	10 h	IC_{50}	oxygen uptake	450	6429	a	(Regno et al., 1998)

Note:
a: determination of EC_{50} unclear

Table A4.8: Terrestrial toxicity data for tetrachloromethane: exposure via medium.

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result medium [mg/l]	Notes	Reference
Bacteria													
Rhizobium meliloti		N	S		CDM with supplements	7.5	30	20 min	IC_{50}	inhibition of dye reduction	1790		(Botsford et al., 1997)

Table A4.9: Terrestrial toxicity data for dichloroethane (unspecified): exposure via medium.

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result medium [mg/l]	Notes	Reference
Bacteria													
Rhizobium meliloti		N	S		CDM with supplements	7.5	30	20 min	IC_{50}	inhibition of dye reduction	240		(Botsford et al., 1997)

Table A4.10: Terrestrial toxicity data for 1,1-dichloroethane: exposure via medium.

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result medium [mg/l]	Notes	Reference
Macrophyta													
Populus deltoides x *nigra*	cuttings	Y	Sc	>99%	Hoagland's nutrient solution half-strength			14 d	EC_{50}	reduction transpiration rate	802		(Dietz and Schnoor, 2001)

Table A4.11: Terrestrial toxicity data for 1,2-dichloroethane: exposure via soil.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg$_{dw}$]	Result stand. soil [mg/kg$_{dw}$]	Notes	Reference
Bacteria													
Mix of microbial organism, respiration		sandy loam			7%	25	10 h	IC_{50}	oxygen uptake	510	7286	a	(Regno et al., 1998)

Note:
a: determination of EC_{50} unclear

Table A4.12: Terrestrial toxicity data for 1,1,1-trichloroethane: exposure via soil.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg$_{dw}$]	Result stand. soil [mg/kg$_{dw}$]	Notes	Reference
Bacteria													
Mix of microbial organism, respiration		Sandy loam			7%	25	10 h	IC_{50}	Oxygen uptake	590	8429	a	(Regno et al., 1998)
Macrophyta													
Lactuca sativa		artificial soil	7.5	1.8	24	21±4	7 d	EC_{50}	growth	>1000	>5556		(Hulzebos et al., 1993)
Lactuca sativa		artificial soil	7.5	1.8	24	21±4	14 d	EC_{50}	growth	>1000	>5556		(Hulzebos et al., 1993)
Lactuca sativa		artificial soil	7.5	1.8	24	21±4	7 d	NOEC	growth	>1000	>5556		(Hulzebos et al., unpublished data)
Lactuca sativa		artificial soil	7.5	1.8	24	21±4	14 d	NOEC	growth	>1000	**>5556**		(Hulzebos et al., unpublished data)

Note:
a: determination of EC_{50} unclear

Table A4.13: Terrestrial toxicity data for 1,1,1-trichloroethane: exposure via medium.

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result Medium [mg/l]	Notes	Reference
Annelida													
Aeolosoma hemprichi		N	Sc		lettuce egg yolk extract		20		EC_{50}	growth rate	92	a	(Inamori et al., 1989)
Enchytraeus buchholzi									LC_{50}	mortality	390	b	(Inamori et al., 1989)
Protozoa													
Colpoda sp.		N	Sc		lettuce egg yolk extract		20		EC_{50}	growth rate	205	a	(Inamori et al., 1989)
Bacteria													
Rhizobium meliloti		N	S		CDM with supplements	7.5	30	20 min	IC_{50}	inhibition of dye reduction	46		(Botsford et al., 1997)

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result Medium [mg/l]	Notes	Reference
Macrophyta													
Lactuca sativa		Y			Steiner solution	7.5	21±4	16/21 d	EC_{50}	growth	104		(Hulzebos et al., unpublished data)
Lactuca sativa		Y			Steiner solution	7.5	21±4	16/21 d	EC_{50}	growth	32		(Hulzebos et al., unpublished data)
Populus deltoides x *nigra*	cuttings	Y	Sc	>99%	Hoagland's nutrient solution half-strength			14 d	EC_{50}	reduction transpiration rate	160		(Dietz and Schnoor, 2001)
Rotifera													
Philodina erytrophthalma		N	Sc		lettuce egg yolk extract		20		EC_{50}	growth rate	162	a	(Inamori et al., 1989)

Notes:

a: medium was a lettuce-egg yolk extract medium with suspended activated sludge bacteria; test performed in the dark; the number of organisms were determined daily for the *Colpoda* species and every four days for the two other species.

b: no details of the test, LC_{50} value presented in table

Table A4.14: Terrestrial toxicity data for 1,1,1-trichloroethane: exposure via air.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result Air [mg/l]	Notes	Reference
Nicotiana tabacum	0.5 mg pollen.					22	2 h	ED_{50}	germination	13	a, b	(Schubert et al., 1995)
Nicotiana tabacum	0.5 mg pollen.					22	2 h	ED_{10}	germination	0.9	a, b	(Schubert et al., 1995)
Exposure by air												
Sorghum bicolor	< 5 d	compost	6.7	7.3		20±2	14 d	EC_{50}	growth	50.47	a	(Thompson and Carmichael, 1989)
Sorghum bicolor	< 5 d	compost	6.7	7.3		20±2	14 d	EC_{10}	growth	41.02	a	(Thompson and Carmichael, 1989)
Brassica napus	< 5 d	compost	6.7	7.3		20±2	14 d	EC_{50}	growth	25.59	a	(Thompson and Carmichael, 1989)
Brassica napus	< 5 d	compost	6.7	7.3		20±2	14 d	EC_{10}	growth	10.84	a	(Thompson and Carmichael, 1989)
Insecta												
Tribolium castaneum	1-2 d pupae	no soil				26±1	24 h exposure; 20 d observation	LC_{50}	emergence, mortality	208.4		(Rajendran, 1990)

Notes:

a: Determined from presented data with log-logistic model

b: Germination in petri-disk

Table A4.15: Terrestrial toxicity data for 1,1,2-trichloroethane: exposure via medium.

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result Medium [mg/l]	Notes	Reference
Macrophyta													
Populus deltoides x *nigra*	cuttings	Y	Sc	>99%	Hoagland's nutrient solution half-strength			14 d	EC_{50}	reduction transpiration rate	253		(Dietz and Schnoor, 2001)

Table A4.16: Terrestrial toxicity data for 1,1,2,2-tetrachloroethane: exposure via soil.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg$_{dw}$]	Result stand. soil [mg/kg$_{dw}$]	Notes	Reference
Bacteria													
Mix of microbial organism, respiration		sandy loam			7%	25	10 h	IC_{50}	oxygen uptake	120	1714	a	(Regno et al., 1998)

Notes:
a: determination of EC50 unclear

Table A4.17: Terrestrial toxicity data for 1,1,2,2-tetrachloroethane: exposure via medium.

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result Medium [mg/l]	Notes	Reference
Macrophyta													
Populus deltoides x nigra	cuttings	Y	Sc	>99%	Hoagland's nutrient solution half-strength			14 d	EC_{50}	reduction transpiration rate	151		(Dietz and Schnoor, 2001)

Table A4.18: Terrestrial toxicity data for 1,1,2,2-tetrachloroethane: exposure via air.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test Air [mg/l]	Notes	Reference
Macrophyta												
Nicotiana tabacum	0.5 mg pollen. germination in petri-disk					22	2 h	ED_{50}	germination	0.065	a	(Schubert et al., 1995)
Nicotiana tabacum	0.5 mg pollen. germination in petri-disk					22	2 h	ED_{10}	germination	0.0039	a	(Schubert et al., 1995)

Notes:
a: determined from presented data with log-logistic model

Table A4.19: Terrestrial toxicity data for 1,2-dichloropropane exposure via soil.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg$_{dw}$]	Result stand. soil [mg/kg$_{dw}$]	Notes	Reference
Bacteria													
Mix of microbial organism, respiration		Sandy loam			7%	25	10 h	IC_{50}	oxygen uptake	320	4571	a	(Regno et al., 1998)
Fungi													
Soil fungi		loam	7.7	0.91	11.2	20-25	7	LC_{95-100}	mortality	1000	10989		(Moje et al., 1957)
Bacteria + actinomycetes		loam	7.7	0.91	11.2	20-25	7	LC_{85}	mortality	>1000	>10989		(Moje et al., 1957)
Nematoda													
Tylenchulus semipenetrans		loam	7.7	0.91	11.2	20-25	7	LC_{95-100}	mortality	250	2747		(Moje et al., 1957)
Annelida													
Allolobophora tuberculata	adult (Eisen)	artificial soil	6.0±0.5	10	20	20	14 d	LC_{50}	mortality	4272	4272	b	(Neuhauser et al., 1986)
Eisenia fetida	300-500 mg, adult (Savigny)	artificial soil	6.0±0.5	10	20	20	14 d	LC_{50}	mortality	4240	4240	c	(Neuhauser et al., 1986), (Neuhauser et al., 1986), (Neuhauser et al., 1985)
Eudrilus eugeniae	adult (Kinberg)	artificial soil	6.0±0.5	10	20	20	14 d	LC_{50}	mortality	5300	5300	b	(Neuhauser et al., 1986)
Perionyx excavatus	adult (Perrier)	artificial soil	6.0±0.5	10	20	20	14 d	LC_{50}	mortality	3880	3880	b	(Neuhauser et al., 1986)
Eisenia fetida	young, <10 mg, <1 w old (Savigny)	artificial soil	-	14	~0	25	8 w	NOEC	reproduction (number of cocoons), mortality	80800	57714		(Neuhauser and Callahan, 1990)

