Appendix B:
Ecological Effects - Risks of Metolachlor Use to Federally Listed Endangered Barton Springs Salamander

May 2007

APPENDIX B – ECOLOGICAL EFFECTS
Table 1 Summary of Registrant Submitted Acute Toxicity Studies for Fish

Species	LC_{50} (mg/L)	Slope	95% C.I. (mg/L)	LOAEC (mg/L)	NOAEC (mg/L)	MRID	Toxicity Category	Study Classification	Notes
Technical Racemic Metoachlor (CGA-24705)									
Rainbow trout* *(Onchorhyncus mykiss)*	**3.8**	N/A	3.3-4.6	4.1	2.8	00018722	Moderately toxic	Core	1978 study
Crucian Carp *(Carassius carassius)*	4.9	N/A	3.6-6.8	N/A	N/A	00015534	Moderately toxic	Supplemental	1974 studies. Sublethal effects: hypersensitivity, loss of equilibrium, apathy
Channel catfish *(Ictalurus punctatus)*	4.9	N/A	3.6-6.8	2.1	1		Moderately toxic	Core	
Guppy *(Lebistes reticulates)*	8.6	N/A	7.4-10.5	N/A	N/A		Moderately toxic	Supplemental	
Bluegill sunfish *(Lepomis macrochirus)*	15.0	N/A	N/A	N/A	N/A		Slightly toxic	Supplemental	
Fathead minnow *(Pimophales promelas)*	9.2	N/A	7.9-11.0	N/A	N/A	00162428	Moderately toxic	Supplemental	Mortality to juvenile fish observed at ≥2.6 ppm
Bluegill sunfish *(Lepomis macrochirus)*	10.0	N/A	8.6-12	8.8	6	00018723	Moderately toxic	Core	1978 study
Sheepshead minnow *(Cyrpinodon variegatus)*	7.9	N/A	4.4-infinity	9.4	4.4	43044602	Moderately toxic	Supplemental	Single partial kill, (70%) at highest concentration tested
Sheepshead minnow *(Cyrpinodon variegatus)*	9.8	N/A	8.5-11.4	6.2	3.6	4347101	Moderately toxic	Core	Sub-lethal effects at ≥6.2 ppm: lethargy, loss of equilibrium
Technical S-metolachlor (CGA-77102)									
Bluegill sunfish* *(Lepomis macrochirus)*	**3.2**	14.8	2.8-4.6	2.6	1.5	43928910	Moderately toxic	Core	Sub-lethal effects at ≥3.3 ppm: loss of equilibrium

Species	LC_{50} (mg/L)	Slope	95% C.I. (mg/L)	LOAEC (mg/L)	NOAEC (mg/L)	MRID	Toxicity Category	Study Classification	Notes
Rainbow trout *(Onchorhyncus mykiss)*	11.9	N/A	8.3-15	5.3	2.5	43928911	Slightly toxic	Core	Sub-lethal effects at ≥5.3 ppm: loss of equilibrium, extended abdomen, lethargy.
Metabolite, Metolachlor-OA (CGA-51202)									
Rainbow trout *(Onchorhyncus mykiss)*	>96.3	N/A	N/A	N/A	>96.3	44929501	Practically non-toxic	Supplemental	Purity not available, however analytical measurements provided
Crucian Carp* *(Carassius carassius)*	**>93.1**	N/A	N/A	N/A	>96.3	44929502	Practically non-toxic	Supplemental	
Metabolite, Metolachlor-ESA (CGA-354743)									
Rainbow trout* *(Onchorhyncus mykiss)*	**48**	N/A	36-64	64	36	449931702	Slightly toxic	Supplemental	Sub-lethal effects at ≥58 ppm: loss of equilibrium, erratic swimming, pigmentation changes.

N/A – not available, * and **LC_{50}** are lowest values.

