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OFFICE OF
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MEMORANDUM

Subject:	Tier I Sulfometuron Methyl Drinking Water Assessment for Reregistration Eligibility Decision Document (slightly revised)
To:	John Pates, Review Manager Special Review and Reregistration Division (SRRD) (7505P)
From:	Michael R. Barrett, Ph.D., Senior Chemist Environmental Risk Branch V Environmental Fate and Effects Division (7507P)
Thru:	Mah Shamim, Ph.D., Chief Environmental Risk Branch V Environmental Fate and Effects Division (7507P)

This memo presents the Tier I Estimated Drinking Water Concentrations (EDWCs) of sulfometuron methyl (CAS No. 74222-97-2), calculated using FIRST (surface water) and SCI-GROW (ground water) for use in the human health risk assessment. Exposure estimates have also been generated for the total residues of sulfometuron methyl which include sulfometuron and major degradates such as a pyrimidine amine, a sulfonamide degradate, and saccharin (See Appendix 1 for full chemical names and structures). Sulfometuron methyl is a non-selective herbicide for use in forestry plantings, on rights-of-way, industrial sites, around buildings, railroads, pipelines, etc.

Exposure to sulfometuron methyl parent and sulfometuron total residues has been estimated with FIRST (FQPA Index Reservoir Screening Tool; v.1.1.0; dated 1/1/2007) and SCI-GROW (Screening Concentration In GROund Waterm v2.3), results are summarized below.

Parent Exposure estimates:
For surface water, the acute value is **31.98 ppb** and the chronic is **14.51 ppb**. The groundwater screening concentration is **0.33 ppb**. These values represent upper-bound estimates of the

concentrations that might be found in surface water (a vulnerable reservoir) and ground water due to the use of sulfometuron methyl at the maximum allowable rate within the watershed.

Parent + Degradate exposure estimates:

For surface water, the acute value is **32.35 ppb** and the chronic is **21.82 ppb**. The groundwater screening concentration is **1.13 ppb**. These values represent upper-bound estimates of the concentrations that might be found in surface water (a vulnerable reservoir) and ground water due to the use of sulfometuron methyl at the maximum allowable rate within the watershed.

Data Gaps:

The available environmental fate studies do not provide sufficient data for modeling of individual degradates of sulfometuron methyl that could be of toxicological concern. Should such estimates be required in the future, than additional environmental fate studies specific to the degradates of concern may be required.

Error Correction Note:

This document replaces the October 31, 2007 Drinking Water Assessment. The only revision is that a duplicate (and mislabeled) degradate entry in Appendix 1 has been deleted.

SULFOMETURON METHYL DRINKING WATER ASSESSMENT

Nature of Chemical Stressor

Sulfometuron methyl, (2-[[[[(4,6-Dimethyl-2-pyrimidinyl) amino] carbonyl] amino] sulfonyl] benzoic acid, methyl ester), is a broad-spectrum pre- and post-emergence herbicide that is currently registered for weed control in forestry and non-food crop situations, including vegetative management in right of ways and railroads. It is used to control a variety of broad-leaf weeds and grasses. Similar to other sulfonylurea herbicides, the mode of action of sulfometuron methyl involves inhibiting the activity of the enzyme acetolactate synthase (ALS), which in turn inhibits the synthesis of selected amino acids that are required for cell proliferation in plants.

Sulfometuron methyl is formulated as a water dispersible granule (WDG) and applied using a variety of methods including helicopter, fixed-wing aircraft, ground spray (boom and backpack) and spot treatment. It is generally applied once per year for non-crop areas in years that vegetation management is needed. In some instances (weed escapes) a second application may be made, but all products limit the total quantity of sulfometuron methyl that may be applied (from any source) to 6 ounces of active ingredient per acre per year (0.375 lb ai/A). Therefore, application rates in general forestry, and for site preparation and/or release in conifer, hardwood and Christmas tree plantations, will vary significantly depending upon the specific purpose of the application and the desirable tree species. In forestry, uses can be similar to plantation sites, but may also include the maintenance of access routes and fire breaks. It is further noted that use rates can also vary with climate and soil type.

Environmental Fate and Transport Characterization

The body of environmental fate data submitted demonstrate sulfometuron is mobile and persistent in the environment (Appendix 2). Sulfometuron methyl is more soluble in neutral and alkaline water than in acidic water. The major route of dissipation for sulfometuron methyl is believed to be aerobic and anaerobic degradation / metabolism in soil and water (pseudo first-order degradation half-lives generally around 2 to 6 months), with hydrolysis potentially dominant under acidic conditions. First-order rate aerobic soil metabolism half lives range from 52 to 58 days in two laboratory studies (technically both with the same soil type, but measured in two independent studies several years apart). In comparison, dissipation half-lives in the field ranged from 44 to 128 days at four sites (when considering only the residues remaining in the upper 15 cm of topsoil). The longer persistence of residues in the soil at one field site indicates that degradation in some soils is slower under some field conditions than observed in many of the laboratory studies. Sulfometuron methyl is subject to hydrolysis at environmental pHs; with significantly more rapid hydrolysis occurring under acidic conditions (e.g., a hydrolysis half-life of 9 days at pH 5 and 139 days at pH 7). However, laboratory and field studies in soil or sediment / water environments, albeit all at measured pHs somewhat greater than 5, do not generally show as rapid degradation as measured in the pH hydrolysis study.

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Metabolism in the aquatic environment is variable, ranging from half-life of 17 to 104 days in anaerobic conditions and 9 to 187 days for aerobic conditions (the more rapid degradation with a 9-day total system half-life took place in a test system with sediment pH of 5.4 and water pH of 7.6). Although sulfometuron methyl persistence is expected to generally increase with higher soil pH (rotational crop restrictions for many other sulfonylureas, which are all weak acids, reflect this), a consistent trend was not found in the available studies.