Notes:
a: determination of EC_{50} unclear
a: EEC artificial soil test method
b: EEC 79/831 Rev. 3

Table A4.20: Terrestrial toxicity data for chloroethylene: exposure via air.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test Air [mg/l air]	Notes	Reference
Macrophytes												
Several plant species									growth, foliar injury, leaf abscission	0.026-2.600	a	(Besemer et al., 1984)

Note:
a: cited in reference

Table A4.21: Terrestrial toxicity data for 1,1-dichloroethylene via soil.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg$_{dw}$]	Result stand. soil [mg/kg$_{dw}$]	Notes	Reference
Macrophyta													
Brassica napus							14 d	EC_{50}		>1000		a	(GDCh, 1988)
Avena sativa							14 d	EC_{50}		>1000		a	(GDCh, 1988)
Sinapsis alba	L.	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>100 ≤1000	>392 ≤3922	b	(Pestemer and Auspurg, 1986)
Brassica napus	(L.) *napus*	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>1000	>3922	b	(Pestemer and Auspurg, 1986)
Brassica rapa	*rapa* (DC.) Metzg.L	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>1000	>3922	b	(Pestemer and Auspurg, 1986)
Brassica chinensis		loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>100 ≤1000	>392 ≤3922	b	(Pestemer and Auspurg, 1986)
Raphanus sativus	var. radicula Pers.	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>1000	>3922	b	(Pestemer and Auspurg, 1986)
Vicia sativa	L.	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>1000	>3922	b	(Pestemer and Auspurg, 1986)
Phaseolus aureus	Roxb. Vigna radiata (L.) Wilczek	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>1000	>3922	b	(Pestemer and Auspurg, 1986)
Trifolium pratense	L.	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>1000	>3922	b	(Pestemer and Auspurg, 1986)
Trigonella meliotus-coerulea	L.	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>1000	>3922	b	(Pestemer and Auspurg, 1986)
Lolium perenne	L.	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>100 ≤1000	>392 ≤3922	b	(Pestemer and Auspurg, 1986)
Avena sativa	L.	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>100 ≤1000	>392 ≤3922	b	(Pestemer and Auspurg, 1986)
Triticum aestivum	L.	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>1000	>3922	b	(Pestemer and Auspurg, 1986)
Sorghum vulgare	Pers.	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>1000	>3922	b	(Pestemer and Auspurg, 1986)
Lepidium sativum	L.	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>100 ≤1000	>392 ≤3922	b	(Pestemer and Auspurg, 1986)
Lactuca sativa	L.	loamy sand	6	2.55	1	20	14 d	EC_{50}	germination and shoot growth (fresh weight)	>100 ≤1000	>392 ≤3922	b	(Pestemer and Auspurg, 1986)
Annelida													
Eisenia fetida		artificial soil	-				28 d	LC_{50}	mortality	>1000		a	(IPCS, 2003)

Notes:
a: cited in reference
b: BBA guideline; photoperiod 16:8 h light:dark

Table A4.22: Terrestrial toxicity data for 1,1-dichloroethylene: exposure via medium.

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result Medium [mg/l]	Notes	Reference
Bacteria													
Methanotrophic mixed culture, 92% Methylosinus trichosporium					am		20		EC_{7}	growth	0.005	a	(Anderson and McCarty, 1996)
Methanotrophic mixed culture, 92% Methylosinus trichosporium					am		20		EC_{24}	growth	0.05	b	(Anderson and McCarty, 1996)
Methanotrophic mixed culture, 92% Methylosinus trichosporium					am		20		EC_{66}	growth	0.1	b	(Anderson and McCarty, 1996)
Methanotrophic mixed culture, 92% Methylosinus trichosporium					am		20		EC_{50}	growth	0.098	c	(Anderson and McCarty, 1996)
Macrophyta													
Populus deltoides x nigra	cuttings	Y	Sc	>99%	Hoagland's nutrient solution half-strength			14 d	EC_{50}	reduction transpiration rate	281		(Dietz and Schnoor, 2001)

Notes:
a: inoculum of 460 µg/l methane
b: inoculum of 0.01 µg/l methane
c: determined from reported data with log-logistic model

Table A4.23: Terrestrial toxicity data for trans-1,2-dichloroethylene: exposure via medium.

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result Medium [mg/l]	Notes	Reference
Bacteria													
Methanotrophic mixed culture, 92% Methylosinus trichosporium					am		20		EC_{20}	growth	1	a	(Anderson and McCarty, 1996)
Methanotrophic mixed culture, 92% Methylosinus trichosporium					am		20		EC_{54}	growth	4.75	b	(Anderson and McCarty, 1996)
Macrophyta													
Populus deltoides x nigra	cuttings	Y	Sc	>99%	Hoagland's nutrient solution half-strength			14 d	EC_{50}	reduction transpiration rate	349		(Dietz and Schnoor, 2001)

Notes:
a: inoculum of 0.01 µg/l methane
b: inoculum of 460 µg/l methane

Table A4.24: Terrestrial toxicity data for trans-1,2-dichloroethylene: exposure via air.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test Air [mg/l air]	Notes	Reference
Macrophyta												
Nicotiana tabacum	0.5 mg pollen. germination in petri-disk					22	2 h	ED_{50}	germination	78	a	(Schubert et al., 1995)
Nicotiana tabacum	0.5 mg pollen. germination in petri-disk					22	2 h	ED_{10}	germination	11	a	(Schubert et al., 1995)

Notes:
a: Determined from presented data with log-logistic model

Table A4.25: Terrestrial toxicity data for cis-1,2-dichloroethylene: exposure via soil.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg_{dw}]	Result stand. soil [mg/kg_{dw}]	Notes	Reference
Bacteria													
Mix of microbial organism, respiration		Sandy loam			7%	25	10 h	IC_{50}	Oxygen uptake	450	6429	a	(Regno et al., 1998)

Note:
a: determination of EC_{50} unclear

Table A4.26: Terrestrial toxicity data for cis-1,2-dichloroethylene: exposure via medium.

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result Medium [mg/l]	Notes	Reference
Macrophyta													
Populus deltoides x nigra	cuttings	Y	Sc	>99%	Hoagland’s nutrient solution half-strength			14 d	EC_{50}	reduction transpiration rate	494		(Dietz and Schnoor, 2001)

Table A4.27: Terrestrial acute toxicity data for trichloroethylene: exposure via soil.

Species	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [°C]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg$_{dw}$]	Result stand. soil [mg/kg$_{dw}$]	Notes	Reference
Bacteria													
Mix of microbial organism, respiration		Sandy loam			7%	25	10 h	IC_{50}	Oxygen uptake	560	8000	a	(Regno et al., 1998)
Lumbricidae													
Eisenia fetida						21 ± 2	28 d	LC_{50}	mortality	≥1000			(Viswanathan and Korte, 1984)
Eisenia fetida								LC_{50}	mortality	≥1000			(Scheubel, 1984)
Eisenia fetida								LC_{50}		≥1000			(Korte and Freitag, 1984)
Eisenia fetida		filter paper				20	2 d	LC_{50}		0.105 mg/cm2 filter paper			(Neuhauser et al., 1985)

Note:
a: determination of EC_{50} unclear

Table A4.28: Terrestrial chronic toxicity data for trichloroethylene: exposure via soil.

Species	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [°C]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg$_{dw}$]	Result stand. soil [mg/kg$_{dw}$]	Notes	Reference
Lumbricidae													
Eisenia fetida							28 d	NOEC	weight, mortality, cocoon production	≥1000			(Scheubel, 1984)
Macrophyta													
Avena sativa								NOEC	growth	≥1000			(Korte and Freitag, 1984)
Avena sativa								NOEC	growth	≥1000			(Scheubel, 1984)
Brassica rapa								NOEC	growth	≥1000			(Scheubel, 1984)
Brassica rapa								NOEC	growth	≥1000			(Korte and Freitag, 1984)

Table A4.29: Terrestrial acute toxicity data for trichloroethylene: exposure via medium.

