



## CHEMICAL UPDATE WORKSHEET

<b>Chemical Name:</b>	<b>Metolachlor</b>
<b>CAS #:</b>	<b>51218-45-2</b>
<b>Revised By:</b>	RRD Toxicology Unit
<b>Revision Date:</b>	August 31, 2015

### (A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	283.83	283.80	EPI	EXP
Physical State at ambient temp	Liquid	Liquid	MDEQ	
Melting Point (°C)	---	-62.10	EPI	EXP
Boiling Point (°C)	---	NA	NA	
Solubility (ug/L)	5.30E+5	530000	EPI	EXP
Vapor Pressure (mmHg at 25°C)	0.00002	3.14E-05	EPI	EXP
HLC (atm-m <sup>3</sup> /mol at 25°C)	9.90E-9	9.00E-09	EPI	EXP
Log Kow (log P; octanol-water)	3.13	3.13	EPI	EXP
Koc (organic carbon; L/Kg)	361	488.5	EPI	EST
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm <sup>2</sup> /s)	0.08	2.19E-02	W9	EST
Diffusivity in Water (Dw; cm <sup>2</sup> /s)	8.0E-6	5.48E-06	W9	EST
Soil Water Partition Coefficient (Kd; inorganics)	NR	NR	NA	NA

	Part 201 Value	Updated Value	Reference Source	Comments
Flash Point (°C)	NA	93.3	PC	EXP
Lower Explosivity Level (LEL; unitless)	NA	NA	NA	NA
Critical Temperature (K)		NA	NA	NA
Enthalpy of Vaporization (cal/mol)		NA	NA	NA
Density (g/mL, g/cm <sup>3</sup> )		1.12	CRC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm <sup>2</sup> )	NA	1.70E-07	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm <sup>2</sup> )	NA	1.70E-07	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm <sup>2</sup> )	NA	2.04E-07	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm <sup>2</sup> )	NA	2.04E-07	EMSOFT	EST