Soil retention of sulfometuron methyl is low, with Freundlich adsorption K_F values ranging between 0.15 and 2.1 ml/g in four test soils with soil organic carbon content ranging between 0.6 and 2.6 percent. Sorption was not found to be strongly dependent on any of the major properties of the tested soils in the registrant-submitted studies. The pKa of sulfometuron methyl is 5.4, and theoretically, adsorption may increase in very acidic soils where the methyl ester form of sulfometuron would predominate. However, the pH range of the four test soils in the batch equilibrium adsorption / desorption study was only 6.7 to 7.7. The published literature do seem to show more of a relationship of sulfometuron methyl and other sulfonylureas to mobility in soil; Weber et al. (2004)[1]have reviewed the literature and concluded that there is a consistent relationship between pH and mobility of sulfonylureas ("$NHSO_2$ acid herbicides" means sulfonylurea herbicides):

> OM and pH were also the primary soil properties in best-fit K_d equations obtained for five of the six $NHSO_2$ acid herbicides, with all three soil properties utilized in the K_d equation for sulfometuron-methyl. Cl was also one component of the K_d equation for sulfometuron-methyl, but Cl and pH were also related soil properties. As was the case for the COOH acid herbicides, sorption increased as OM increased or as pH decreased.

Other abbreviations used in the above excerpt from the Weber et al. article:
OM = Soil organic mater content
Cl = Chloride ion concentration
COOH acid herbicides = Herbicides with a carboxy acid functional group such as 2,4-D and Imazethapyr

In terrestrial field dissipation studies at four US sites, leaching of parent sulfometuron methyl occurred at measurable concentrations (>10 ppb in depth increments from 15 to 90 cm) was noted at each test site. Leaching of the degradates was not evaluated in the field dissipation studies.

Sulfometuron persistence in water indicates that if, either via spray drift or any runoff event, sulfometuron methyl reaches surface water, it may persist for a few weeks to several months and present some concern to surface water resources. The fairly low use rate (maximum annual rate of 0.375 lb ai/A) and the apparent typical use pattern of applying in only one or two years out of a several year period should limit the actual exposure of sulfometuron methyl residues in surface water (however, note that sulfometuron methyl could negatively affect certain sensitive plants at very low exposure levels because it is such a potent herbicide with respect to many plant species).

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[1] Weber, J.B., G.G. Wilkersona and C.F. Reinhardt. 2004 Calculating pesticide sorption coefficients (Kd) using selected soil properties. Chemosphere 55:157–166

Volatility studies were not reported. However, based its chemical properties, volatilization is not expected to be a route of dissipation of sulfometuron methyl in water or soils.

Sulfometuron methyl degrades to CO_2 under aerobic, non-sterile conditions (relatively little mineralization occurs under sterile conditions), but with significant accumulation of intermediate degradates, including a sulfonamide and saccharin from the phenyl ring part of the parent molecule and a pyrimidine amine from the pyrimidine ring portion (see Appendix 1). For the phenyl ring labeled studies, CO_2 was up to 28 to 44 % of applied at study termination whereas for the pyrimidine-ring labeled studies CO_2 was up to 53% of applied at study.

The only submitted studies directly evaluating the fate of sulfometuron methyl degradates were adsorption / desorption studies on the pyrimidine amine and saccharin. The soil retention characteristics of two of the sulfometuron methyl degradates were studied in batch equilibrium adsorption / desorption studies: saccharin K_fs were 0.03 to 0.27 and the pyrimidine amine K_fs were 0.17 to 3.70 in the four test soils. This means saccharin would be slightly more mobile and the pyrimidine amine slightly less mobile than parent (K_fs of 0.15 to 2.12 in the same four soils)

Drinking Water Exposure Estimation

While some monitoring data are available, the data are not targeted to watersheds known to present the highest exposure potential for sulfometuron methyl. Consequently, EFED's Tier I models were used for this drinking water exposure assessment.

Model Descriptions

Surface Water: The FIRST (FQPA Index Reservoir Screening Tool, Version 1.1.0) model by the Environmental Fate and Effects Division (EFED) of the USEPA Office of Pesticide Programs (OPP) was used to assess potential for contamination of surface drinking water sources from the proposed sulfometuron methyl use.

FIRST is a single-event model (one runoff event), but can account for spray drift from multiple applications. FIRST is hardwired to represent the Index Reservoir, a standard water body used by the Office of Pesticide Programs to assess drinking water exposure (Office of Pesticide Programs, 2002). It was based on a real reservoir, Shipman City Lake in Illinois, which was known to be vulnerable to pesticide contamination (with ample confirmation from pesticide monitoring data). The single runoff event moves a maximum of 8% of the applied pesticide into the reservoir. This amount can be reduced due to degradation on the field and the effects of binding to soil in the field. FIRST also uses a Percent Cropped Area (PCA) factor to adjust for the area within the watershed that is planted to the modeled crop. The national default PCA of 0.87 was applied in this assessment.

Ground Water: Sulfometuron methyl concentrations in ground water were estimated by the Screening Concentration in Ground Water (SCI-GROW v2.3, Jul. 29, 2003) model. SCI-GROW is a regression model used as a screening tool to estimate pesticide concentrations found in groundwater used as drinking water. SCI-GROW was developed by fitting a linear model to ground water concentrations with the Relative Index of Leaching Potential (RILP) as the independent variable. Groundwater concentrations were taken from 90-day average high concentrations from Prospective Ground Water studies. The RILP is a function of aerobic soil metabolism and the soil-water partition coefficient. The output of SCI-GROW represents the concentrations sulfometuron methyl residues that might be expected in shallow unconfined aquifers under sandy soils.

Further information on these models can be found at the EFED water model website at http://www.epa.gov/oppefed1/models/water/html.