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result Medium [mg/l]	Notes	Reference
Annelida													
Aeolosoma hemprichi		N			LE medium		20	N	EC_{50}	growth rate	47	a	(Inamori et al., 1989)
Enchytraeus buchholzi									LC_{50}	mortality	125	b	(Inamori et al., 1989)
Bacteria													
Rhizobium meliloti		N	S		CDM with supplements	7.5	30	20 min	IC_{50}	inhibition of dye reduction	411		(Botsford et al., 1997)
Macrophyta													
Populus deltoides x nigra	cuttings	Y	Sc	>99%	Hoagland's nutrient solution half-strength			14 d	EC_{50}	reduction transpiration rate	131		(Dietz and Schnoor, 2001)
Protozoa													
Colpoda sp.		N			LE medium		20	N	EC_{50}	growth rate	75	a	(Inamori et al., 1989)
Rotifera													
Philodina erythrophthalma		N			LE medium		20	N	EC_{50}	growth rate	92	a	(Inamori et al., 1989)

Notes:
a: medium was a lettuce-egg yolk extract medium with suspended activated sludge bacteria; test performed in the dark; the number of organisms were determined daily for the *Colpoda* species and every four days for the two other species.
b: no details of the test, LC_{50} value presented in table

Table A4.30: Terrestrial chronic toxicity data for trichloroethylene: exposure via medium

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result Medium [mg/l]	Notes	Reference
Macrophyta													
Populus deltoides x nigra	cuttings	Y	Sc	>99%	Hoagland's nutrient solution half-strength			14 d	NOEC	increase in mass of plants	118	a	(Dietz and Schnoor, 2001)

Notes:
a: Reported as NOEC in the EU-RAR; In the original the publication (Dietz and Schnoor, 2001) this value is reported as zero growth. With regard to the endpoint growth this can be interpreted as an EC_{100} instead of a NOEC. In the publication loss of weight is observed at higher concentrations. This is due to the loss of leaves and desiccation of the stems.

Table A4.31: Terrestrial acute toxicity data for tetrachloroethylene; exposure via soil

Species	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [°C]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg$_{dw}$]	Result stand. soil [mg/kg$_{dw}$]	Notes	Reference
Bacteria													
Mix of microbial organism, respiration		sandy loam			7%	25	10 h	IC_{50}	oxygen uptake	340	4857	a	(Regno et al., 1998)
Annelida													
Eisenia fetida		artificial	6	10	20		14 d	mortality	LC50	179	179	b	(Vonk et al., 1986)
Eisenia fetida	2 months old, 246-585 mg	artificial	6	10	20	20	14 d	mortality	LC50	945	945		(Römbke et al., 1991)
Insecta													
Folsomia candida		LUFA Speyer		0.7			1 d	mortality	LC50	113	1614		(Heimann and Härle, 1993)
Macrophyta													
Avena sativa	germinated plants	standard		2.29			16 d	growth	EC50	580	2533		(Bauer and Dietze, 1992)

Notes:
a: determination of EC_{50} unclear
b: value is geometric mean of 100-320

Table A4.32: Terrestrial acute toxicity data for tetrachloroethylene; exposure via medium.

Species/process/activity	Species properties	A	Test type	Purity	Medium	pH	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result Medium [mg/l]	Notes	Reference
Annelida													
Aeolosoma hemprichi		N			LE medium		20	N	EC_{50}	growth rate	13	a	(Inamori et al., 1989)
Enchytraeus buchholzi									LC_{50}	mortality	81	b	(Inamori et al., 1989)
Bacteria													
Rhizobium meliloti		N	S		CDM with supplements	7.5	30	20 min	IC_{50}	inhibition of dye reduction	411		(Botsford et al., 1997)
Macrophyta													
Populus deltoides x nigra	cuttings	Y	Sc	>99%	Hoagland's nutrient solution half-strength			14 d	EC_{50}	reduction transpiration rate	38		(Dietz and Schnoor, 2001)
Protozoa													
Colpoda sp.		N			LE medium		20	N	EC_{50}	growth rate	64	a	(Inamori et al., 1989)
Rotifera													
Philodina erythrophthalma		N			LE medium		20	N	EC_{50}	growth rate	33	a	(Inamori et al., 1989)

Notes:
a: medium was a lettuce-egg yolk extract medium with suspended activated sludge bacteria; test performed in the dark; the number of organisms were determined daily for the *Colpoda* species and every four days for the two other species.
b: no details of the test, LC_{50} value presented in table

Table A4.33: Terrestrial chronic toxicity data for tetrachloroethylene; exposure via soil.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg_{dw}]	Result stand. soil [mg/kg_{dw}]	Notes	Reference
Annelida													
Eisenia fetida		artificial	6	10	20		28 d	NOEC	cocoon production	≤ 18		b	(Vonk et al., 1986)
Eisenia fetida		artificial	6	10	20		28 d	NOEC	appearance of worms	18-32			(Vonk et al., 1986)
Eisenia fetida	2 months old, 246-585 mg	artificial	6	10	20	20	14 d	NOEC	mortality	577	577		(Römbke et al., 1991)
Bacteria													
Pseudomonas putida							16 h			≥ 45			(Knie et al., 1983)
other bacteria							28 d	NOEC	soil respiration	< 2000		a, b	(Vonk et al., 1986)
other bacteria		humic sand					28 d	NOEC	nitrification with humic sand	< 40		a, b	(Vonk et al., 1986)
other bacteria		loam					28 d	NOEC	nitrification with loam	≤ 0.1		a, b	(Vonk et al., 1986)
Insecta													
Poecilus cupreus							14 d	NOEC	mortality	5			(Römbke et al., 1991)
Macrophyta													
Avena sativa	germinated plants	standard		2.29			16 d	NOEC	growth	100	437		(Bauer and Dietze, 1992)
Avena sativa	germinated plants	standard		2.29			16 d	NOEC	sublethal effects	1	4.37		(Bauer and Dietze, 1992)

Table A4.34: Terrestrial chronic toxicity data for tetrachloroethylene; exposure via air.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test Air [mg/l air]	Notes	Reference
Macrophyta												
Brassica oleracea								NOEC	stem dry weight	0.000758	a	(Plant Research International, 2000)
Fagus sylvatia								NOEC	foliar injury	0.000750	a	(Plant Research International, 2000)
Molinia caerulea								NOEC	senescence	0.000109	a	(Plant Research International, 2000)
Phaseolus vulgaris								NOEC	pod dry weight	0.000046	a	(Plant Research International, 2000)
Picea abies								NOEC	foliar injury	0.000109	a	(Plant Research International, 2000)
Pinus silverstris								NOEC	foliar injury	0.000109	a	(Plant Research International, 2000)
Pleurozium schreberi								NOEC	post-exposure-growth	0.000984	a	(Plant Research International, 2000)
Polytrichum formosum								NOEC	post-exposure-growth	0.002101	a	(Plant Research International, 2000)
Rhytidiadelphus squarrosus								NOEC	post-exposure-growth	0.002101	a	(Plant Research International, 2000)

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test Air [mg/l air]	Notes	Reference
Trifolium repens								EC_{10}	shoot dry weight	0.000543	a	(Plant Research International, 2000)
Triticum aestivum								NOEC	ear dry weight	0.000747	a	(Plant Research International, 2000)
Vaccinium myrtillus								NOEC	senescence	0.000109	a	(Plant Research International, 2000)

Note:
a: NOEC values are revised by authors of EU-RAR.