**(B) Toxicity Values/Benchmarks**

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Dose (RfD) (mg/kg/day)	2.3E-1	1.0E-1	OPP, 2014	
RfD details	<p>2-year &amp; 2-generation rat studies (Ciba-Geigy, 1981 &amp; 1983); Critical effect = decreased body weight gain, and reduced pup weights and parental food consumption. NOAEL = 300 ppm ----&gt; 22.8 mg/kg-d (using a food consumption conversion factor of 0.076 which was avg. of all rats, both sexes). IRIS used conversion factor of 0.05 -----&gt; 15 mg/kg.</p> <p>CCD date: 6/22/1988</p>	<p><b>Tier 1 Sources:</b>  <b>EPA-OPP:</b>  <b>Basis:</b> OPP is a Tier 1 source and is a more recent evaluation than IRIS. Best available chronic data; RfD = 0.10 mg/kg/d = 1.0E-1 mg/kg/d  <b>Critical Study:</b> Hazelette, J. (1989) Metolachlor Technical: Chronic Toxicity Study in Dogs: Study No. 862253. Unpublished study prepared by Ciba-Geigy Corp. 758 p. (MRID: 40980701)  <b>Methods:</b> Metolachlor was fed to beagle dogs at dose levels of 0, 100, 300, or 1000 ppm for up to 52 weeks  <b>Critical effect:</b> Decreased body weight gain.  <b>End point or Point of Departure (POD):</b> NOAEL = 300 ppm = 9.7 mg/kg/day for female dogs.  <b>Uncertainty Factors:</b> UF = 100 (10 each for interspecies extrapolation and intraspecies variability)  <b>Source and date:</b> EPA-OPP Memo: Metolachlor and S-Metolachlor Human and Health Scoping Document in Support of Registration Review Nov 19, 2014. EPA-RED: Metolachlor document, April, 1995.</p> <p><b>Per OPP-EPA (2014):</b> A two-generation reproduction study in albino CD rats, with doses of 0, 30, 300 or 1000 ppm in the diet, revealed a reproductive NOEL of 300 ppm (23.5-26.0 mg/kg/day) (MRID 00080897). This NOEL was derived from reduced pup weights in the F and F litters at the 1a 2a highest dose tested, i.e., 1000 ppm (75.8-85.7 mg/kg/day). The NOEL for parental toxicity was 1000 ppm (Guideline 83-4; Document Number 010088).</p> <p><b>Critical Study:</b> Smith, S.H.; O'Loughlin, C.K.; Salamon, C.M.; et al. (1981) Two-generation Reproduction Study in Albino Rats with Metolachlor Technical: Study No. 450-0272. Final rept. (Unpublished study received Sep 30, 1981 under 100-597; prepared by Whittaker Corp., submitted by Ciba-Geigy Corp., Greensboro, N.C.; CDL:245959-A; 245960; 245961). (MRID 00080897) The NOAEL based on</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>Hazelette et al 1989 is lower than the NOAEL based on reproductive effects and thus was selected as the critical study.</p> <p><b>Tier 1 and 2 Sources:</b>  <b>IRIS (01/01/1994):</b> RfD = 1.5E-1 mg/kg/d.</p> <p><b>Critical Studies:</b>                      1) Ciba-Geigy Corporation. (1983). 2-Year Rat Feeding Study. MRID No. 00129377.                      2) Ciba-Geigy Corporation. (1981). 2-Generation Rat Reproduction Study. MRID No. 00080897.</p> <p><b>Method(s):</b>                      1) Ciba-Geigy (1983): Albino CD rats (60-70/sex/dose) were exposed to metolachlor at doses of 0, 1.5, 15, or 150 mg/kg/day via diet for 2 years. Test substance described as technical metolachlor.                      2) Ciba-Geigy (1981): Charles River CD strain albino rats (15 males and 30 females/group) were fed technical metolachlor in the diet at doses 0, 30, 300, or 1000 ppm (0, 1.5, 15, and 50 mg/kg/day) for 32 days. Animals were mated after either 14 weeks (F0) or 17 weeks (F1) on test. Mating occurred once per generation. The F1 parental animals were randomly selected from the F1a litter after weaning of F1a. F0 males were sacrificed after 135 days on test and F0 females were sacrificed after 164 days on test.</p> <p><b>Critical effect:</b> 1) decreased body weight gain and 2) reduced pup weights and parental food consumption</p> <p><b>End point or Point of Departure (POD):</b> The same NOEL was identified for both critical studies for their respective critical effects. NOEL = 300 ppm (15 mg/kg/day) (1 ppm = 0.05 mg/kg/d).</p> <p><b>Uncertainty Factors:</b> UF = 100 (10 each for intraspecies variability and interspecies extrapolation).</p> <p><b>Source and date:</b> IRIS, Last revision date - 1/01/1994.</p> <p><b>PPRTV:</b> No PPRTV record for metolachlor is available at this time.  <b>MRL:</b> No MRL record for metolachlor is available at this time.</p>		