Table 2 Summary of Registrant Submitted Acute Toxicity Studies for Aquatic Invertebrates

Species	LC_{50} (mg/L)	Slope	95% C.I. (mg/L)	LOAEC (mg/L)	NOAEC (mg/L)	MRID	Toxicity Category	Study Classification	Notes
Technical Racemic Metoachlor (CGA-24705)									
Eastern oyster *(Crassostrea virginica)*	EC_{50} 1.6	5	1.4-1.9	1.1	0.7	43487102	Moderately toxic	Core	LOAEC based on reduced mean shell deposition. Sublethal effects at 4.5 ppm: reduced feeding and digestive activity
Mysid shrimp *(Mysidopsis bahia)*	4.9	6.6	4.2-5.9	4	2.3	43487103	Moderately toxic	Core	Sublethal effects at ≥4.0 ppm: lethargy, dark pigmentation
Water flea *(Daphnia magna)*	25.1	N/A	21.4-29.1	10	5.6	0005546	Slightly toxic	Core	None
Technical S-metolachlor (CGA-77102)									
Water flea *(Daphnia magna)*	26	9.1	23-30	7.9	4.8	43928912	Slightly toxic	Core	Sublethal effects at ≥7.9 ppm: lethargy
Metabolite, Metolachlor-OA (CGA-51202)									
Water flea *(Daphnia magna)*	15.4	6.1	13.0-18.4	9.1	5.2	44929503	Slightly toxic	Supplemental	
Metabolite, Metolachlor-ESA (CGA-354743)									
Water flea *(Daphnia magna)*	>108	N/A	N/A	N/A	108	44931703	Practically non-toxic	Core	108 ppm highest concentration tested

Table 3 Summary of Registrant Submitted Acute Toxicity Studies for Aquatic Plants

Species	LC_{50} (mg/L)	Slope	95% C.I. (mg/L)	LOAEC (mg/L)	NOAEC (mg/L)	MRID	Study Classification
Technical Racemic Metoachlor (CGA-24705)							
Green algae *(Selenasturm capricornutum)*	**0.010**	1.7	0.006-0.20	0.0014	0.0007	43541301	Core
Duckweed *(Lemna gibba)*	0.048	N/A	0.043-0.056	0.015	0.0084	43487105	Core
SW diatom *(Skeletenema costatum)*	0.061	N/A	0.049-0.076	0.0048	0.0017	43487106	Core
FW diatom *(Navicula pelliculosa)*	0.38	0.89	0.27-0.56	0.013	0.0037	43541302	Core
Bluegreen algae *(Anabaena flos-aquae)*	1.2	1.2	0.9-1.6	0.19	0.063	43487104	Core
Technical S-metolachlor (CGA-77102)							
Green algae *(Selenasturm capricornutum)*	**0.008**	3	0.0026-0.025	0.003	0.0015	43928929	Core
Duckweed *(Lemna gibba)*	0.021	N/A	0.019-0.023	0.018	0.0076	43928931	Core
SW diatom *(Skeletenema costatum)*	0.11	N/A	0.091-0.128	0.081	0.021	43928930	Core
Metabolite, Metolachlor-OA (CGA-51202)							
Green algae *(Scenedesmus subspicatus)*	**57.1**	N/A	29.3-infinity	92.2	29.3	44929515	Supplemental
Duckweed *(Lemna gibba)*	>95.1	N/A	N/A	>95.4	95.4	44929514	Core
Metabolite, Metolachlor-ESA (CGA-354743)							
Duckweed *(Lemna gibba)*	**43**	1.6	30-61	6.1	4	44931720	Core
Green algae *(Selenasturm capricornutum)*	>99.45	N/A	N/A	>99.45	99.45	44931719	Supplemental

Table 4 Summary of Registrant Submitted Acute Toxicity Studies for Terrestrial Plants

Test	Species	Endpoint	EC_{25} (lb ai/A)	95% C.I. (lb ai/A)	LOAEC (lb ai/A)	NOAEC (lb ai/A)	MRID	Classification	Notes
Technical Racemic Metoachlor (CGA-24705)									
Seedling emergence	Ryegrass (monocot)	Height, dry weight	0.02	0.017-0.033	0.0061	0.0031	43487107	Core	1995 study (part of RED data call-in)
	Lettuce (dicot)	Dry weight	0.09	0.012-0.62	0.25	0.012			
	Cucumber (dicot)	Dry weight	0.09	0.043-0.19	>0.049	0.049			
Vegetative vigor	Ryegrass (monocot)	Dry weight	0.016	0.012-0.20	0.0061	0.0031	43487108	Core	1995 study (part of RED data call-in)
	Cucumber (dicot)	Dry weight	0.03	0.020-0.046	0.049	0.025			
Technical S-metolachlor (CGA-77102)									
Seedling emergence	Ryegrass (monocot)	Phytotoxicity	0.0048	N/A	0.011	0.001	43928932	Supplemental	Supplemental because only six tests were run rather than required ten. Data is acceptable. NOAECsare predicted EC_{05}.
	Lettuce (dicot)	Dry weight	0.0057	0.0011-0.0308	0.0037	0.0003			
Vegetative vigor	Ryegrass (monocot)	Dry weight	0.021	0.012-0.037	0.033	0.011	43928933	Supplemental	
	Cucumber (dicot)	Phytotoxicity	0.27	0.12-0.65	0.033	0.01			
Metabolite, Metolachlor-OA (CGA-51202)									
Seedling emergence	Monocot & dicot	Multiple	>0.5	N/A		<0.5	44929513	Core	Tier I tests
Vegetative vigor									
Metabolite, Metolachlor-ESA (CGA-354743)									
Seedling emergence	Ryegrass (monocot)	Dry weight	<0.5	N/A	N/A	<0.5	4491718	Core	Tier I test. Ryegrass shoot dry weight reduced 31% at 0.5 lb ai/A
	Multiple (dicot)	Multiple		N/A	N/A	<0.5 (tomato, cucumber, carrot)	4491718	Core	
Vegetative vigor	Multiple (dicot & monocot)	Multiple	>0.5	N/A	N/A	0.5 (monocot & dicot)	44929513	Core	Tier I tests