Table A4.35: Terrestrial toxicity data for 1,3-dichloropropene, exposure via soil.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg_{dw}]	Result stand. soil [mg/kg_{dw}]	Notes	Reference
Bacteria													
Soil bacteria		sandy loam	6.1	1.71		5	2-42 d	NOEC	population growth	≥150	>877	a	(Tu, 1973)
Soil bacteria		sandy loam	6.1	1.71		28	2-42 d	NOEC	population growth	≥150	>877	a	(Tu, 1973)
Soil fungi		sandy loam	6.1	1.71		5	14 d	NOEC	population growth	25	146	a	(Tu, 1973)
Soil fungi		sandy loam	6.1	1.71		5	14 d	EC_{27}	population growth	150	877	a,b	(Tu, 1973)
Soil fungi		sandy loam	6.1	1.71		5 and 28	2-42 d	NOEC	population growth	≥150	>877	a	(Tu, 1973)
Soil micro-organisms		sandy loam	6.1	1.71		5 and 28	1,2,4 weeks	NOEC	ammonification	≥150	>877	a,c	(Tu, 1973)
Soil micro-organisms		sandy loam	6.1	1.71		5	1 week	EC_{181}	ammonification	25	146	a,d,e	(Tu, 1973)
Soil micro-organisms		sandy loam	6.1	1.71		5	1 week	EC_{201}	ammonification	150	877	a,d,e	(Tu, 1973)
Soil micro-organisms		sandy loam	6.1	1.71		28	1,2,4 weeks	NOEC	ammonification	≥150	>877	a,d,e	(Tu, 1973)
Soil micro-organisms		sandy loam	6.1	1.71		5	2 week	EC120	nitrification	25	146	a,e	(Tu, 1973)
Soil micro-organisms		sandy loam	6.1	1.71		28	2,4,6 weeks	NOEC	nitrification	≥ 150	>877	a	(Tu, 1973)
Soil micro-organisms		sandy loam	6.1	1.71		5	2,4,6 weeks	NOEC	nitrification	≥ 150	>877	a,f	(Tu, 1973)
Soil micro-organisms		sandy loam	6.1	1.71		28	4 weeks	EC_{24}	nitrification	25	146	a,f	(Tu, 1973)
Soil micro-organisms		sandy loam	6.1	1.71		28	4 weeks	EC_{17}	nitrification	150	877	a,f	(Tu, 1973)
Soil micro-organisms		sandy loam	6.1	1.71		28	4 weeks	EC_{41}	sulfur oxidation	25	146	a	(Tu, 1973)
Soil micro-organisms		sandy loam	7.8	2.9		28	2-6 days	NOEC	N2(C2H2) fixation	≥60	>207	a	(Tu, 1978)
Non symbiotic nitrogen fixers		sandy loam	7.8	2.9		28	2-6 days	NOEC	population growth	≥60	>207	a	(Tu, 1978)
Soil bacteria		sandy loam	7.8	2.9		28	2-6 days	NOEC	population growth	≥60	>207	a	(Tu, 1978)
Soil fungi		sandy loam	7.8	2.9		28	2 d	NOEC	population growth	30	103	a	(Tu, 1978)
Soil fungi		sandy loam	7.8	2.9		28	2 d	EC_{50}	population growth	60	207	a	(Tu, 1978)
Soil bacteria and actinomycetes		clay loam	7.2	1.75		28	2 d	EC_{53}	population growth	60	343		(Tu, 1981)
Soil bacteria and		clay loam	7.2	1.75		28	2 d	NOEC	population growth	30	171		(Tu, 1981)

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg$_{dw}$]	Result stand. soil [mg/kg$_{dw}$]	Notes	Reference
actinomycetes													
Soil bacteria and actinomycetes		clay loam	7.2	1.75		28	7d	NOEC	population growth	>60	>207		(Tu, 1981)
Soil bacteria and actinomycetes		clay loam	7.2	1.75		28	2 d, 7 d	NOEC	population growth	>60	>207		(Tu, 1981)
Soil fungi		clay loam	7.2	1.75		28	2 d	EC_{71}	population growth	30	171		(Tu, 1981)
Soil fungi		clay loam	7.2	1.75		28	2 d	EC_{47}	population growth	60	343		(Tu, 1981)
Soil fungi		clay loam	7.2	1.75		28	7 d	NOEC	population growth	>60	>207		(Tu, 1981)
Non symbiotic nitrogen fixers		clay loam	7.2	1.75		28	2 d	NOEC	nitrogen fixation	>60	>207		(Tu, 1981)
Non symbiotic nitrogen fixers		clay loam	7.2	1.75		28	7d	EC_{200}	nitrogen fixation	30	171		(Tu, 1981)
Urease		clay loam	7.2	1.75		28	2, 7 d	NOEC	urease	>60	>207		(Tu, 1981)
Urease		clay loam	7.2	1.75		28	2d	EC_{158}	urease	30	>207		(Tu, 1981)
Urease		clay loam	7.2	1.75		28	7d	EC_{150}	urease	30	171		(Tu, 1981)

Notes:
a: soil moisture at 60% of moisture holding capacity
b: effect only at 5% after 14 days, recovery after 28 d
c: no extra N source
d: 1 mg peptone N/g added
e: stimulating effect of compound
f: 200 µg $(NH_4)2SO_4$-N/g added

Table A4.36: Terrestrial toxicity data for trans-1,3-dichloropropene via soil

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg$_{dw}$]	Result stand. soil [mg/kg$_{dw}$]	Notes	Reference
Nematoda													
Tylenchulus semipenetrans		loam	7.7	0.91	11.2	20-25	7	LC_{95-100}	mortality	275	93		(Moje et al., 1957)
Fungi													
Soil fungi		loam	7.7	0.91	11.2	20-25	7	LC_{95-100}	mortality	2747	934		(Moje et al., 1957)
Fungi													
Bacteria + actinomycetes		loam	7.7	0.91	11.2	20-25	7	LC_{85}	mortality	10989	3736		(Moje et al., 1957)

Table A4.37: Terrestrial toxicity data for cis-1,3-dichloropropene via soil.

Species/process/activity	Species properties	Soil type	pH	o.m. [%]	Clay [%]	Temperature [ºC]	Exp. time	Criterion	Test endpoint	Result test soil [mg/kg$_{dw}$]	Result stand. soil [mg/kg$_{dw}$]	Notes	Reference
Nematoda													
Tylenchulus semipenetrans		loam	7.7	0.91	11.2	20-25	7	LC_{95-100}	mortality	2.5	27		(Moje et al., 1957)
Fungi													(Moje et al., 1957)
Soil fungi		loam	7.7	0.91	11.2	20-25	7	LC_{85-95}	mortality	25	275		(Moje et al., 1957)
Fungi													(Moje et al., 1957)
Bacteria + actinomycetes		loam	7.7	0.91	11.2	20-25	7	LC_{95-100}	mortality	250	2747		(Moje et al., 1957)
Bacteria + actinomycetes		loam	7.7	0.91	11.2	20-25	7	LC_{85-95}	mortality	25	275		(Moje et al., 1957)

Appendix 5. Monitoring data

Table A5.1: Surface water monitoring data for 1,1-dichloroethane at several locations in the Netherlands (data from Waterbase (V&W, 2005)).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Belfeld boven	2001	0.01	0.01	0.008	0.008	< 0.01
	2002	0.01	0.01	0.009	0.01	< 0.01
	2003	0.01	0.01	0.008	0.01	< 0.01
	2004	0.01	0.01	0.007	0.005	< 0.01
Brienenoord (kilometer 996.5)	2004	< 0.01	-	-	-	< 0.01
Eijsden ponton	2001	0.01	0.01	0.008	0.01	< 0.01
	2002	0.02	0.02	0.012	0.01	0.01
	2003	0.01	0.01	0.01	0.01	0.01
	2004	0.02	0.01	0.01	0.01	< 0.01
Haringvlietsluis	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
IJmuiden (kilometer 2)	2004	< 0.01	-	-	-	< 0.01
Keizersveer	2004	< 0.01	-	-	-	< 0.01
Ketelmeer west	2004	< 0.01	-	-	-	< 0.01
Lobith ponton	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Maassluis	2001	0.21	0.005	0.021	0.005	< 0.01
	2002	0.01	0.009	0.006	0.005	< 0.01
	2003	0.01	0.01	0.006	0.005	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Nieuwegein	2004	< 0.01	-	-	-	< 0.01
Puttershoek	2004	< 0.01	-	-	-	< 0.01
Schaar van Ouden Doel	2001	0.01	0.01	0.007	0.005	< 0.01
	2002	0.01	0.01	0.008	0.01	< 0.01
	2003	0.01	0.01	0.007	0.005	< 0.01
	2004	0.01	0.005	0.005	0.005	< 0.01
Vrouwezand	2004	< 0.01	-	-	-	< 0.01