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p><b>Tier 3 Source:</b>  <b>MDEQ/RRD:</b> Per DEQ-CCD, RfD = 2.3E-1. 2-year &amp; 2-generation rat studies (Ciba-Geigy, 1981 &amp; 1983); Critical effect = decreased body weight gain, and reduced pup weights and parental food consumption. NOAEL = 300 ppm = 22.8 mg/kg-d (using conversion factor of 0.076 which was avg. of all rats, both sexes).</p>		
<b>Oral Cancer Slope Factor (CSF) (mg/kg-day)<sup>-1</sup></b>	3.5E-3	NA	MDEQ, 2014	
<b>CSF details</b>	<p>Hazelton-Raltech, Inc. (1983). Charles River CD rats fed 0, 30, 300, or 3000 ppm metolachlor in the diet for 104 weeks. Critical effect: liver tumors in the high dose group of females. Revised species scaling factor of (BWh/BWa) to the 0.25 power used for q* calculation. CCD date – 9/23/1999</p>	<p><b>Basis:</b> USEPA-OPP (2014) did not conduct a quantitative estimate of cancer risk by oral exposure through the development of an oral slope factor. Instead, risk was quantified using a nonlinear (Margin of Exposure) approach and it was suggested that the noncarcinogenic oral reference dose was protective of cancer effects. The MDEQ/WRD’s cancer evaluation took into consideration the third Cancer Peer Review of Metolachlor’s (EPA, 1993) demonstration of statistically significant liver tumor incidence among high dose female rats.</p> <p><b>Tier 1 Sources:</b>  <b>OPP (2014)</b> Metolachlor has been classified as a Group C, possible human carcinogen based on liver tumors in rats at the highest dose tested, with risk quantitated using a nonlinear (Margin of Exposure) approach. A linear risk assessment is not required. The chronic RfD is protective of any potential cancer effect.  <b>Critical Study:</b> Hazelette, J. (1989) Metolachlor Technical: Chronic Toxicity Study in Dogs: Study No. 862253. Unpublished study prepared by Ciba-Geigy Corp. 758 p. (MRID: 40980701)  <b>Methods:</b> Metolachlor was fed to beagle dogs at dose levels of 0, 100, 300, or 1000 ppm for up to 52 weeks  <b>Source and date:</b> EPA-OPP Memo: Metolachlor and S-Metolachlor Human and Health Scoping Document in Support of Registration Review Nov 19, 2014</p> <p><b>IRIS (10/01/1993):</b> Per IRIS, no oral toxicity value for metalochlor is available at this time.</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p><b>Tier 2 Sources:</b>  <b>PPRTV:</b> No PPRTV record for metolachlor is available at this time.  <b>MRL:</b> NA; MRLs are for non-cancer effects only.</p> <p><b>Tier 3 Sources:</b>  <b>MDEQ/WRD (03/27/2006):</b> SF = 3.5E-3 per mg/kg/d.  <b>Critical Study:</b> Hazelton-Raltech, Inc. (1983) Chronic Rat Study of Metolachlor. Cited in U.S. EPA, 1985  <b>Method(s):</b> Charles River CD rats (60-70/sex/dose) were exposed via diet to 0, 30, 300, or 3000 ppm metolachlor for 104 weeks. The study authors did not indicate that there was a statistically significant increase in any tumors. Re-analysis in the third Cancer Peer Review of Metolachlor (EPA, 1993) showed that there was a statistically significant increase in liver tumors (neoplastic nodules and carcinomas combined) in the high dose female rats.  <b>Carcinogen Weight-of-Evidence (WOE) Class:</b> C; possible human carcinogen (IRIS, 10/01/1993); Metolachlor has been classified as a Group C carcinogen with risk quantitated using a nonlinear (Margin of Exposure) approach (EPA-OPP Memo Metolachlor and S-Metolachlor Human and Health Scoping Document in Support of Registration Review Nov 19, 2014)  <b>IRIS WOE Basis:</b> Based on the appearance of proliferative liver lesions (combined neoplastic nodules and carcinomas) at highest dose tested (3000 ppm) in female rats. (IRIS 1993)</p>		
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (µg/m³)	--	NA	MDEQ, 2015	
RfC/ITSL details	NA	<p><b>Tier 1 Sources:</b>  <b>EPA-OPP 2014:</b> USEPA-OPP references an oral exposure study in dogs as the basis of their intermediate term inhalation exposure scenario. However, no oral-to-inhalation extrapolation methodology or supporting information is provided.  <b>Critical Studies:</b></p>		Complete