Table 5 Summary of Registrant-Submitted Chronic Toxicity Data for Aquatic Organisms

Species	LOAEC (mg/L)	NOAEC (mg/L)	95% C.I. (mg/L)	MRID	Study Classification	Notes
Technical Racemic Metoachlor (CGA-24705)						
Water flea *(Daphnia magna)*	6.9	3.2	5.9-12	43802601	Supplemental	None
Sheepshead minnow *(Cyrpinodon variegates)*	2.2	1	1.0-2.2	43044602	Supplementa	Based on reduction in larvale fish dry weight. Increase in mortality affected at ≥ 5 ppm. Hatch rate affected at 8.6 ppm
Technical S-metolachlor (CGA-77102)						
Mysid shrimp *(Mysidopsis bahia)*	0.25	0.13	N/A	44995902	Core	LOAEC for female growth. LOAECs for other endpoints: neonates produced 0.51 ppm, survival >0.51 ppm.
Fathead minnow *(Pimephales promelas)*	0.056	0.03	N/A	44995903	Supplemental	Based on reduced dry weight of larval fish

N/A – not available.

Table 6 Summary of ECOTOX Toxicity Studies on Metolachlor for Aquatic and Semi-aquatic Animals

Species	Measurement	Type of Effect	Endpoint	Concentration (mg/L)	ECOTOX Ref#
Aquatic Invertebrates					
Water flea *(Ceriodaphnia dubia)*	Immobilization (*i.e.,* mortality)	Acute	EC_{50}	1.10	67777
Midge fly larvae *(Chironomus plumosus)*	Immobilization (*i.e.,* mortality)	Acute	EC_{50}	3.80	6797
Water flea *(Daphnia magna)*	Immobilization (*i.e.,* mortality)	Acute	EC_{50}	4.25	67700
Midge fly larvae *(Chironomus plumosus)*	Immobilization (*i.e.,* mortality)	Acute	EC_{50}	4.40	6797
Water flea *(Ceriodaphnia dubia)*	Mortality	Acute	LC_{50}	15.93	13689
Water flea *(Daphnia magna)*	Immobilization (*i.e.,* mortality)	Acute	EC_{50}	23.50	6797
Water flea *(Daphnia magna)*	Immobilization (*i.e.,* mortality)	Acute	EC_{50}	26.00	6797
Hydra (*Hydra attenuata)*	Mortality	Acute	LC_{50}	>45	67700
Water flea *(Ceriodaphnia dubia)*	Length, longevity, days to first brood, broods per female, number young per female	Chronic	*Racemic* NOAEC LOAEC *S*- NOAEC LOAEC	 0.001 0.01 0.1 0.5	83887
Rusty crayfish *(Oronectes rusticus)*	Behavioral: food seeking and alarm response, based on olfactory	Chronic	LOAEL	0.025	68515
Sour paste nematode *(Panagrellus redividus)*	Maturation, condition index	Chronic	LOAEL	2	67700
Water flea *(Ceriodaphnia dubia)*	Reproduction	Chronic	NOAEC	6.25	13689