Table A5.2: Surface water monitoring data for 1,2-dichloroethane at several locations in the Netherlands (data from Waterbase (V&W, 2005)).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Belfeld boven	1999	0.22	0.12	0.08	0.09	0.01
	2000	0.32	0.2	0.13	0.105	< 0.05
	2001	1.2	0.53	0.29	0.205	< 0.05
	2002	0.45	0.36	0.15	0.11	< 0.05
	2003	0.42	0.23	0.10	0.07	< 0.05
	2004	0.29	0.2	0.13	0.025	< 0.05
Brienenoord (kilometer 996.5)	2004	< 0.05		-		< 0.05
Eijsden ponton	1999	0.58	0.41	0.26	0.27	0.03
	2000	0.44	0.40	0.26	0.28	0.09
	2001	0.78	0.57	0.38	0.36	0.18
	2002	1.1	0.61	0.41	0.36	0.2
	2003	0.46	0.41	0.26	0.23	0.12
	2004	3.7	1.3	0.69	0.36	0.07
Haringvlietsluis	1999	0.03	0.018	0.010	0.005	0.005
	2000	0.03	0.025	0.014	0.010	0.005
	2001	0.07	0.045	0.030	0.025	< 0.05
	2002	< 0.05	-	-	-	< 0.05
	2003	< 0.05	-	-	-	< 0.05
	2004	< 0.05	-	-	-	< 0.05
IJmuiden (kilometer 2)	2004	< 0.05	-	-	-	< 0.05
Keizersveer	2004	0.09	0.076	0.039	0.025	< 0.05
Ketelmeer west	2004	< 0.05	-	-	-	< 0.05
Lobith ponton	1999	0.06	0.038	0.022	0.020	0.005
	2000	0.04	0.025	0.021	0.020	0.005
	2001	0.15	0.082	0.043	0.025	< 0.05
	2002	0.14	0.045	0.036	0.025	< 0.05
	2003	< 0.1	-	-	-	< 0.05
	2004	0.06	0.043	0.029	0.025	< 0.05
Maassluis	1999	0.98	0.23	0.21	0.17	0.04
	2000	0.9	0.59	0.28	0.15	0.04
	2001	0.7	0.47	0.21	0.18	< 0.05
	2002	1.3	0.45	0.27	0.14	< 0.05
	2003	1	0.63	0.34	0.26	< 0.05
	2004	0.38	0.20	0.13	0.08	< 0.05
Nieuwegein	2004	< 0.05	-	-	-	< 0.05
Puttershoek	2004	0.07	0.05	0.03	0.03	< 0.05
Schaar van Ouden Doel	1999	0.14	0.078	0.046	0.040	0.01
	2000	0.66	0.050	0.093	0.045	< 0.05
	2001	0.15	0.13	0.059	0.050	< 0.05
	2002	0.11	0.076	0.050	0.050	< 0.05
	2003	0.08	0.066	0.040	0.025	< 0.05
	2004	0.1	0.068	0.039	0.025	< 0.05
Vrouwezand	2004	< 0.05	-	-	-	< 0.05

Table A5.3: Surface water monitoring data for 1,1,1-trichloroethane at several locations in the Netherlands (data from Waterbase (V&W, 2005)).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Belfeld boven	1999	0.03	0.012	0.011	0.01	0.005
	2000	0.02	0.01	0.009	0.01	0.005
	2001	0.02	0.02	0.012	0.01	0.005
	2002	0.02	0.02	0.013	0.01	0.005
	2003	0.01	0.01	0.008	0.01	0.005
	2004	0.01	0.01	0.007	0.005	0.005
Brienenoord (kilometer 996.5)	2004	< 0.01	-	-	-	0.005
Eijsden ponton	1999	0.11	0.065	0.029	0.02	0.01
	2000	< 0.1	-	-	-	< 0.01
	2001	0.04	0.03	0.021	0.02	< 0.01
	2002	0.07	0.038	0.025	0.02	0.01
	2003	0.03	0.02	0.018	0.02	0.01
	2004	0.14	0.01	0.020	0.01	0.01
Haringvlietsluis	1999	< 0.01	-	-	-	< 0.01
	2000	0.14	0.005	0.014	0.005	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	0.01	0.009	0.006	0.005	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
IJmuiden (kilometer 2)	2004	< 0.01	-	-	-	< 0.01
Keizersveer	2004	0.01	0.009	0.006	0.005	< 0.01
Ketelmeer west	2004	< 0.01	-	-	-	< 0.01
Lobith ponton	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	0.01	0.005	0.005	0.005	< 0.01
	2002	0.01	0.005	0.005	0.005	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Maassluis	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	0.48	0.005	0.042	0.005	< 0.01
	2002	0.01	0.005	0.005	0.005	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Nieuwegein	2002	< 0.1	-	-	-	< 0.05
	2004	< 0.01	-	-	-	< 0.01
Puttershoek	2004	< 0.01	-	-	-	< 0.01
Schaar van Ouden Doel	1999	0.04	0.028	0.013	0.01	< 0.01
	2000	0.04	0.036	0.016	0.01	< 0.01
	2001	0.03	0.02	0.017	0.02	< 0.01
	2002	0.02	0.02	0.012	0.01	< 0.01
	2003	0.02	0.01	0.008	0.005	< 0.01
	2004	0.01	0.005	0.005	0.005	< 0.01
Vrouwezand	2004	< 0.01	-	-	-	< 0.01

Table A5.4: Surface water monitoring data for 1,1,2-trichloroethane at several locations in the Netherlands (data from Waterbase(V&W, 2005)).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Belfeld boven	2000	0.02	0.02	0.02	0.02	0.02
	2001	0.02	0.02	0.01	0.01	< 0.01
	2002	0.02	0.02	0.01	0.01	< 0.01
	2003	0.02	0.01	0.01	0.01	< 0.01
	2004	0.02	0.015	0.01	0.005	< 0.01
Brienenoord (kilometer 996.5)	2004	< 0.01	-	-	-	< 0.01
Eijsden ponton	2000	0.01	0.01	0.01	0.01	0.01
	2001	0.03	0.026	0.01	0.01	< 0.01
	2002	0.04	0.02	0.02	0.02	0.01
	2003	0.02	0.02	0.02	0.02	0.01
	2004	0.07	0.05	0.03	0.02	< 0.01
Haringvlietsluis	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
IJmuiden (kilometer 2)	2004	< 0.01	-	-	-	< 0.01
Keizersveer	2004	0.01	0.015	0.01	0.005	< 0.01
Ketelmeer west	2004	0.03	0.02	0.01	0.01	< 0.01
Lobith ponton	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	0.02	0.009	0.01	0.005	< 0.01
	2003	0.01	0.005	0.01	0.005	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Maassluis	2001	0.02	0.005	0.01	0.005	< 0.01
	2002	0.01	0.009	0.01	0.005	< 0.01
	2003	0.02	0.01	0.01	0.005	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Nieuwegein	2004	< 0.01	-	-	-	< 0.01
Puttershoek	2004	< 0.01	-	-	-	< 0.01
Schaar van Ouden Doel	2001	0.04	0.04	0.03	0.03	0.01
	2002	0.06	0.04	0.03	0.03	0.02
	2003	0.04	0.04	0.03	0.03	0.02
	2004	0.04	0.03	0.03	0.03	0.02
Vrouwezand	2004	< 0.01	-	-	-	< 0.01

Table A5.5: Surface water monitoring data for 1,1,2,2-tetrachloroethane at two locations in the Netherlands (data from factsheet presented at www.kaderrichtlijnwater.nl).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Schaar van Ouden Doel	2002	< 0.01	-	-	-	< 0.01
Hansweert en Vlissingen	2002	< 0.01	-	-	-	< 0.01