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
		<p>1) Jessup, D.C.; Arceo, R.J.; Estes, F.L.; et al. (1980) 6-Month Chronic Oral Toxicity Study in Beagle Dogs: IRDC No. 382-054. (Unpublished study received Jun 5, 1980 under 100-587; prepared by International Research and Development Corp., submitted by Ciba-Geigy Corp., Greensboro, N.C.; CDL:242672-A) (MRID: 00032174)</p> <p>2) Breckenridge, C. (1994) Metolachlor Technical: A Supplement to the 6-Month Chronic Oral Toxicity Study in Beagle Dogs: (MRID # 00032174). Unpublished study prepared by Ciba-Geigy Corp. Plant Protection Division.(MRID: 43244001)</p> <p><b>Methods:</b> In a subchronic oral toxicity study (MRIDs 00032174 and 43244001), metolachlor (96.8% ai) was administered in the diet to Beagle dogs (8/sex/group for control and high dose groups; 6/sex/group for low- and mid-dose groups) at dose levels of 0, 100, 300 or 1000 ppm (males: 0, 2.92, 9.71 and 29.61 mg/kg/day, respectively; females: 0, 2.97, 8.77 and 29.42 mg/kg/day, respectively) for six months.</p> <p><b>Critical effect:</b> decreased body weight gain</p> <p><b>End point or Point of Departure (POD):</b> NOAEL = 8.8 mg/kg/day</p> <p><b>Uncertainty Factors:</b> Total UF = 3000. EPA-OPP; UF (MOE) = 1000; 10 each for Intraspecies variability, intraspecies variability and database. MDEQ UF = 3 for subchronic to chronic.</p> <p><b>Source and date:</b> EPA-OPP Memo: Metolachlor and S-Metolachlor Human and Health Scoping Document in Support of Registration Review Nov 19, 2014</p> <p><b>IRIS:</b> Per IRIS (01/31/1987), no value at this time.</p> <p><b>Tier 2 Sources:</b>  <b>PPRTV:</b> No PPRTV record for metalochlor is available at this time.  <b>MRL:</b> No MRL record for metalochlor is available at this time.</p> <p><b>Tier 3 Source:</b>  <b>MDEQ:</b> Per DEQ-CCD, no inhalation toxicity value for metalochlor is available at this time.</p>		

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Inhalation Unit Risk Factor (IURF) (( $\mu\text{g}/\text{m}^3$ ) <sup>-1</sup> )	--	NA	MDEQ, 2015	
IURF details	NA	<p><b>Carcinogen Weight-of-Evidence (WOE) Class:</b> EPA-OPP (2014) Metolachlor has been classified as a Group C carcinogen with risk quantitated using a nonlinear (Margin of Exposure) approach.</p> <p><b>Source and date:</b> EPA-OPP Memo: Metolachlor and S-Metolachlor Human and Health Scoping Document in Support of Registration Review Nov 19, 2014</p> <p><b>Tier 1 Source:</b>  <b>IRIS:</b> Per IRIS (10/01/1993), no value for metolachlor at this time.  <b>EPA-OPP:</b> No value for metolachlor at this time.</p> <p><b>Tier 2 Sources:</b>  <b>PPRTV:</b> No PPRTV record for metalochlor is available at this time.  <b>MRL:</b> NA; MRLs are for non-cancer effects only.</p> <p><b>Tier 3 Source:</b>  <b>MDEQ:</b> Per DEQ-CCD, no inhalation toxicity value for metalochlor is available at this time.</p>		Complete
Mutagenic Mode of Action (MMOA)? (Y/N)	--	NO	USEPA, 2015	
MMOA Details	--	Not listed as a carcinogen with mutagenic MOA in the USEPA OSWER List.		
Developmental or Reproductive Effector? (Y/N)	Yes	No-oral, No-inhalation	MDEQ, 2015	
Developmental or Reproductive Toxicity Details	NA	Developmental effects: reduced pup weights and parental food consumption (Ciba-Geigy, 1981).		
State Drinking Water Standard (SDWS) (ug/L)	--	NO	SDWA, 1976	
SDWS details	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399		