Model Inputs and Results (Drinking Water Estimated Concentrations)

Key inputs for FIRST modeling, including data sources and parameter estimation methods (if applicable) are summarized in Table 1 and results for parent sulfometuron methyl are given in Table 3 and for the total residues in Table 4. These are conservative estimates, in most cases the potential exposure will be lower because the fraction of watershed land which represents legally possible sulfometuron methyl use sites, and furthermore, represents actual sulfometuron methyl use sites in any given year is smaller than 0.87, the default percent crop (or use site) area that needs to be used.

For ground water, SCI-GROW modeling inputs are presented in Table 2 and Tier I estimated concentrations for drinking water arising from ground water are provided for parent compound in Table 3 and for total residues in Table 4. The predicted exposure levels are lower than for surface water sources for drinking water.

Care needs to be used in assessing risk to sulfometuron total residues including degradates from the DWECs presented here. The nature of the total residue modeling method means that the total residues are estimated as parent equivalents. Similar weight / volume drinking water estimated concentrations for individual degradates which arise from fractionation of the parent molecule would be substantially less (if they could be calculated from the available environmental fate data). Given the limited environmental fate data on the degradates, no estimation of individual degradate concentrations is possible at this time. The DWECs in these tables cannot be manipulated to provide separate degradate and parent concentrations.

Table 1. FIRST input parameters for modeling (DWECs).

Input Parameter	*Value**	*Reference*
Molecular Weight (gram mole $^{-1}$)	364.38	MRID: 416728-02
Vapor Pressure (torr)	5.4×10^{-16}	
Aerobic Soil Metabolism Half-life (days)	61	90% Upper Confidence Limit of the mean of measured values (MRIDs 42091401; 43174102 and 245375)
Water column Half-life (days) (Aerobic Aquatic Metabolism half-life)	292	90% Upper Confidence Limit of the mean of measured values (MRIDs 42091403 and 43174103)

Table 1. FIRST input parameters for modeling (DWECs).

Input Parameter	*Value**	*Reference*
Benthic sediment Half-life (days) (Anaerobic Aquatic Metabolism half-life)	76	90% Upper Confidence Limit of the mean of measured values (MRIDs 43174102, 245375, 42091402, and 43188601)
Application Rate (lb a.i. / A)	Up to 0.375	Efficiency= 0.99 for ground spray, 0.95 for aerial.
Application Number (Method of application)	One, two or three	Product Label; typical use. Maximum annual rate of 0.375 lb ai/ A was used in each case.
Application method; Depth of Incorporation (cm)	Aerial: NA Ground: 0	Product Label; typical use.
Spray Drift (fraction)	0.16 (GS), 0.064 (aerial)	Default values for the FIRST model. (GS= ground spray) – Not a user input.
Solubility (ppm)	244	Highest solubility was recorded for alkaline water (12,500 ppm at pH 8.6). However, experience from other studies indicates these experimental values are too high.
K_{oc} (L Kg^{-1})	35	Lowest Koc value of the three non-sand soils tested (MRID 42789301). Koc model was determined to be appropriate.
Hydrolysis Half-life @ pH 7 (days)	139 days	MRID 42715201.
Direct Aqueous Photolysis Half-life(days)	Stable	Maximum dark control corrected value (MRIDs 42182401 and 43174101)

Fate data values are as per Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides; Version II February 28, 2002.

Table 2. SCI-GROW modeling inputs.

Input Parameter	*Value**	*Reference*
Aerobic Soil Metabolism Half-life (days)	55.2 (136 for total residues)	Mean of measured values (MRIDs 42091401; 43174102 and 245375)
Application Rate (Kg a.i. / ha)	0.41	Maximum permitted single (and annual) rate.
Application Number (Method of application)	One	Typical use.
K_{oc} (L Kg^{-1})	73.4 (same for total residues)	Median of four values (MRID 42789301).

Table 3. Tier I EDWCs for sulfometuron methyl from forestry or rights of way uses.

Chemical	**Application**			**Peak Day (Acute)**	**Annual Average (Chronic)**
Surface Water	Rate (lb a.i./A)	Number	Interval	Concentration (µg/L)	
Aerial	0.375	1	NA	31.96	**14.51**
Ground	0.375	1	NA	**31.98**	14.50
Aerial	0.188	2	30	27.57	12.52
Aerial	0.125	3	90	16.53	7.5
Aerial	0.125	3	45	21.39	9.7
Ground Water					
Aerial or ground	0.375	1	NA	0.33	0.33

Table 4. Tier I EDWCs for sulfometuron total residues from forestry or rights of way uses*.

Chemical	**Application**			**Peak Day (Acute)**	**Annual Average (Chronic)**
Surface Water	Rate (lb a.i./A)	Number	Interval	Concentration (µg/L)	
Aerial	0.375	1	NA	**32.35**	**21.82**
Aerial	0.188	2	30	30.21	20.38
Ground Water					
Aerial or ground	0.375	1	NA	1.13	1.13

* Includes sulfometuron methyl, sulfometuron free acid, sulfometuron pyrimidine amine, sulfometuron sulfonamide, and saccharin.

Review of Monitoring Data

In the most widespread monitoring survey available, sulfometuron methyl was detected only rarely (2 of 132 samples from 52 sites – mostly Midwestern US streams and rivers, but including some reservoirs as well); see Battaglin et al. (2000)[2]. The maximum concentration of sulfometuron methyl detected was 0.018 ug/L; but it is not known how much sulfometuron methyl usage was associated with the watersheds included in this monitoring survey.

