

**CHEMICAL UPDATE WORKSHEET**

Chemical Name:	Glyphosate (DD)
CAS #:	1071-83-6
Revised By:	RRD Toxicology Unit
Revision Date:	August 21, 2015

(A) Chemical-Physical Properties

	Part 201 Value	Updated Value	Reference Source	Comments
Molecular Weight (g/mol)	169.09	169.07	EPI	EXP
Physical State at ambient temp	Solid	Solid	MDEQ	
Melting Point (°C)	---	189.50	EPI	EXP
Boiling Point (°C)	---	NA	NA	
Solubility (ug/L)	1.16E+7	10500000	EPI	EXP
Vapor Pressure (mmHg at 25°C)	NA	9.8E-8	PP	Exp; Tomlin, C 2003
HLC (atm-m³/mol at 25°C)	1.50E-9	2.10E-12	PP	EST
Log Kow (log P; octanol-water)	-4.47	-3.40	EPI	EXP
Koc (organic carbon; L/Kg)	4.04E-5	1	EPI	EST
Ionizing Koc (L/kg)		NR	NA	NA
Diffusivity in Air (Di; cm²/s)	0.08	4.96E-02	W9	EST
Diffusivity in Water (Dw; cm²/s)	8.0E-6	9.63E-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	NA	NA	NA
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 ³)		1.705	PC	EXP
EMSOFT Flux Residential 2 m (mg/day/cm ²)	NA	2.44E-08	EMSOFT	EST
EMSOFT Flux Residential 5 m (mg/day/cm ²)	NA	2.44E-08	EMSOFT	EST
EMSOFT Flux Nonresidential 2 m (mg/day/cm ²)	NA	2.45E-08	EMSOFT	EST
EMSOFT Flux Nonresidential 5 m (mg/day/cm ²)	NA	2.45E-08	EMSOFT	EST