Species	Measurement	Type of Effect	Endpoint	Concentration (mg/L)	ECOTOX Ref#
Fish					
Fathead minnow *(Pimephales promelas)*	Mortality	Acute	LC_{50}	8	6797
Fathead minnow *(Pimephales promelas)*	Mortality	Acute	LC_{50}	8.40	6797
Amphibians					
African clawed frog *(Xenopus laevis)*	Mortality	Acute	LC_{50}	13.6	66376
American bullfrog *(Rana catesbeiana)*	Mortality	Acute	EC_{50}	17.38	20274
American bullfrog *(Rana catesbeiana)*	Cellular damage	Acute sublethal	LOAEL	0.272	20274
African clawed frog *(Xenopus laevis)*	Reduced length	Acute sublethal	NOAEL	1	66376
African clawed frog *(Xenopus laevis)*	Abnormal growth	Acute sublethal	EC_{50}	76	66376

Table 7 Summary of Selected[1] ECOTOX Toxicity Studies on Metolachlor for Terrestrial Plants

Species	Plant Type	Measurement	Endpoint	Concentration (lb ai/A)	Exposure Type	ECOTOX Ref #
Barnyard grass *(Echinochloa crus-galli)*	Monocot	Growth (height)	90% reduction	0.11	Laboratory	73233
Mutton bluegrass *(Seteria faberi)*	Monocot	Growth (height)	90% reduction	0.11	Laboratory	73233
Purple crabgrass *(Digitaria sanguinalis)*	Monocot	Growth (height)	90% reduction	0.11	Laboratory	73233
Millet *(Panicum millaceum)*	Monocot	Growth (height)	50% reduction	0.11	Laboratory	73233
Broomcorn *(Sorghum bicolor)*	Monocot	Growth (height)	NOAEL	0.11	Laboratory	73233
Velvet leaf *(Abutilon theophrasti)*	??	Growth (height)	NOAEL	0.11	Laboratory	73233
Tatarian maple *(Acer tataricum)*	Dicot	Growth	LOAEL	3.0	Field	73251
Flowering dogwood *(Cormus florida)*	Dicot	Mortality	LOAEL	8.0	Field	73249
Pin oak *(Quercus palustris)*	Dicot	Growth, mortality	LOAEL	8.0	Field	73249
Willow oak *(Quercus phellos)*	Dicot	Mortality	LOAEL	8.0	Field	73249
Pin oak *(Quercus palustris)*	Dicot	Growth, mortality	NOAEL	4.0	Field	73249
Sugar maple *(Acer saccharum)*	Dicot	Growth, mortality	NOAEL	8.0	Field	73249
River birch *(Betula nigra)*	Dicot	Growth, mortality	NOAEL	8.0	Field	73249
Eastern redbud *(Cercis canandensis)*	Dicot	Growth, mortality	NOAEL	8.0	Field	73249
Flowering dogwood *(Cormus florida)*	Dicot	Growth	NOAEL	8.0	Field	73249

Species	Plant Type	Measurement	Endpoint	Concentration (lb ai/A)	Exposure Type	ECOTOX Ref #
Sweetgum *(Liquidambar styraciflua)*	Dicot	Growth, mortality	NOAEL	8.0	Field	73249
Willow oak *(Quercus phellos)*	Dicot	Growth	NOAEL	8.0	Field	73249
European white birch *(Betula pendula)*	Dicot	Growth	NOAEL	9.1	Field	73251

[1] Other studies were reported by ECOTOX, but were not in units readily convertible to units used in modeling (lbs ai/A or kg ai/ha), or were primarily efficacy studies

Reviews for ECOTOX Papers Used Quantitatively in this Assessment

Open Literature Review Summary

Chemical Name: Metolachlor

PC Code: 108801

ECOTOX Record Number and Citation:

Foster, S., Thomas, M., and Korth, W. (1998). Laboratory-Derived Acute Toxicity of Selected Pesticides to Ceriodaphnia dubia. *Aust.J.Ecotoxicol.* 4: 53-59.
EcoReference No.: 67777
Chemical of Concern: SZ,ATZ,CPY,MTL,TBC,MLT,MLN,BSF,BMC,DU; Habitat: A; Effect Codes: PHY; Rejection Code: LITE EVAL CODED(MTL,ATZ,SZ),OK(ALL CHEMS).

Purpose of Review (DP Barcode or Litigation):

Litigation

Barton Springs Salamander

California Red-legged Frog

Date of Review:

March 16, 2007

Summary of Study Findings:

Test methods based on USEPA (1991) *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms (4th Edition).*

Test organism *Ceriodaphnia dubia* neonates.