Blomquist et al. (2001) in a monitoring study of 12 reservoir systems across the United States found sulfometuron methyl occurred above the minimum reporting limit of 0.05 ug/L in 12% of the samples collected with a maximum concentration of 0.16 ug/L and a 95th percentile concentration of

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[2] Battaglin, WA, Furlongb, ET, Burkhardt, MR, Peter, CJ. 2000. Occurrence of sulfonylurea, sulfonamide, imidazolinone, and other herbicides in rivers, reservoirs and ground water in the Midwestern United States. *Sci. Tot. Environ.* 248: 123-133

0.10 ug/L.[3] This study focused on drinking water supplies and the results are directly relevant to this drinking water assessment; however these data cannot be used for a conservative (protective) estimate of drinking water exposure since there is no basis to conclude that the study sites represent watersheds where exposure to sulfometuron methyl is the highest.

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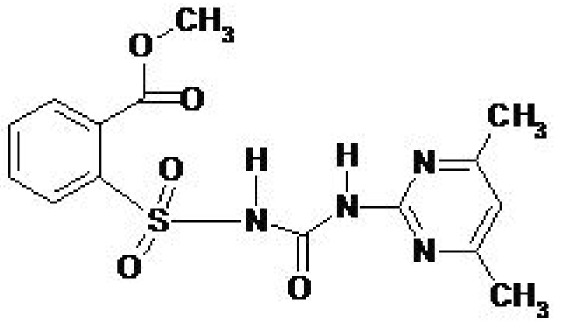
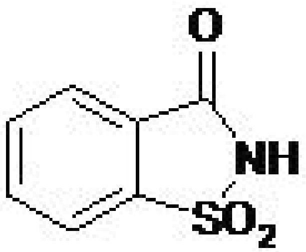
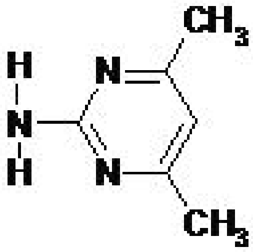
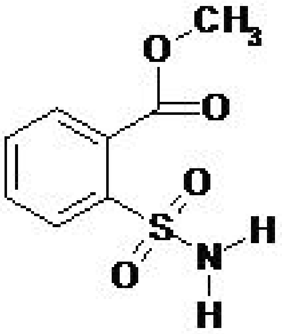
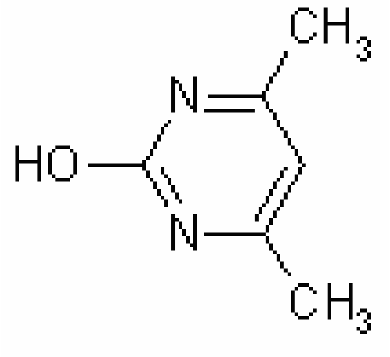
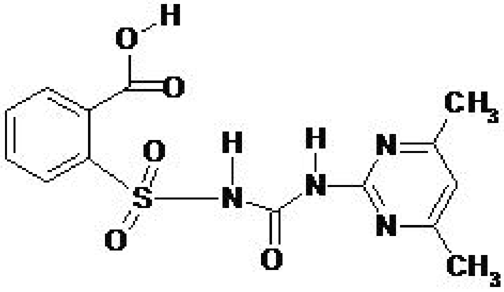
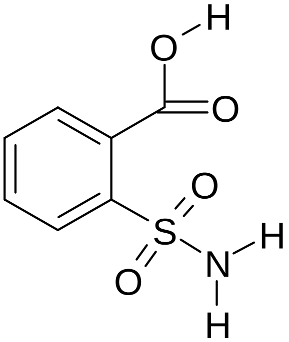
[3] Blomquist, J.D., Denis, J.M., Hetrick, J.A., Jones, R.D., and Birchfield, N.B. (2001) Pesticides in selected water-supply reservoirs and finished drinking water, 1999-2000; summary of results from a pilot monitoring program: U.S. Geological Survey Open-File Report 01-0456, 65 p.

APPENDIX 1: STRUCTURES AND CHEMICAL NAMES OF SULFOMETURON METHYL METABOLITES

Chemical Structures Trivial or common names Company id or similar alternate names Full chemical names	
 Sulfometuron methyl DPX-T5648; DPX-5648; IN-T5648; IN T5648-18 Methyl 2-(4,6-dimethylpyrimidin-2-ylcarbamoylsulfamoyl)benzoate	 Saccharin IN-581 1,2-Benzisothiazol-3(2H)-one, 1,1-dioxide
 Sulfometuron pyrimidine amine IN-X0993; IN-X993; PA 4,6-Dimethyl-2-pyrimidinamine 4,6-dimethyl-2-pyrimidinamine	 Sulfometuron sulfonamide IN-D5803; SA; methyl phenylsulfonamide Methyl 2-(aminosulfonyl)benzoate. 2-(Aminosulfonyl)-benzoic acid, methyl ester

 Pyrimidine-ol IN-11859 4,6-Dimethyl-2-pyrimidinol	 Sulfometuron free acid FA-SM; IN-T6385 2-[[[[(4,6-Dimethyl-2-pyrimidinyl)amino]carbonyl]amino]sulfonyl]-benzoic acid
 Free acid Sulfonamide FA-Sulfonamide; Free acid; IN-D5119 2-(Aminosulfonyl)benzoic acid	

APPENDIX 2: ENVIRONMENTAL FATE SUMMARY TABLE

Table 5. Key results of sulfometuron methyl environmental fates studies.