(B) Toxicity Values/Benchmarks

	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
Reference Dose (RfD) (mg/kg/day)	1.0E-1	1.0E-1	IRIS, 1990	
RfD details	<p>3-generation rat reproduction study. Critical effect = increased incidence of renal tubular dilation in F3b offspring. NOAEL= 10 mg/kg-day, UF=100. (Monsanto, 1981a). CCD date: 3/11/1986</p>	<p>Tier 1 Source: IRIS: Basis: IRIS is a Tier 1 source. IRIS (1990) RfD = 1.0E-1 mg/kg-day. OPP review is in process (see below). Critical Study: Monsanto Company (1981) 3-Generation Rat Reproduction Study. MRID No. 0081674, 00105995. Methods: Sprague-Dawley rats were exposed to glyphosate continuously for three successive generations. Dietary concentrations of glyphosate were adjusted weekly to achieve dose levels of 0, 3, 10, and 30 mg/kg/day. Each generation (F0, F1, F2) consisted of 12 male and 24 female rats. Each parent generation was mated to produce to litters. Offspring from the second litters of the F0 and F1 parents (F1b and F2b litters, respectively) were selected to be parents for subsequent generations. Critical effect: Increase in the incidence of unilateral renal tubular dilation in male pups from the F3b mating. No treatment-related effects on fertility were noted, nor were any systemic effects in adult rats apparent. End point or Point of Departure (POD): NOEL = 10 mg/kg/day. Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation). Source and date: IRIS, Last revision date - 9/01/1990</p> <p>Tier 1 Source: EPA-OPP: OPP chronic RfD = 1.75 or 2.0 mg/kg/day: Critical Study: Rodwell, D.E.; Tasker, E.J.; Blair, M., et al. (1980) Teratology Study in Rabbits: IRDC No. 401-056. (Unpublished study received May 23, 1980 under 524-308; prepared by International Research and Development Corp., submitted by Monsanto Co., Washington, D.C.; CDL:242516-B) (00046363). Methods: Pregnant Dutch Belted rabbits were administered 0, 75, 175 or 350 mg/kg/day of glyphosate by gavage during gestation days 6 through 27.</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>Critical effect: Diarrhea, nasal discharge and death in maternal animals. Developmental toxicity was not observed at any dose tested.</p> <p>End point or Point of Departure (POD): Maternal NOAEL = 175 mg/kg/day</p> <p>Uncertainty Factors: UF = 100 (10 each for intraspecies variability and interspecies extrapolation and 1 for FQPA safety factor)</p> <p>Additional note: In 1991, the OPP HED Reference Dose Committee concluded that the focal tubular dilation of the kidney at the 30 mg/kg/day dose level was a “spurious rather the glyphosate-related effect”. Per OPP, an FQPA SF of 1 indicates that there is no increased susceptibility of the young, i.e. developmental and reproductive studies did not show effects in rats or rabbits and neurotoxicity in mice, rats, rabbits or dogs was not observed.</p> <p>OPP’s responses to comments (12/2009) indicate that OPP will utilize newly available data during the Registration Review of glyphosate.</p> <p>Source and date: EPA-OPP Memorandum: Glyphosate Human Health Assessment Scoping Document in Support of Registration Review, 6/3/2009 (Final RED is not available at this time); EPA-OPP Memorandum: Glyphosate Public Comments Regarding the HED’s Human Health Assessment Scoping Document in Support of Registration Review of 3-Jun-2009. HED’s Response to Public Comments (12/28/2009).</p> <p>Tier 2 Sources: PPRTV: No PPRTV record for glyphosate is available at this time. MRL: No MRL for glyphosate is record available at this time.</p> <p>Tier 3 Source: MDEQ/RRD: Per DEQ-CCD, RfD value is the same as the IRIS RfD. 3-generation rat reproduction study. Monsanto (1981) Critical effect = increased incidence of renal tubular dilaion in F3b offspring. NOAEL= 10 mg/kg-day, UF=100.</p>		
Oral Cancer Slope Factor (CSF) (mg/kg-day) ⁻¹	--	NA	MDEQ, 2015	
CSF details	NA	Carcinogen Weight-of-Evidence (WOE) Class and Basis: IRIS (10/01/1993): D - not classifiable as to human carcinogenicity due to a lack of		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		<p>statistical significance and uncertainty as to a treatment-related effect.</p> <p>International Research Agency for Research on Cancer (IARC) (3/20/2015): Limited evidence of carcinogenicity in humans for non-Hodgkin lymphoma. The evidence in humans is from studies of exposures, mostly agricultural, in the USA, Canada, and Sweden published since 2001. In addition, there is convincing evidence that glyphosate also can cause cancer in laboratory animals. The IARC Working Group considered the significant findings from the US EPA Scientific Advisory Panel report and several more recent positive results in concluding that there is sufficient evidence of carcinogenicity in experimental animals. Glyphosate also caused DNA and chromosomal damage in human cells, although it gave negative results in tests using bacteria. One study in community residents reported increases in blood markers of chromosomal damage (micronuclei) after glyphosate formulations were sprayed nearby. Source and Date: IRIS, 10/01/1993; IARC, 3/20/2015</p> <p>Tier 1 and 2 Sources: IRIS: Per IRIS (10/01/1993), no value at this time. EPA-OPP: Per OPP (6/3/2009), no value at this time. PPRTV: No PPRTV record for glyphosate is available at this time. MRL: NA; MRLs are for non-cancer effects only.</p> <p>Tier 3 Source: MDEQ: Per DEQ-CCD, no value at this time.</p>		
Reference Concentration (RfC) or Initial Threshold Screening Level (ITSL) (µg/m³)	--	NA	MDEQ, 2015	
RfC/ITSL details	NA	<p>Tier 1 and 2 Sources: IRIS: Per IRIS (10/01/1993), no value at this time. PPRTV: No PPRTV record for glyphosate is available at this time. MRL: No MRL record for glyphosate is available at this time.</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
		Tier 3 Source: MDEQ: Per DEQ-CCD, no value at this time.		
Inhalation Unit Risk Factor (IURF) (($\mu\text{g}/\text{m}^3$)⁻¹)	--	NA	MDEQ, 2015	
IURF details	NA	<p>Carcinogen Weight-of-Evidence (WOE) Class and Basis: IRIS (10/01/1993): D - not classifiable as to human carcinogenicity due to a lack of statistical significance and uncertainty as to a treatment-related effect. International Research Agency for Research on Cancer (IARC) (3/20/2015): Limited evidence of carcinogenicity in humans for non-Hodgkin lymphoma. The evidence in humans is from studies of exposures, mostly agricultural, in the USA, Canada, and Sweden published since 2001. In addition, there is convincing evidence that glyphosate also can cause cancer in laboratory animals. The IARC Working Group considered the significant findings from the US EPA Scientific Advisory Panel report and several more recent positive results in concluding that there is sufficient evidence of carcinogenicity in experimental animals. Glyphosate also caused DNA and chromosomal damage in human cells, although it gave negative results in tests using bacteria. One study in community residents reported increases in blood markers of chromosomal damage (micronuclei) after glyphosate formulations were sprayed nearby. Source and Date: IRIS, 10/01/1993; IARC, 3/20/2015</p> <p>Tier 1 Sources: IRIS: Per IRIS (10/01/1993), no value at this time. EPA-OPP: Per OPP (6/3/2009), no value at this time.</p> <p>Tier 2 Sources: PPRTV: No PPRTV record for glyphosate is available at this time. MRL: NA; MRLs are for non-cancer effects only.</p> <p>Tier 3 Source: MDEQ: Per DEQ-CCD, no value at this time.</p>		Complete