5 cladocerans per chamber, 5 replicates at each concentration (25 organisms/concentration).

Control group present.

Methanol solvent used for atrazine and simazine. Controls had >90% survival in solvent control. Paper also states a "control group was present for all 15-ml static tests," but does not specify if those were controls in test water only, or if those included solvent as appropriate for the particular pesticides tested. Solvent used (methanol) is acceptable and the concentration was in acceptable range (1%). Based on author's description of adherence to test standards and protocols, it is the reviewer's judgement that control use and survivability is adequate.

Both laboratory water and "supply" water tested. Supply water drawn from main irrigation supply channel at Griffith, NSW, Australia, and filtered through 60μm nylon mesh.

Endpoint was immobilization, examined under dark field illumination at 6.5X magnification. Results were recorded at 24 and 48 hours. EC_{50} and confidence intervals determined using trimmed Spearman-Karber method.

Water parameters monitored and reasonable. Supply water was more turbid and had a greater hardness compared to the laboratory water.

Pesticide concentration measured using GC-MSD.

Raw data not included in paper.

Results consistent with other toxicology data on metolachlor, and species sensitivity distribution of aquatic invertebrates.

Metolachlor results

Endpoint measured: Immobilization

Laboratory water

24-hr EC_{50} (95% CI) 5100 μg/L (1600-16000 μg/L)

48-hr EC_{50} (95% CI) 1100 μg/L (900-1400 μg/L)

Supply water

24-hr EC_{50} (95% CI) 2000 μg/L (1600-2400 μg/L)

Description of Use in Document (QUAL, QUAN, INV):

QUAL: 48-hr EC_{50} value used as toxicity value to evaluate risk to aquatic invertebrates representing prey species for the Barton Springs Salamander.

Rationale for Use:

Most sensitive endpoint located while preparing assessment.

Limitations of Study:

No specific limitations noted.

Primary Reviewer:

Paige Doelling Brown, Fisheries Biologist, ERB1

Secondary Reviewer

Edward Odenkirchen, Senior Scientist, ERB1

Open Literature Review Summary

Chemical Name: Metolachlor and S-metolachlor

PC Code: 108801 and 108800

ECOTOX Record Number and Citation:

Liu, H., Ye, W., Zhan, X., and Liu, W. (2006). A Comparative Study of Rac- and S-Metolachlor Toxicity to Daphnia magna. *Ecotoxicol.Environ.Saf.* 63: 451-455.
EcoReference No.: 83887

Chemical of Concern: MTC; Habitat: A; Effect Codes: REP,GRO,MOR; Rejection Code: LITE EVAL CODED(MTC),OK(ALL CHEMS).

Purpose of Review (DP Barcode or Litigation):

Litigation

Barton Springs Salamander

California Red-legged Frog

Date of Review:

March 16, 2007

Summary of Study Findings:

Test organism: *Daphnia magna* neonates (<24 hr)

Acute test: 20 neonates/test solution concentration, 4 replicates for each treatment (80 organisms /treatment). Mortality observations at 24 hours

Chronic test: Single daphnid/test solution concentration, 10 replicates for each treatment (10 organisms/treatment). 21-day test. 10 concentrations tested (including control), ranging from 0.001 mg/L to 15 mg/L.

Authors note test design is in accordance with OECD (1995) and ISO (1996) guidance for toxicity tests using *Daphnia magna*.

Parameters measured in chronic test: length, longevity, days to first brood, broods per female, number of young per female.

Concentration of pesticide in stock solution was determined analytically (HPLC), with 95-97% of original concentration remaining after one week. Stock solutions were renewed weekly during the test to minimize degradation of the compound. Authors do not describe analytical measurements of test solutions, thus concentrations are considered to be nominal.

Authors do not mention the number of daphnids used in controls, nor state survivability.

Significance for chronic testing was determined using ANOVA, followed by Duncan's test.

The most sensitive parameter was the number of young per female, which was significantly different at 0.01 mg/L for racemic metolochlor, and 0.5 mg/L for S-metolachlor. Other measured parameters were not significantly different until concentrations reached 1mg/L. For 3 out of 5 parameters measured, racemic metolachlor was toxic to daphnids at a lower concentration than S-metolachlor. For one parameter (length), effects were significant at the same concentration. Days to first brood was not affected at concentrations tested for either chemical.