Parameter [Guideline #]	***Value[1]***	***MRID(s)***
Hydrolysis [161-1]	**$t_{½}$= 8.8 days (LL)** @ 25 ^{o}C, pH 5; **$t_{½}$=139 days (LL)** @ 25 ^{o}C, pH 7; **$t_{½}$= 224 days (LL)** @ 25 ^{o}C, pH 9. **Major degradates (from cleavage of the sulfonylurea bridge):** Sulfonamide – only in acidic water Saccharin – all pH levels Pyrimidine amine – all pH levels	42715201
Direct photolysis in water [161-2]	**Combined labels results:** **$t_{½}$= 428 days (LL)** @ 24 ^{o}C, pH 5; **$t_{½}$= stable** @ 24 ^{o}C, pH 7; **$t_{½}$= stable** @ 24 ^{o}C, pH 9. (calculated by the difference in degradation rates between irradiated and dark controls and adjusting for typical light levels on sunny days) **Major degradates (irradiated water):** pH 5: sulfonamide, pyrimidine amine; pH 7: none; pH 9: none.	42182401 43174101
Photolysis on soil [161-3]	**$t_{½}$= 72.1 days (LL)** @ 25 ^{o}C, Study duration was 33 days, substantial degradation occurred in dark controls and the calculated photolysis half-life represents the difference in the dissipation rate in the irradiated and the dark control samples. **Major degradates (from cleavage of the sulfonylurea bridge):** Saccharin reached a maximum of 48.4% of the applied at 33 days (study termination.) Pyrimidine amine reached a maximum of 53.1% at 33 days (study termination.) There was no substantial difference in the degradation pathway of sulfometuron methyl between the irradiated- and the dark control soil. No other degradate accounted for >4% of the applied radioactivity regardless of whether the phenyl ring or the pyrimidine ring was ^{14}C-labeled.	41420601

Table 5. Key results of sulfometuron methyl environmental fates studies.

Parameter [Guideline #]	***Value***^{1}	***MRID(s)***
Aerobic soil metabolism [162-1]	Study with [pyrimidine-2-^{14}C] Sulfometuron Methyl **Soil: Keyport Silt loam (pH 6.3, 1.6% O.C.) from Delaware** First Order **t**$_{½}$: 57.8 days (LL) ($r^2 = 0.9239$). Observed DT50: 23 days. Observed DT90: 110 days. Sterile soil First Order **t**$_{½}$: 364 days (LL) Major transformation products: Pyrimidine amine (maximum 41.0% of the applied) Pyrimidine-ol (maximum 10.5% of the applied). CO_2 (maximum 53.1% of applied). Minor transformation products: Free acid sulfometuron methyl. Pyrimidine urea.	42091401
Aerobic soil metabolism [162-1]	Study with U- ^{14}C-phenyl-labeled Sulfometuron Methyl **Soil: Keyport Silt loam (pH 6.4, 1.6 % O.C.) from Delaware (0.12 mg a.i./kg).** First Order **t**$_{½}$: 52.5 days (LL) ($r^2 = 0.9239$). Observed DT50: 29 days. Observed DT90: 162 days. Major transformation products: Sulfonamide. Saccharin. Free acid sulfonamide plus urea (1.0 mg a.i./Kg only). CO_2. Minor transformation products: Free acid sulfonamide plus urea (0.12 mg a.i./Kg only)	43174102 and 245375

Table 5. Key results of sulfometuron methyl environmental fates studies.

Parameter [Guideline #]	***Value[1]***	***MRID(s)***
Anaerobic aquatic metabolism [162-3]	Study performed with [pyrimidine-2-^{14}C] Sulfometuron Methyl **Matrix: Bradenton Pond water-sand sediment.** First Order **t**$_{½}$: 37.4 days (LL) ($r^2 = 0.6125$). Observed total system DT50: 22 to 61 days (inconsistent decline data). Observed total system DT90: 102 days. **Matrix: Landenberg Pond water-sandy loam sediment.** First Order **t**$_{½}$; total system: 17.1 days (LL) (r^2 = 0. 0.6394). Observed total system DT50: 6.1 days. Observed total system DT90: 21.7 days. Major transformation products (both systems): free acid sulfometuron methyl. pyrimidine amine. Minor identified transformation products: pyrimidine-ol. CO_2.	42091402 and 43188601

Table 5. Key results of sulfometuron methyl environmental fates studies.

Parameter [Guideline #]	***Value***[1]	***MRID(s)***
Anaerobic aquatic metabolism [162-3]	Study with [phenyl-U-^{14}C] Sulfometuron Methyl **Matrix: Pond water-sandy loam sediment from Bradenton, Florida. (water pH 5.5 . Sediment: pH 5.1; O.C. = 5.9 %).** First Order $\mathbf{t}_{1/2}$; total system: 104 days (LL) (r^2 = 0.4883)*. Observed DT50 in total system: *ca.* 21 days. Sterile $\mathbf{t}_{1/2}$; total system: 44 days (LL) ** Based upon limited and inconsistent data.* **Matrix: Pond water-silt loam sediment from Landenberg, Pennsylvania.** **(water pH 5.8 . Sediment: pH 5.6; O.C. = 2.1 %).** First Order $\mathbf{t}_{1/2}$; total system: 87 days (LL) (r^2 = 0.3577). Observed DT50 in total system: *ca.* 28 days. Sterile $\mathbf{t}_{1/2}$; total system: 175 days (LL) **Matrix: Pond water-loam sediment from Saskatoon, Canada. (water pH 8.3 . Sediment: pH 7.8; O.C. = 0.9 %).** First Order $\mathbf{t}_{1/2}$; total system: 77 days (LL) (r^2 = 0.5853). Observed DT50 in total system: *ca.* 70 days. Sterile $\mathbf{t}_{1/2}$; total system: 399 days (LL) **Matrix: Pond water-silt loam sediment from Walnut Grove, Tennessee. (water pH 5.5 . Sediment: pH 5.1; O.C. = 0.5 %).** First Order $\mathbf{t}_{1/2}$; total system: 73 days (LL) (r^2 = 0.5691). Observed DT50 in total system: *ca.* 28 days. Sterile $\mathbf{t}_{1/2}$; total system: 95 days (LL) Major transformation products: saccharin. free acid sulfonamide. Minor identified transformation products: Methyl-2-aminocarbonyl(aminosulfonyl)benzoate.	4413010-20 (143540)

Table 5. Key results of sulfometuron methyl environmental fates studies.