	Part 201 Value	Updated Value	Source/Reference/Date	Comments/Notes/Issues
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	YES-oral, the RfD is based on a reproductive-developmental effect. Oral Exposure Pathways- Single Exposure	MDEQ, 2015	
Developmental or Reproductive Toxicity Details	NA	Reproductive effect: Increase in the incidence of unilateral renal tubular dilation in male pups from the F3b mating. Critical Study): Monsanto Company. 1981a. 3-Generation Rat Reproduction Study. MRID No. 0081674, 00105995.		
State Drinking Water Standard (SDWS) (ug/L)	700	700	SDWA, 1976	
SDWS details	SDWA, 1976	MI Safe Drinking Water Act (SDWA) 1976 PA 399		
Secondary Maximum Contaminant Level (SMCL) (ug/L)	--	NO	SDWA, 1976 and USEPA SMCL List	
SMCL details	NA	MI Safe Drinking Water Act (SDWA) 1976 PA 399 and USEPA SMCL List, 2015		
Is there an aesthetic value for drinking water? (Y/N)	NO	Not evaluated.	NA	
Aesthetic value (ug/L)	NA	NA	NA	
Aesthetic Value details	NA	NA		
Phytotoxicity Value? (Y/N)	NO	Not evaluated.	NA	
Phytotoxicity details	NA	NA	NA	
Others				



(C) Chemical-specific Absorption Factors

	Part 201 Value	Update	Source/Reference/ Dates	Comments/Notes /Issues
Gastrointestinal absorption efficiency value (ABS _{gi})	---	1.0	MDEQ, 2015/USEPA RAGS-E, 2004	
ABS _{gi} details		RAGS E (USEPA, 2004) Default Value		
Skin absorption efficiency value (AE _d)	---	0.1	MDEQ, 2015	
AE _d details				
Ingestion Absorption Efficiency (AE _i)		0.5	MDEQ, 2015	
AE _i Details				
Relative Source Contribution for Water (RSC _w)		0.2	MDEQ, 2015	
Relative Source Contribution for Soil (RSC _s)		1.0	MDEQ, 2015	
Relative Source Contribution for Air (RSC _A)		1.0	MDEQ, 2015	
Others				

(D) Rule 57 Water Quality Values and GSI Criteria

Current GSI value (µg/L)	NA
Updated GSI value (µg/L)	NA
Rule 57 Drinking Water Value (µg/L)	NA

	Rule 57 Value (µg/L)	Verification Date
Human Non-cancer Values- Drinking water source (HNV-drink)		
Human Non-Cancer Values- Non-drinking water sources (HNV-Non-drink)		
Wildlife Value (WV)		
Human Cancer Values for Drinking Water Source (HCV-drink)		
Human Cancer values for non-drinking water source (HCV-Non-drink)		
Final Chronic Value (FCV)		
Aquatic maximum value (AMV)		
Final Acute Value (FAV)		

Sources:

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



(E) Target Detection Limits (TDL)

	Value	Source
Target Detection Limit – Soil ($\mu\text{g}/\text{kg}$)	1,000	MDEQ, 2015
Target Detection Limit – Water ($\mu\text{g}/\text{L}$)	100	MDEQ, 2015
Target Detection Limit – Air (ppbv)	NA	MDEQ, 2015
Target Detection Limit – Soil Gas (ppbv)	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 OEHHA	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