"After the first brood was produced, all mothers died successively in both rac- and S-metolachlor at concentrations from 1 to 15 mg L^{-1}, especially at 10 to 15 mg L^{-1}. All mothers died after 21 days of exposure."

Authors also calculated the intrinsic rate of natural increase (*r*), based on results of the 21-day test. Racemic metolachlor significantly reduced *r* at concentrations above 0.01 mg/L and S-metolachlor significantly reduced *r* at concentrations above 0.5 mg/L.

Based on this study the chronic endpoints are:

Racemic metolachlor	NOAEC 0.001 mg/L	LOAEC 0.01 mg/L
S-metolachlor	NOAEC 0.1 mg/L	LOAEC 0.5 mg/L

Description of Use in Document (QUAL, QUAN, INV):

QUAN

Although some information is not reported in this study that would be required for guideline studies, based on information presented, reviewer believes the study is of sufficient quality to warrant inclusion into the risk assessment.

Rationale for Use:

Most sensitive endpoint located while preparing assessment.

Limitations of Study:

Concentrations of pesticide are nominal. However, both racemic and S-metolachlor are known to be persistent in aqueous solution, and nominal value is likely reflective of actual concentration to which the organisms were exposed.

Primary Reviewer:

Paige Doelling Brown, Fisheries Biologist, ERB1

Secondary Reviewer

Edward Odenkirchen, Senior Scientist, ERB1

Aquatic RQ Calculations for metolachlor (Barton Springs Salamander)
(PDB 04/12/07)

	means NOAEC from chronic study
blue	means confidence interval estimate
red	means exceedence of LOC
[1]	not applicable except in case of obligate relation

FW Fish (All units in ppm)

Estimate	Peak EEC	LC50	RQ	60-day EEC	NOAEC	RQ	RQ
Background	0.000013	3.2	4.06E-06	0.000013	1	1.30E-05	0.000
Spring EEC high (prior to plant aerial)	0.017228	3.2	5.38E-03	0.000411	1	4.11E-04	0.000
Spring EEC low (before emergence ground)	0.011802	3.2	3.69E-03	0.000263	1	2.63E-04	0.000

FW Aquatic Invertebrates (Acute *C. dubia*, chronic *D. magna*) (All units in ppm)

Estimate	Peak EEC	LC50	RQ	21-day EEC	NOAEC	RQ	RQ
Background	0.000013	1.1	0.00	0.000013	0.001	1.30E-02	0.013
Spring EEC high (prior to plant aerial)	0.017228	1.1	0.02	0.00101	0.001	1.01E+00	1.010
Spring EEC low (before emergence ground)	0.011802	1.1	0.01	0.000657	0.001	6.57E-01	0.657

FW Vascular Plant (Lemna) (All units in ppm)

Estimate	Peak EEC	LC50	Acute RQ	Peak EEC	NOAEC	ES RQ	ES RQ[1]
Background	0.000013	0.021	0.001	0.000013	0.0076	1.71E-03	0.002
Spring EEC high (prior to plant aerial)	0.017228	0.021	0.820	0.017228	0.0076	2.27E+00	2.267
Spring EEC low (before emergence ground)	0.011802	0.021	0.562	0.011802	0.0076	1.55E+00	1.553

FW Alga (All units in ppm)

Estimate	Peak EEC	LC50	Acute RQ	Peak EEC	NOAEC	ES RQ	ES RQ[1]
Background	0.000013	0.008	0.002	0.000013	0.0015	8.67E-03	0.009
Spring EEC high (prior to plant aerial)	0.017228	0.008	2.154	0.017228	0.0015	1.15E+01	11.485
Spring EEC low (before emergence ground)	0.011802	0.008	1.475	0.011802	0.0015	7.87E+00	7.868

FW Alga (95% CI) (All units in ppm)

Estimate	Peak EEC	LC50	Acute RQ	Peak EEC	NOAEC	ES RQ	ES RQ[1]
Spring EEC high (prior to plant aerial) lower bound	0.017228	0.003	5.743	0.017228	0.0015	1.15E+01	11.485
Spring EEC low (before emergence ground) lower bound	0.011802	0.003	3.934	0.011802	0.0015	7.87E+00	7.868
Spring EEC high (prior to plant aerial) upper bound	0.017228	0.025	0.689	0.017228	0.0015	1.15E+01	11.485
Spring EEC low (before emergence ground) upper bound	0.011802	0.025	0.472	0.011802	0.0015	7.87E+00	7.868