Parameter [Guideline #]	***Value***[1]	***MRID(s)***
Aerobic aquatic metabolism [162-4]	Study performed with [pyrimidine-2-^{14}C] Sulfometuron Methyl **Matrix used: Pond water-silt loam sediment (Landenberg, acidic system).** First Order **t**$_{½}$; total system: 9.2 days (LL) (r^2 = 0.94). Observed DT50 in total system: 15 days. Observed DT90 in total system: 31 days (extrapolated). Major transformation products: Pyrimidine amine (pyrimidine label). Hydroxymethyl-pyrimidine sulfometuron methyl. Free acid sulfonamide (phenyl label). Sulfonamide (phenyl label). Minor identified transformation products: CO_2. **Matrix used: Pond water-sand sediment (Bradenton, alkaline system).** First Order **t**$_{½}$; total system: 187.3 days (LL) (r^2 = 0.5713). Observed DT50 in total system: >39 days. Major transformation products: Pyrimidine amine (pyrimidine label). Free acid sulfonamide (phenyl label). Minor identified transformation products: Hydroxymethyl-pyrimidine sulfometuron methyl. Sulfonamide (phenyl label). CO_2.	42091403 and 43174103

Table 5. Key results of sulfometuron methyl environmental fates studies.

Parameter [Guideline #]	***Value[1]***	***MRID(s)***
Adsorption/ Desorption (K_d and **K_{oc}** in L Kg^{-1})	**<u>Parent sulfometuron methyl</u>:** Soil type: Chino Sandy loam; pH 7.1, organic carbon 1.0%. Adsorption K_d: 0.35. Adsorption K_{oc}: 35. Freundlich adsorption K_F: 0.153. Freundlich adsorption K_{Foc}: 14.7. Soil type: Fargo silt loam ; pH 7.7, organic carbon 2.6%. Adsorption K_d: 2.07. Adsorption K_{oc}: 79.6. Freundlich adsorption K_F: 2.12. Freundlich adsorption K_{Foc}: 83.2. Soil type: Miaka Sand ; pH 7.0, organic carbon 0.6%. Adsorption K_d: Not applicable. Adsorption K_{oc}: Not applicable. Freundlich adsorption K_F: 0.508. Freundlich adsorption K_{Foc}: 87.6. Soil type: Tama Silt loam ; pH 6.7, organic carbon 1.5%. Adsorption K_d: 0.79. Adsorption K_{oc}: 52.7. Freundlich adsorption K_F: 0.974. Freundlich adsorption K_{Foc}: 67.2.	42789301

Table 5. Key results of sulfometuron methyl environmental fates studies.

Parameter [Guideline #]	***Value*[1]**	***MRID(s)***
Adsorption/ Desorption Of **<u>Degradates</u>**	**<u>Pyrimidine amine</u>** Soil type: Chino Sandy loam. Freundlich adsorption K_F: 3.3. Freundlich adsorption K_{Foc}: 315. Soil type: Fargo Silt loam. Freundlich adsorption K_F: 3.7. Freundlich adsorption K_{Foc}: 145. Soil type: Miaka Sand. Freundlich adsorption K_F: 0.17. Freundlich adsorption K_{Foc}: 29.4. Soil type: Tama Silt loam. Freundlich adsorption K_F: 2.9. Freundlich adsorption K_{Foc}: 203. **Results Synopsis: [^{14}C]Saccharin** Soil type: Chino Sandy loam. Freundlich adsorption K_F: 0.11. Freundlich adsorption K_{Foc}: 10.5. Soil type: Fargo silt loam. Freundlich adsorption K_F: 0.27. Freundlich adsorption K_{Foc}: 10.6. Soil type: Miaka Sand. Freundlich adsorption K_F: 0.033. Freundlich adsorption K_{Foc}: 5.73. Soil type: Tama Silt loam. Freundlich adsorption K_F: 0.13. Freundlich adsorption K_{Foc}: 8.72.	42789301

Table 5. Key results of sulfometuron methyl environmental fates studies.

Parameter [Guideline #]	***Value[1]***	***MRID(s)***
Terrestrial Field/Lysimeter Dissipation [2]	Greenville, MS silty clay loam soil: pH 6.7, 0.6% O.C. Half-life: 49.2 days (LL) (based on 0- to 359-day data); 12.2 days (LL) (based on 0- to 91-day data). DT90: 32 days Major transformation products detected (>0.01 ppm): Sulfometuron free acid (SFA) Pyrimdine amine (PYA) Sulfonamide IN-D5803 (SFN) Saccharin IN-581 (SCC) Rochelle, IL silty clay loam soil: pH 6.8, 1.0% O.C. Half-life: 128 days (based on 0- to 723-day data, residues in 0-15 cm depth only); 14.4 days (based on 0- to 90-day data). DT90: 35 days Major transformation products detected (>0.01 ppm): PYA, SFN, and SCC Uvale, TX clay soil: pH 7.9, 1.3% O.C. Half-life: 53.3 days (LL) (based on 0- to 447-day data); 13.0 days (LL) (based on 0- to 90-day data). DT90: 25 days Major transformation products detected (>0.01 ppm): PYA, SFN, and SCC Maldera, CA sandy loam soil: pH 7.8, 0.7% O.C. Half-life: 44.1 days (LL) (based on 0- to 420-day data); 22.9 days (LL) (based on 0- to 180-day data). DT90: 55 days Major transformation products detected (>0.01 ppm): PYA, SFN, and SCC	Numbers 43212101 and 43637101

[1] LL = "Log-linear" degradation rate calculation; process of calculating degradation rates and half-lives from linear regression of log-transformed concentration measurements over time. This provides a first-order type of measurement of pesticide decline.