	Part 201 Value	Updated Value	Source/Reference/ Date	Comments/Notes /Issues
<b>Secondary Maximum Contaminant Level (SMCL) (ug/L)</b>	--	NO	SDWA, 1976 and USEPA SMCL List	
<b>SMCL details</b>	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399 and USEPA SMCL List, 2015		
<b>Is there an aesthetic value for drinking water? (Y/N)</b>	NO	Not evaluated.	NA	
<b>Aesthetic value (ug/L)</b>	NO	NA	NA	
<b>Aesthetic Value details</b>	NA	NA		
<b>Phytotoxicity Value? (Y/N)</b>	NO	Not evaluated.	NA	
<b>Phytotoxicity details</b>	NA	NA	NA	
<b>Others</b>				

**(C) Chemical-specific Absorption Factors**

	Part 201 Value	Update	Source/Reference/ Dates	Comments/Notes /Issues
Gastrointestinal absorption efficiency value (ABS <sub>gi</sub> )	---	1.0	MDEQ, 2015/USEPA RAGS-E, 2004	
ABS <sub>gi</sub> details		RAGS E (USEPA, 2004) Default Value		
Skin absorption efficiency value (A <sub>Ed</sub> )	---	0.1	MDEQ, 2015	
A <sub>Ed</sub> details				
Ingestion Absorption Efficiency (A <sub>Ei</sub> )		1.0	MDEQ, 2015	
A <sub>Ei</sub> Details				
Relative Source Contribution for Water (RSC <sub>w</sub> )		0.2	MDEQ, 2015	
Relative Source Contribution for Soil (RSC <sub>s</sub> )		1.0	MDEQ, 2015	
Relative Source Contribution for Air (RSC <sub>A</sub> )		1.0	MDEQ, 2015	
Others				

**(D) Rule 57 Water Quality Values and GSI Criteria**

<b>Current GSI value (µg/L)</b>	15
<b>Updated GSI value (µg/L)</b>	15
<b>Rule 57 Drinking Water Value (µg/L)</b>	78

	<b>Rule 57 Value (µg/L)</b>	<b>Verification Date</b>
<b>Human Non-cancer Values- Drinking water source (HNV-drink)</b>	3,300	3/2006
<b>Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)</b>	14,000	3/2006
<b>Wildlife Value (WV)</b>	NA	NA
<b>Human Cancer Values for Drinking Water Source (HCV-drink)</b>	78	3/2006
<b>Human Cancer values for non-drinking water source (HCV-Non-drink)</b>	340	3/2006
<b>Final Chronic Value (FCV)</b>	15	4/2006
<b>Aquatic maximum value (AMV)</b>	110	4/2006
<b>Final Acute Value (FAV)</b>	210	4/2006

Sources:

1. MDEQ Surface Water Assessment Section Rule 57 [website](#)
2. MDEQ Rule 57 [table](#)



**(E) Target Detection Limits (TDL)**

	<b>Value</b>	<b>Source</b>
<b>Target Detection Limit – Soil (<math>\mu\text{g}/\text{kg}</math>)</b>	200	MDEQ, 2015
<b>Target Detection Limit – Water (<math>\mu\text{g}/\text{L}</math>)</b>	10	MDEQ, 2015
<b>Target Detection Limit – Air (ppbv)</b>	NA	MDEQ, 2015
<b>Target Detection Limit – Soil Gas (ppbv)</b>	NA	MDEQ, 2015

**CHEMICAL UPDATE WORKSHEET ABBREVIATIONS:**

CAS # - Chemical Abstract Service Number.