Table A5.6: Surface water monitoring data for hexachloroethane at several locations in the Netherlands (data from Waterbase(V&W, 2005)).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Belfeld boven	1999	0.004	0.0025	0.0015	0.0015	< 0.001
	2001	0.005	0.0029	0.0014	0.00075	< 0.001
	2002	0.007	0.0044	0.0017	0.001	< 0.001
	2003	0.010	0.005	0.0054	0.005	< 0.01
	2004	0.005	0.005	0.0050	0.005	< 0.01
Brienenoord (kilometer 996.5)	1999	< 0.005	-	-	-	< 0.001
	2000	0.001	0.0005	0.0005	0.0005	< 0.001
	2001	0.001	0.0005	0.0005	0.0005	< 0.001
	2002	0.001	0.0005	0.0005	0.0005	< 0.001
	2003	0.001	0.0005	0.0005	0.0005	< 0.001
	2004	0.005	0.005	0.0050	0.005	< 0.01
Eijsden ponton	1999	0.002	0.001	0.0008	0.0005	< 0.001
	2000	0.002	0.00095	0.0007	0.0005	< 0.001
	2001	0.005	0.005	0.0029	0.0035	< 0.001
	2002	0.005	0.0029	0.0013	0.0005	< 0.001
	2003	0.005	0.005	0.0050	0.005	< 0.01
	2004	0.005	0.005	0.0050	0.005	< 0.01
Gouda voorhaven	1999	< 0.005	-	-	-	< 0.001
	2000	0.001	0.0005	0.0005	0.0005	< 0.001
	2001	< 0.009	-	-	-	< 0.001
	2002	< 0.003	-	-	-	< 0.001
	2003	0.001	0.0005	0.0005	0.0005	< 0.001
	2004	0.001	0.0005	0.0005	0.0005	< 0.001
Haringvlietsluis	1999	0.001	0.0005	0.0005	0.0005	< 0.001
	2000	0.001	0.0005	0.0005	0.0005	< 0.001
	2001	0.001	0.0005	0.0005	0.0005	< 0.001
	2002	0.004	0.0014	0.0008	0.0005	< 0.001
	2003	0.005	0.005	0.0050	0.005	< 0.01
	2004	0.005	0.005	0.0050	0.005	< 0.01
IJmuiden (kilometer 2)	1999	0.006	0.0023	0.0011	0.0005	< 0.001
	2000	0.001	0.0005	0.0005	0.0005	< 0.001
	2001	0.001	0.001	0.0006	0.0005	< 0.001
	2002	0.001	0.0009	0.0006	0.0005	< 0.001
	2003	0.001	0.0005	0.0005	0.0005	< 0.001
	2004	< 0.01	-	-	-	< 0.01
Keizersveer	2004	< 0.01	-	-	-	< 0.01
Ketelmeer west	2004	< 0.01	-	-	-	< 0.01
Lobith ponton	1999	< 0.004	-	-	-	< 0.001
	2000	0.001	0.0005	0.0005	0.0005	< 0.001
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.003	-	-	-	< 0.001
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Maassluis	1999	< 0.005	-	-	-	< 0.001
	2000	0.001	0.0005	0.0005	0.0005	< 0.001
	2001	0.001	0.0005	0.0005	0.0005	< 0.001
	2002	0.001	0.0005	0.0005	0.0005	< 0.001
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Nieuwegein	2004	< 0.01	-	-	-	< 0.01
Puttershoek	1999	0.003	0.0021	0.0008	0.0005	< 0.001

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
	2000	0.001	0.0005	0.0005	0.0005	< 0.001
	2001	0.001	0.0005	0.0005	0.0005	< 0.001
	2002	< 0.008	-	-	-	< 0.001
	2003	0.001	0.0005	0.0005	0.0005	< 0.001
	2004	< 0.01	-	-	-	< 0.01
Schaar van Ouden Doel	1999	< 0.005	-	-	-	< 0.001
	2000	0.001	0.0005	0.0005	0.0005	< 0.001
	2001	0.001	0.0005	0.0005	0.0005	< 0.001
	2002	< 0.003	-	-	-	< 0.001
	2003	< 0.01	0.005	-	0.005	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Vrouwezand	1999	< 0.005	-	-	-	< 0.001
	2000	< 0.012	-	-	-	< 0.001
	2001	0.001	0.0005	0.0005	0.0005	< 0.001
	2002	< 0.005	-	-	-	< 0.001
	2003	0.001	0.0005	0.0005	0.0005	< 0.001
	2004	< 0.01	-	-	-	< 0.01

Table A5.7: Floating dust monitoring data for hexachloroethane at several locations in the Netherlands (data from Waterbase(V&W, 2005)).

Location	Date	Max [µg/kg]	90th P [µg/kg]	Avg [µg/kg]	Med [µg/kg]	Min [µg/kg]
Amsterdam (kilometer 25, IJtunnel)	2001	4.9	2.26	1.1	0.5	< 1
	2002	< 10	-	-	-	< 10
Belfeld boven	1999	2	1.9	0.83	1.5	< 1
	2000	< 2	-	-	-	< 1
	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Bovensluis	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Brienenoord (kilometer 996.5)	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Eemmeerdijk, kilometer 23	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Eijsden ponton	2000	1	0.95	0.75	0.75	< 1
	2001	1.7	0.5	0.54	0.5	< 1
	2002	< 10	-	-	-	< 10
	2003	< 10	-	-	-	< 10
	2004	< 10	-	-	-	< 10
Genemuiden	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Gouda voorhaven	2001	2.8	0.5	0.68	0.5	< 1
	2002	< 10	-	-	-	< 10
Haringvlietsluis	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
IJmuiden (kilometer 2)	2001	8	5.86	1.59	0.5	< 1
	2002	< 10	-	-	-	< 10
Kampen	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Keizersveer	1999	1	0.5	0.54	0.5	< 1
	2000	< 2	-	-	-	< 1

Location	Date	Max [µg/kg]	90th P [µg/kg]	Avg [µg/kg]	Med [µg/kg]	Min [µg/kg]
	2001	5.7	0.9	0.94	0.50	< 1
	2002	< 10	-	-	-	< 10
Ketelmeer west	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Lobith ponton	2000	2	1.85	1.3	1.25	< 1
	2001	1.4	0.5	0.56	0.5	< 1
	2002	< 10	-	-	-	< 10
	2003	< 10	-	-	-	< 10
	2004	< 10	-	-	-	< 10
Maassluis	2000	< 1	-	-	-	< 1
	2001	1.3	0.5	0.53	0.5	< 1
	2002	< 10	-	-	-	< 10
	2003	< 10	-	-	-	< 10
	2004	< 10	-	-	-	< 10
Markermeer midden (zwaartepunt Markermeer)	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Nederweert	1999	< 1	-	-	-	< 1
	2000	< 3	-	-	-	< 1
	2001	4	2.25	1.1	0.5	< 1
	2002	10	10	6.4	5	< 10
Nieuwegein	1999	1	0.7	0.57	0.5	< 1
	2000	< 3	-	-	-	< 1
	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Puttershoek	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Sas van Gent	2001	1.2	0.85	0.62	0.5	< 1
	2002	< 10	-	-	-	< 10
Schaar van Ouden Doel	2000	< 1	-	-	-	< 1
	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
	2003	< 10	-	-	-	< 10
	2004	< 10	-	-	-	< 10
Steenbergen (Roosendaalsevliet)	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Stevensweert	1999	< 1	-	-	-	< 1
	2000	< 2	-	-	-	< 1
	2001	2	1.6	0.87	0.5	< 1
	2002	< 10	-	-	-	< 10
Veluwemeer midden (zwaartepunt Veluwemeer)	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Vrouwezand	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Wiene	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10
Wolderwijd midden (zwaartepunt Wolderwijd)	2001	< 1	-	-	-	< 1
	2002	< 10	-	-	-	< 10

Table A5.8: Surface water monitoring data for chloroethylene at one location in the Netherlands (data from factsheet presented at www.kaderrichtlijnwater.nl).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Hansweert en Vlissingen	2002	<1	-	-	-	<1

Table A5.9: Surface water monitoring data for 1,1-dichloroethylene at several locations in the Netherlands (data from Waterbase(V&W, 2005)).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Belfeld boven	2001	< 0.01	-	-	-	< 0.01
	2002	0.02	0.005	0.0062	0.005	< 0.01
	2003	0.01	0.005	0.0054	0.005	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Brienenoord (kilometer 996.5)	2004	< 0.01		-		< 0.01
Eijsden ponton	2001	< 0.01	-	-	-	< 0.01
	2002	0.02	0.005	0.0065	0.005	< 0.01
	2003	0.01	0.005	0.0069	0.005	< 0.01
	2004	0.02	0.005	0.0069	0.005	< 0.01
Haringvlietsluis	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
IJmuiden (kilometer 2)	2004	< 0.01	-	-	-	< 0.01
Keizersveer	2004	< 0.01	-	-	-	< 0.01
Ketelmeer west	2004	< 0.01	-	-	-	< 0.01
Lobith ponton	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Maassluis	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Nieuwegein	2004	< 0.01	-	-	-	< 0.01
Puttershoek	2004	< 0.01	-	-	-	< 0.01
Schaar van Ouden Doel	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Vrouwezand	2004	< 0.01	-	-	-	< 0.01