[2] For these field dissipation studies, differences between half-lives measured over various time durations apparently reflect both slowing of degradation at lower temperatures and a large variability in measured concentrations; also, a 2-compartment degradation model for adsorbed and dissolved sulfometuron is quite possibility more appropriate (little dissipation of the remaining residues in the topsoil occurred during the second year of these studies, for example). A 2-compartment model was not used to represent dissipation rate here because the data are not sufficient robust (e.g., very high variability between replicate measurements), the effects of weather changes on degradation rate cannot easily be isolated, and the amount of residues lost through dissipation out of the topsoil also cannot be separated from the amount lost to degradation.

APPENDIX 3: MODELING INPUT AND OUTPUT

FIRST Modeling Input and Output Files

Sulfometuron methyl parent, Single application, Aerial.

```
RUN No.   1 FOR Sulfometuron met ON   Forest        * INPUT VALUES *
   --------------------------------------------------------------------
    RATE (#/AC)   No.APPS &   SOIL  SOLUBIL  APPL TYPE  %CROPPED INCORP
     ONE(MULT)    INTERVAL    Koc   (PPM )   (%DRIFT)     AREA    (IN)
   --------------------------------------------------------------------
   .375(   .375)   1   1      35.0  244.0   AERIAL(16.0)  87.0    .0


   FIELD AND RESERVOIR HALFLIFE VALUES (DAYS)
   --------------------------------------------------------------------
   METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
    (FIELD)  RAIN/RUNOFF  (RESERVOIR)  (RES.-EFF)   (RESER.)   (RESER.)
   --------------------------------------------------------------------
     61.00        2          N/A       .00-     .00   292.00    292.00


   UNTREATED WATER CONC (MICROGRAMS/LITER (PPB)) Ver 1.1.0  JAN 1, 2007
   --------------------------------------------------------------------
        PEAK DAY  (ACUTE)      ANNUAL AVERAGE (CHRONIC)
          CONCENTRATION             CONCENTRATION
   --------------------------------------------------------------------
             31.962                     14.508
```

Sulfometuron methyl parent, Single application, Ground.

```
   RUN No.   3 FOR Sulfometuron met ON   Forest - G    * INPUT VALUES *
   --------------------------------------------------------------------
    RATE (#/AC)   No.APPS &   SOIL  SOLUBIL  APPL TYPE  %CROPPED INCORP
     ONE(MULT)    INTERVAL    Koc   (PPM )   (%DRIFT)     AREA    (IN)
   --------------------------------------------------------------------
   .375(   .375)   1   1      35.0  244.0   GROUND( 6.4)  87.0    .0


   FIELD AND RESERVOIR HALFLIFE VALUES (DAYS)
   --------------------------------------------------------------------
   METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
    (FIELD)  RAIN/RUNOFF  (RESERVOIR)  (RES.-EFF)   (RESER.)   (RESER.)
   --------------------------------------------------------------------
     61.00        2          N/A       .00-     .00   292.00    292.00


   UNTREATED WATER CONC (MICROGRAMS/LITER (PPB)) Ver 1.1.0  JAN 1, 2007
   --------------------------------------------------------------------
        PEAK DAY  (ACUTE)      ANNUAL AVERAGE (CHRONIC)
          CONCENTRATION             CONCENTRATION
   --------------------------------------------------------------------
             31.980                     14.500
```

Sulfometuron methyl parent, 2 applications, Aerial.

```
RUN No.   8 FOR Sulfometuron met ON   Forest - A    * INPUT VALUES *
--------------------------------------------------------------------
 RATE (#/AC)   No.APPS &   SOIL  SOLUBIL  APPL TYPE  %CROPPED INCORP
  ONE(MULT)    INTERVAL    Koc   (PPM )   (%DRIFT)     AREA    (IN)
--------------------------------------------------------------------
.188(   .321)   2  30      35.0  244.0   AERIAL(16.0)  87.0    .0


FIELD AND RESERVOIR HALFLIFE VALUES (DAYS)
--------------------------------------------------------------------
METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
 (FIELD)  RAIN/RUNOFF  (RESERVOIR)  (RES.-EFF)   (RESER.)   (RESER.)
--------------------------------------------------------------------
  61.00        2          N/A       .00-     .00   292.00    292.00


UNTREATED WATER CONC (MICROGRAMS/LITER (PPB)) Ver 1.1.0  JAN 1, 2007
--------------------------------------------------------------------
     PEAK DAY  (ACUTE)      ANNUAL AVERAGE (CHRONIC)
       CONCENTRATION             CONCENTRATION
--------------------------------------------------------------------
          27.573                    12.519
```

Sulfometuron methyl parent, 3 applications, 90-day interval, Aerial.

```
RUN No.  10 FOR Sulfometuron met ON   Forest - a    * INPUT VALUES *
--------------------------------------------------------------------
 RATE (#/AC)   No.APPS &   SOIL  SOLUBIL  APPL TYPE  %CROPPED INCORP
  ONE(MULT)    INTERVAL    Koc   (PPM )   (%DRIFT)     AREA    (IN)
--------------------------------------------------------------------
.125(   .186)   3  90      35.0  244.0   AERIAL(16.0)  87.0    .0


FIELD AND RESERVOIR HALFLIFE VALUES (DAYS)
--------------------------------------------------------------------
METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
 (FIELD)  RAIN/RUNOFF  (RESERVOIR)  (RES.-EFF)   (RESER.)   (RESER.)
--------------------------------------------------------------------
  61.00        2          N/A       .00-     .00   292.00    292.00


UNTREATED WATER CONC (MICROGRAMS/LITER (PPB)) Ver 1.1.0  JAN 1, 2007
--------------------------------------------------------------------
     PEAK DAY  (ACUTE)      ANNUAL AVERAGE (CHRONIC)
       CONCENTRATION             CONCENTRATION
--------------------------------------------------------------------
          16.532                     7.512
```