**Section (A) Chemical-Physical Properties****Reference Source(s):**

CRC	Chemical Rubber Company Handbook of Chemistry and Physics, 95th edition, 2014-2015
EMSOFT	USEPA Exposure Model for Soil-Organic Fate and Transport (EMSOFT) (EPA, 2002)
EPA2001	USEPA (2001) Fact Sheet, Correcting the Henry's Law Constant for Soil Temperature. Office of Solid Waste and Emergency Response, Washington, D.C.
EPA4	USEPA (2004) User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings. February 22, 2004.
EPI	USEPA's Estimation Programs Interface SUITE 4.1, Copyright 2000-2012
HSDB	Hazardous Substances Data Bank
MDEQ	Michigan Department of Environmental Quality
NPG	National Institute for Occupational Safety and Health Pocket Guide to Chemical Hazards
PC	National Center for Biotechnology Information's PubChem database
PP	Syracuse Research Corporation's PhysProp database
SCDM	USEPA's Superfund Chemical Data Matrix
SSG	USEPA's Soil Screening Guidance: Technical Background Document, Second Edition, 1996
USEPA/EPA	United States environmental protection agency's Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). July, 2004.

W9 USEPA's User Guide for Water9 Software, Version 2.0.0, 2001

**Basis/Comments:**

EST	estimated
EXP	experimental
EXT	extrapolated
NA	not available or not applicable
NR	not relevant

**Section (B) Toxicity Values/Benchmarks****Sources/References:**

ATSDR	Agency for Toxic Substances and Disease Registry
CALEPA	California Environmental Protection Agency
CAL DTSC	California Department of Toxic Substances Control
CAL OEHHHA	CAEPA Office of Environmental Health Hazard Assessment
CCD	MDEQ Chemical Criteria Database
ECHA	European Chemicals Agency (REACH)
OECD HPV	Organization for Economic Cooperation and Development HPV Database
HEAST	USEPA's Health Effects Assessment Summary Tables
IRIS	USEPA's Integrated Risk Information System
MADEP	Massachusetts Department of Environmental Protection
MDEQ/DEQ	Michigan Department of Environmental Quality
DEQ-CCD/AQD	MDEQ Air Quality Division
DEQ-CCD/RRD	MDEQ Remediation and Redevelopment Division
DEQ-CCD/WRD	MDEQ Water Resources Division
MNDOH	Minnesota Department of Health

NJDEP	New Jersey Department of Environmental Protection
NYDEC	New York State Department of Environmental Conservation
OPP/OPPT	USEPA's Office of Pesticide Programs
PPRTV	USEPA's Provisional Peer Reviewed Toxicity Values
RIVM	The Netherlands National Institute of Public Health and the Environment
TCEQ	Texas Commission on Environmental Quality
USEPA	United States Environmental Protection Agency
USEPA OSWER	USEPA Office of Solid Waste and Emergency Response
USEPA MCL	USEPA Maximum Contaminant Level
WHO	World Health Organization
WHO IPCS	International Programme on Chemical Safety (IPCS/INCHEM)
WHO IARC	International Agency for Research on Cancers
NA	Not Available.
NR	Not Relevant.

**Toxicity terms:**

BMC	Benchmark concentration
BMCL	Lower bound confidence limit on the BMC
BMD	benchmark dose
BMDL	Lower bound confidence limit on the BMD
CSF	Cancer slope Factor
CNS	Central nervous system
IURF or IUR	Inhalation unit risk factor
LOAEL	Lowest observed adverse effect level
LOEL	Lowest observed effect level
MRL	Minimal risk level (ATSDR)
NOAEL	No observed adverse effect level
NOEL	No observed effect level

RfC	Reference concentration
RfD	Reference dose
p-RfD	Provisional RfD
aRfD	Acute RfD
UF	Uncertainty factor
WOE	Weight of evidence

**Section (C) Chemical-specific Absorption Factors**

MDEQ	Michigan Department of Environmental Quality
USEPA RAGS-E	United States Environmental Protection Agency's Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). July, 2004.

**Section (D) Rule 57 Water Quality Values and GSI Criteria**

GSI	Groundwater-surface water interface
NA	A value is not available or not applicable.
ID	Insufficient data to derive value
NLS	No literature search has been conducted