Table A5.10: Surface water monitoring data for trans-1,2-dichloroethylene at several locations in the Netherlands (data from factsheet presented at www.kaderrichtlijnwater.nl).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Belfeld boven	2001	0.02	0.01	0.0075	0.005	< 0.01
	2002	0.03	0.02	0.012	0.01	< 0.01
	2003	0.01	0.01	0.010	0.01	< 0.01
	2004	0.01	0.005	0.005	0.005	< 0.01
Brienenoord (kilometer 996.5)	2004	< 0.01	-	-	-	< 0.01
Eijsden ponton	2001	0.01	0.005	0.0054	0.005	< 0.01
	2002	0.01	0.01	0.0062	0.005	< 0.01
	2003	0.01	0.005	0.0054	0.005	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Haringvlietsluis	2001	< 0.01	-	-	-	< 0.01
	2002	0.01	0.005	0.0054	0.005	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
IJmuiden (kilometer 2)	2004	< 0.01	-	-	-	< 0.01
Keizersveer	2004	< 0.01	-	-	-	< 0.01
Ketelmeer west	2004	< 0.01	-	-	-	< 0.01
Lobith ponton	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Maassluis	2001	0.28	0.005	0.026	0.005	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Nieuwegein	2002	< 0.1	-	-	-	< 0.5
	2004	< 0.01	-	-	-	< 0.01
Puttershoek	2004	< 0.01	-	-	-	< 0.01
Schaar van Ouden Doel	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Vrouwezand	2004	< 0.01	-	-	-	< 0.01

Table A5.11: Surface water monitoring data for cis-1,2-dichloroethylene at several locations in the Netherlands (data from Waterbase(V&W, 2005)).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Belfeld boven	2001	0.68	0.43	0.19	0.14	< 0.01
	2002	0.46	0.43	0.23	0.17	0.01
	2003	0.41	0.38	0.28	0.3	0.13
	2004	0.33	0.25	0.14	0.11	0.04
Brienenoord (kilometer 996.5)	2004	0.01	0.01	0.008	0.01	< 0.01
Eijsden ponton	2001	0.16	0.13	0.066	0.07	< 0.01
	2002	0.22	0.13	0.098	0.09	0.05
	2003	0.22	0.16	0.10	0.09	0.07
	2004	0.19	0.15	0.095	0.09	0.04
Haringvlietsluis	2001	0.01	0.01	0.006	0.005	< 0.01
	2002	0.02	0.018	0.008	0.005	< 0.01
	2003	0.01	0.005	0.005	0.005	< 0.01
	2004	< 0.01	-	-	-	< 0.01
IJmuiden (kilometer 2)	2004	0.01	0.01	0.007	0.005	< 0.01
Keizersveer	2004	0.11	0.078	0.046	0.04	0.01
Ketelmeer west	2004	0.01	0.01	0.006	0.005	< 0.01
Lobith ponton	2001	0.02	0.018	0.01	0.01	< 0.01
	2002	0.03	0.03	0.017	0.01	0.01
	2003	0.03	0.02	0.018	0.02	0.01
	2004	0.02	0.02	0.011	0.01	< 0.01
Maassluis	2001	0.15	0.028	0.026	0.02	< 0.01
	2002	0.05	0.028	0.019	0.02	0.01
	2003	0.04	0.028	0.018	0.02	0.01
	2004	0.02	0.018	0.01	0.01	< 0.01
Nieuwegein	2004	0.01	0.01	0.006	0.005	< 0.01
Puttershoek	2004	0.03	0.02	0.013	0.01	< 0.01
Schaar van Ouden Doel	2001	0.05	0.044	0.027	0.02	0.01
	2002	0.06	0.048	0.031	0.03	0.01
	2003	0.08	0.058	0.027	0.02	0.01
	2004	0.04	0.028	0.016	0.01	< 0.01
Vrouwezand	2004	< 0.01	-	-	-	< 0.01

Table A5.12: Surface water monitoring data for 1,2-dichloropropane at several locations in the Netherlands (data from Waterbase(V&W, 2005)).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Belfeld boven	1999	0.01	0.01	0.0089	0.01	< 0.01
	2000	0.02	0.005	0.0063	< 0.01	< 0.01
	2001	0.03	0.02	0.012	0.01	< 0.01
	2002	0.03	0.02	0.012	0.01	< 0.01
	2003	0.02	0.02	0.012	0.01	0.01
	2004	0.02	0.01	0.0085	0.01	< 0.01
Brienenoord (kilometer 996.5)	2004	< 0.01	-	-	-	< 0.01
Eijsden ponton	1999	0.02	0.02	0.011	0.01	< 0.01
	2000	0.1	0.02	0.013	< 0.01	< 0.01
	2001	0.05	0.026	0.018	0.02	< 0.01
	2002	0.05	0.03	0.023	0.02	< 0.01
	2003	0.02	0.02	0.013	0.01	0.01
	2004	0.05	0.04	0.021	0.02	< 0.01
Haringvlietsluis	1999	< 0.01	-	-	-	< 0.01
	2000	0.05	0.005	0.008	< 0.01	< 0.01
	2001	0.01	0.009	0.0058	< 0.01	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
IJmuiden (kilometer 2)	2004	< 0.01	-	-	-	< 0.01
Keizersveer	2004	0.01	0.009	0.0058	< 0.01	< 0.01
Ketelmeer west	2004	< 0.01	-	-	-	< 0.01
Lobith ponton	1999	0.01	0.01	0.0069	< 0.01	< 0.01
	2000	0.06	0.018	0.011	< 0.01	< 0.01
	2001	0.01	0.01	0.0073	< 0.01	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	0.02	0.009	0.0065	< 0.01	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Maassluis	1999	0.12	0.066	0.022	< 0.01	< 0.01
	2000	0.04	0.03	0.011	< 0.01	< 0.01
	2001	0.08	0.018	0.014	< 0.01	< 0.01
	2002	0.01	0.01	0.0069	< 0.01	< 0.01
	2003	0.05	0.018	0.011	< 0.01	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Nieuwegein	2002	0.05	0.05	0.045	0.05	0.025
	2004	< 0.01		-	-	< 0.01
Puttershoek	2004	< 0.01	-	-	-	< 0.01
Schaar van Ouden Doel	1999	0.01	0.01	0.0062	< 0.01	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	0.04	0.034	0.012	< 0.01	< 0.01
	2004	< 0.01		-	-	< 0.01
Vrouwezand	2004	< 0.01	-	-	-	< 0.01

Table A5.13: Surface water monitoring data for 1,3-dichloropropane at several locations in the Netherlands (data from Waterbase(V&W, 2005)).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Belfeld boven	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Brienenoord (kilometer 996.5)	2004	< 0.01	-	-	-	< 0.01
Eijsden ponton	1999	< 0.01	-	-	-	< 0.01
	2000	0.01	0.005	0.0052	0.005	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Haringvlietsluis	1999	< 0.01	-	-	-	< 0.01
	2000	0.01	0.005	0.0053	0.005	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
IJmuiden (kilometer 2)	2004	< 0.01	-	-	-	< 0.01
Keizersveer	2004	< 0.01	-	-	-	< 0.01
Ketelmeer west	2004	< 0.01	-	-	-	< 0.01
Lobith ponton	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Maassluis	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	0.01	0.005	0.0054	0.005	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	0.05	-	-	-	< 0.01
Nieuwegein	2004	< 0.01	-	-	-	< 0.01
Puttershoek	2004	< 0.01	-	-	-	< 0.01
Schaar van Ouden Doel	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Vrouwezand	2004	< 0.01	-	-	-	< 0.01

Table A5.14: Surface water monitoring data for 3-chloropropene at two locations in the Netherlands (data from factsheet presented at www.kaderrichtlijnwater.nl).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Schaar van Ouden Doel	2002	< 0.01	-	-	-	< 0.01
Hansweert en Vlissingen	2002	< 0.01	-	-	-	< 0.01

Table A5.15: Surface water monitoring data for 1,3-dichloropropene at several locations in the Netherlands (data from factsheet presented at www.kaderrichtlijnwater.nl).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Eijsden ponton	2001	< 0.02	-	-	-	< 0.02
Lobith ponton	2001	< 0.02	-	-	-	< 0.02
Maassluis	2001	< 0.02	-	-	-	< 0.02
Schaar van Ouden Doel	2001	< 0.02	-	-	-	< 0.02

Table A5.16: Surface water monitoring data for cis-1,3-dichloropropene at several locations in the Netherlands (data from Waterbase(V&W, 2005)).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Belfeld boven	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Brienenoord (kilometer 996.5)	2004	< 0.01	-	-	-	< 0.01
Eijsden ponton	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Haringvlietsluis	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
IJmuiden (kilometer 2)	2004	< 0.01	-	-	-	< 0.01
Keizersveer	2004	< 0.01	-	-	-	< 0.01
Ketelmeer west	2004	< 0.01	-	-	-	< 0.01
Lobith ponton	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Maassluis	2000	< 0.01	-	-	-	< 0.01
	2001	0.02	0.009	0.0073	0.005	< 0.01
	2002	0.01	0.009	0.0058	0.005	< 0.01
	2003	0.02	0.005	0.0054	0.005	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Nieuwegein	2002	< 0.1	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Puttershoek	2004	< 0.01	-	-	-	< 0.01
Schaar van Ouden Doel	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Vrouwezand	2004	< 0.01	-	-	-	< 0.01