Sulfometuron methyl parent, 3 applications, 45-day interval, Aerial.

```
RUN No.  11 FOR Sulfometuron met ON   Forest aer    * INPUT VALUES *
```

```
    ------------------------------------------------------------------
     RATE (#/AC)   No.APPS &   SOIL  SOLUBIL  APPL TYPE  %CROPPED INCORP
      ONE(MULT)    INTERVAL    Koc   (PPM )   (%DRIFT)     AREA    (IN)
    ------------------------------------------------------------------
    .125(   .245)   3  45      35.0  244.0   AERIAL(16.0)  87.0    .0


    FIELD AND RESERVOIR HALFLIFE VALUES (DAYS)
    ------------------------------------------------------------------
    METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
     (FIELD)  RAIN/RUNOFF  (RESERVOIR)  (RES.-EFF)   (RESER.)   (RESER.)
    ------------------------------------------------------------------
      61.00       2          N/A        .00-     .00   292.00    292.00


    UNTREATED WATER CONC (MICROGRAMS/LITER (PPB)) Ver 1.1.0  JAN 1, 2007
    ------------------------------------------------------------------
         PEAK DAY  (ACUTE)      ANNUAL AVERAGE (CHRONIC)
           CONCENTRATION             CONCENTRATION
    ------------------------------------------------------------------
             21.389                      9.715
```

Sulfometuron methyl total residues, Single application, Aerial.

```
RUN No.  12 FOR Sulfometuron Tot ON   Forest        * INPUT VALUES *
    ------------------------------------------------------------------
     RATE (#/AC)   No.APPS &   SOIL  SOLUBIL  APPL TYPE  %CROPPED INCORP
      ONE(MULT)    INTERVAL    Koc   (PPM )   (%DRIFT)     AREA    (IN)
    ------------------------------------------------------------------
    .375(   .375)   1   1      35.0  244.0   AERIAL(16.0)  87.0    .0


    FIELD AND RESERVOIR HALFLIFE VALUES (DAYS)
    ------------------------------------------------------------------
    METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
     (FIELD)  RAIN/RUNOFF  (RESERVOIR)  (RES.-EFF)   (RESER.)   (RESER.)
    ------------------------------------------------------------------
     136.00       2          N/A        .00-     .00      .00       .00


    UNTREATED WATER CONC (MICROGRAMS/LITER (PPB)) Ver 1.1.0  JAN 1, 2007
    ------------------------------------------------------------------
         PEAK DAY  (ACUTE)      ANNUAL AVERAGE (CHRONIC)
           CONCENTRATION             CONCENTRATION
    ------------------------------------------------------------------
             32.354                     21.819
```

Sulfometuron methyl total residues, 2 applications, 30 day interval, Aerial.

```
    RUN No.  13 FOR Sulfometuron Tot ON   Forest        * INPUT VALUES *
    ------------------------------------------------------------------
     RATE (#/AC)   No.APPS &   SOIL  SOLUBIL  APPL TYPE  %CROPPED INCORP
      ONE(MULT)    INTERVAL    Koc   (PPM )   (%DRIFT)     AREA    (IN)
    ------------------------------------------------------------------
    .188(   .348)   2  30      35.0  244.0   AERIAL(16.0)  87.0    .0
```

```
FIELD AND RESERVOIR HALFLIFE VALUES (DAYS)
--------------------------------------------------------------------
METABOLIC  DAYS UNTIL  HYDROLYSIS   PHOTOLYSIS   METABOLIC  COMBINED
 (FIELD)  RAIN/RUNOFF  (RESERVOIR)  (RES.-EFF)   (RESER.)   (RESER.)
--------------------------------------------------------------------
 136.00        2          N/A       .00-     .00      .00       .00


UNTREATED WATER CONC (MICROGRAMS/LITER (PPB)) Ver 1.1.0  JAN 1, 2007
--------------------------------------------------------------------
     PEAK DAY  (ACUTE)      ANNUAL AVERAGE (CHRONIC)
       CONCENTRATION            CONCENTRATION
--------------------------------------------------------------------
         30.208                    20.375
```

SCI-GROW Modeling Input and Output Files

```
                   SCIGROW VERSION 2.3
            ENVIRONMENTAL FATE AND EFFECTS DIVISION
                 OFFICE OF PESTICIDE PROGRAMS
             U.S. ENVIRONMENTAL PROTECTION AGENCY
                      SCREENING MODEL
                FOR AQUATIC PESTICIDE EXPOSURE
```

Parent Compound:

```
SciGrow version 2.3
 chemical:Sulfometuron Total Resides
 time is 10/31/2007  12:30:46
 -----------------------------------------------------------------------
  Application      Number of       Total Use    Koc      Soil Aerobic
  rate (lb/acre)  applications   (lb/acre/yr)  (ml/g)   metabolism (days)
 -----------------------------------------------------------------------
     0.375           1.0           0.375      7.34E+01       55.2
 -----------------------------------------------------------------------
 groundwater screening cond (ppb) =   3.29E-01
 ***********************************************************************
```

Total Residues:

```
 SciGrow version 2.3
 chemical:Sulfometuron Total Residues
 time is 10/ 4/2007  14:16:15
 -----------------------------------------------------------------------
  Application      Number of       Total Use    Koc      Soil Aerobic
  rate (lb/acre)  applications   (lb/acre/yr)  (ml/g)   metabolism (days)
 -----------------------------------------------------------------------
     0.375           1.0           0.375      7.34E+01      136.0
 -----------------------------------------------------------------------
 groundwater screening cond (ppb) =   1.13E+00
 ***********************************************************************
```