FW diatom (racemic) (All units in ppm)

Estimate	Peak EEC	LC50	Acute RQ	Peak EEC	NOAEC	ES RQ	ES RQ[1]
Spring EEC high (prior to plant aerial) lower bound	0.017228	0.38	0.045	0.017228	0.0037	4.66E+00	4.656
Spring EEC low (before emergence ground) lower bound	0.011802	0.38	0.031	0.011802	0.0037	3.19E+00	3.190

Blue-green (racemic) (All units in ppm)

Estimate	Peak EEC	LC50	Acute RQ	Peak EEC	NOAEC	ES RQ	ES RQ[1]
Spring EEC high (prior to plant aerial) lower bound	0.017228	1.2	0.014	0.017228	0.063	2.73E-01	0.273
Spring EEC low (before emergence ground) lower bound	0.011802	1.2	0.010	0.011802	0.063	1.87E-01	0.187

Aquatic RQ Calculations for metolachlor OA (Barton Springs Salamander)
(PDB 04/18/07)

means NOAEC from chronic study
ND means no data
NOAEC* is based on acute test, not chronic test

FW Fish (All units in ppm)

Estimate	Peak EEC	LC50	RQ	60-day EEC	NOAEC*	RQ	RQ
EOF high (prior to plant)	0.009754	93.1	1.05E-04	0.000178	96.3	1.85E-06	0.000
EOF low (before emergence)	0.005983	93.1	6.43E-05	0.000105	96.3	1.09E-06	0.000

FW Aquatic Invertebrates (Daphnia) (All units in ppm)

Estimate	Peak EEC	LC50	RQ	21-day EEC	NOAEC	RQ	RQ
EOF high (prior to plant)	0.009754	15.4	6.33E-04	0.00051	ND	#VALUE!	#VALUE!
EOF low (before emergence)	0.005983	15.4	3.89E-04	0.000298	ND	#VALUE!	#VALUE!

FW Vascular Plant (Lemna) (All units in ppm)

Estimate	Peak EEC	LC50	Acute RQ	Peak EEC	NOAEC	ES RQ	ES RQ
EOF high (prior to plant)	0.009754	95.1	0.000	0.009754	95.4	1.02E-04	0.000
EOF low (before emergence)	0.005983	95.1	0.000	0.005983	95.4	6.27E-05	0.000

FW Alga (All units in ppm)

Estimate	Peak EEC	LC50	Acute RQ	Peak EEC	NOAEC	ES RQ	ES RQ
EOF high (prior to plant)	0.009754	57.1	0.000	0.009754	29.3	3.33E-04	0.000
EOF low (before emergence)	0.005983	57.1	0.000	0.005983	29.3	2.04E-04	0.000

Aquatic RQ Calculations for metolachlor OA (Barton Springs Salamander)
(PDB 04/18/07)

means NOAEC from chronic study
ND means no data
NOAEC* is based on acute test, not chronic test

FW Fish (All units in ppm)

Estimate	Peak EEC	LC50	RQ	60-day EEC	NOAEC*	RQ	RQ
EOF high (at plant)	0.005251	48	1.09E-04	0.000089	36	2.47E-06	0.000
EOF low (before emergence)	0.002600	48	5.42E-05	0.000045	36	1.25E-06	0.000

FW Aquatic Invertebrates (Daphnia) (All units in ppm)

Estimate	Peak EEC	LC50	RQ	21-day EEC	NOAEC*	RQ	RQ
EOF high (at plant)	0.005251	108	4.86E-05	0.002500	108	2.31E-05	0.000
EOF low (before emergence)	0.002600	108	2.41E-05	0.000129	108	1.19E-06	0.000

FW Vascular Plant (Lemna) (All units in ppm)

Estimate	Peak EEC	LC50	Acute RQ	Peak EEC	NOAEC	ES RQ	ES RQ
EOF high (at plant)	0.005251	95.1	0.000	0.005251	95.4	5.50E-05	0.000
EOF low (before emergence)	0.002600	95.1	0.000	0.002600	95.4	2.73E-05	0.000

FW Alga (All units in ppm)

Estimate	Peak EEC	LC50	Acute RQ	Peak EEC	NOAEC	ES RQ	ES RQ
EOF high (at plant)	0.005251	99.5	0.000	0.005251	99.5	5.28E-05	0.000
EOF low (before emergence)	0.002600	99.5	0.000	0.002600	99.5	2.61E-05	0.000