Table A5.17: Surface water monitoring data for trans-1,3-dichloropropene at several locations in the Netherlands (data from Waterbase(V&W, 2005)).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Belfeld boven	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Brienenoord (kilometer 996.5)	2004	< 0.01	-	-	-	< 0.01
Eijsden ponton	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Haringvlietsluis	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
IJmuiden (kilometer 2)	2004	< 0.01	-	-	-	< 0.01
Keizersveer	2004	< 0.01	-	-	-	< 0.01
Ketelmeer west	2004	< 0.01	-	-	-	< 0.01
Lobith ponton	1999	< 0.01	-	-	-	< 0.01
	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Maassluis	2000	< 0.01	-	-	-	< 0.01
	2001	0.02	0.019	0.0065	0.015	< 0.01
	2002	0.01	0.01	0.0054	0.01	< 0.01
	2003	0.02	0.02	0.0062	0.02	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Nieuwegein	2002	< 0.1	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Puttershoek	2004	< 0.01	-	-	-	< 0.01
Schaar van Ouden Doel	2000	< 0.01	-	-	-	< 0.01
	2001	< 0.01	-	-	-	< 0.01
	2002	< 0.01	-	-	-	< 0.01
	2003	< 0.01	-	-	-	< 0.01
	2004	< 0.01	-	-	-	< 0.01
Vrouwezand	2004	< 0.01	-	-	-	< 0.01

Table A5.18: Surface water monitoring data for 2-chlorobutadiene at one location in the Netherlands (data from factsheet presented at www.kaderrichtlijnwater.nl).

Location	Date	Max [µg/l]
Hansweert en Vlissingen	2002	< 0.01

Table A5.19: Surface water monitoring data for hexachlorobutadiene in the Netherlands (data from Waterbase(V&W, 2005)).

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
Belfeld boven	1999	0.002	0.001	0.0007	0.0005	< 0.001
	2001	< 0.004	-	-	-	< 0.001
	2002	0.002	0.001	0.0007	0.0005	< 0.001
	2003	0.004	0.001	0.0008	0.0005	< 0.001
	2004	< 0.001	-	-	-	< 0.001
Brienenoord (kilometer 996.5)	1999	< 0.005	-	-	-	< 0.001
	2000	< 0.002	-	-	-	< 0.001
	2001	< 0.001	-	-	-	< 0.001
	2002	0.005	0.0009	0.0009	0.0005	< 0.001
	2003	0.002	0.0005	0.0006	0.0005	< 0.001
	2004	< 0.001	-	-	-	< 0.001
Eijsden ponton	1999	0.002	0.001	0.0007	0.0005	< 0.001
	2000	< 0.003	-	-	-	< 0.001
	2001	0.002	0.001	0.0008	0.0005	< 0.001
	2002	< 0.003	-	-	-	< 0.001
	2003	< 0.002	-	-	-	< 0.001
	2004	< 0.003	-	-	-	< 0.001
Gouda voorhaven	1999	< 0.009	-	-	-	< 0.001
	2000	< 0.001	-	-	-	< 0.001
	2001	< 0.003	-	-	-	< 0.001
	2002	0.003	0.0005	0.0007	0.0005	< 0.001
	2003	< 0.001	-	-	-	< 0.001
	2004	< 0.001	-	-	-	< 0.001
Haringvlietsluis	1999	0.001	0.0005	0.0005	0.0005	< 0.001
	2000	< 0.001	-	-	-	< 0.001
	2001	< 0.002	-	-	-	< 0.001
	2002	0.007	0.0009	0.001	0.0005	< 0.001
	2003	< 0.001	-	-	-	< 0.001
	2004	< 0.001	-	-	-	< 0.001
IJmuiden (kilometer 2)	1999	< 0.005	-	-	-	< 0.001
	2000	< 0.002	-	-	-	< 0.001
	2001	< 0.001	-	-	-	< 0.001
	2002	< 0.002	-	-	-	< 0.001
	2003	< 0.001	-	-	-	< 0.001
	2004	< 0.001	-	-	-	< 0.001
Keizersveer	2004	< 0.001	-	-	-	< 0.001
Ketelmeer west	2004	< 0.001	-	-	-	< 0.001
Lobith ponton	1999	< 0.005	-	-	-	< 0.001
	2000	< 0.003	-	-	-	< 0.001
	2001	0.003	0.002	0.001	0.0005	< 0.001
	2002	0.005	0.004	0.002	0.002	< 0.001
	2003	0.003	0.002	0.002	0.002	0.001
	2004	0.003	0.002	0.001	0.001	< 0.001
Maassluis	1999	< 0.003	-	-	-	< 0.001

Location	Date	Max [µg/l]	90th P [µg/l]	Avg [µg/l]	Med [µg/l]	Min [µg/l]
	2000	0.002	0.0007	0.0006	0.0005	< 0.001
	2001	< 0.001	-	-	-	< 0.001
	2002	0.004	0.001	0.0009	0.0005	< 0.001
	2003	0.001	0.0005	0.0005	0.0005	< 0.001
	2004	< 0.001	-	-	-	< 0.001
Nieuwegein	2004	< 0.002	-	-	-	< 0.001
Puttershoek	1999	< 0.005	-	-	-	< 0.001
	2000	< 0.002	-	-	-	< 0.001
	2001	0.002	0.0005	0.0006	0.0005	< 0.001
	2002	0.004	0.003	0.001	0.0005	< 0.001
	2003	0.001	0.001	0.0006	0.0005	< 0.001
	2004	< 0.001	-	-	-	< 0.001
Schaar van Ouden Doel	1999	< 0.005	-	-	-	< 0.001
	2000	< 0.001	-	-	-	< 0.001
	2001	< 0.001	-	-	-	< 0.001
	2002	< 0.001	-	-	-	< 0.001
	2003	< 0.001	-	-	-	< 0.001
	2004	< 0.005	-	-	-	< 0.001
Vrouwezand	1999	< 0.005	-	-	-	< 0.001
	2000	< 0.006	-	-	-	< 0.001
	2001	< 0.002	-	-	-	< 0.001
	2002	< 0.001	-	-	-	< 0.001
	2003	< 0.001	-	-	-	< 0.001
	2004	< 0.001	-	-	-	< 0.001

Table A5.20: Soil/sediment monitoring data for hexachlorobutadiene in the Netherlands (data from Waterbase(V&W, 2005))

Location	Date	Max [µg/kg]	90th P [µg/kg]	Avg [µg/kg]	Med [µg/kg]	Min [µg/kg]
Amsterdam (kilometer 25, IJtunnel)	1999	< 1	-	-	-	< 1
	2000	< 1	-	-	-	< 1
	2001	1	1	1	1	1
Borgharen boven	1999	< 1	-	-	-	< 1
	2000	3	3	3	3	3
	2004	< 5	-	-	-	< 1
Bovensluis	1999	1	1	1	1	1
	2000	2	2	2	2	2
	2002	< 5	-	-	-	< 5
Eemmeerdijk, kilometer 23	1999	< 1	-	-	-	< 1
	2000	2	2	2	2	2
Hagestein boven	1999	< 1	-	-	-	< 1
	2003	2.5	2.5	2.5	2.5	< 5
Haringvlietsluis	1999	< 1	-	-	-	< 1
	2000	< 1	-	-	-	< 1
	2002	< 5	-	-	-	< 5
Ketelmeer west	1999	< 1	-	-	-	< 1
	2000	< 1	-	-	-	< 1
	2001	1.9	1.76	1.2	1.2	< 1
Lobith ponton	1999	< 1	-	-	-	< 1
	2000	< 1	-	-	-	< 1
Markermeer noordoost	1999	< 1	-	-	-	< 1
	2000	< 1	-	-	-	< 1
	2001	2.2	2.2	2.2	2.2	2.2
	2002	< 5	-	-	-	< 5
	2003	< 5	-	-	-	< 1
	2004	< 5	-	-	-	< 1
Sas van Gent	1999	< 1	-	-	-	< 1
	2001	< 1	-	-	-	< 1
Steenbergen (Roosendaalsevliet)	1999	< 1	-	-	-	< 1
	2000	< 1	-	-	-	< 1
	2002	< 5	-	-	-	< 5
Wagenpad zuid	1999	< 1	-	-	-	< 1
	2004	< 5	-	-	-	< 1
Wolderwijd midden (zwaartepunt Wolderwijd)	1999	< 1	-	-	-	< 1
	2000	2	2	2	2	2
	2001	1.3	1.3	1.3	1.3	1.3