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OFFICE OF
PREVENTION, PESTICIDES AND
TOXIC SUBSTANCES

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MEMORANDUM

SUBJECT: Environmental Fate and Ecological Risk Assessment in Support of the Section 3 Registration of the New Chemical Pyrasulfotole (Bayer 309).

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The Environmental Fate and Effects Division (EFED) has completed the draft environmental fate and ecological risk assessment in support of the Section 3 registration decision on the new herbicide pyrasulfotole (Bayer 309). The results of this screening-level risk assessment indicate that the proposed uses of pyrasulfotole at a maximum application rate of 0.045 lb a.i./acre have the potential for direct adverse effects for terrestrial and semi-aquatic dicotyledonous plants, some small mammals less than 35 g (chronic exposure), and listed freshwater vascular plants. Regarding listed species, EFED's screening level analysis shows the possibility of direct effects to listed aquatic vascular plants, terrestrial and semi-aquatic dicotyledonous plants, and mammals (chronic exposure). RQs are reduced to below Agency LOCs for listed aquatic vascular plants and mammals (listed and non-listed) with application rates of **≤0.030 lb a.i./acre and ≤ 0.023 lb** a.i./acre, respectively, indicating direct risks to these taxa would not be expected at these application rates. At this time, no Federally-listed taxa can be excluded from the potential for direct and/or indirect effects from the proposed uses of pyrasulfotole, since there is a potential for indirect effects to taxa that might rely on plants (even at a maximum application rate of 0.023 lb a.i./acre) and/or mammals for some stage of their life-cycle. Based on LOCATES, there is the potential for a total of 390 listed species to be directly affected by the proposed uses of pyrasulfotole, while 427 species may be indirectly affected by the use of the chemical. Details regarding the environmental fate, ecological effects and ecological risks associated with the current uses of pyrasulfotole can be found in the executive summary of the attached document.

Data Gaps

Table A.1. identifies the status of environmental fate and transport study requirements and **Table A.2.** identifies the status of ecological effects study requirements. The available environmental fate and transport data for pyrasulfotole are considered complete and are adequate for risk assessment purposes.

Most of the ecological effects data gaps result from uncertainties surrounding potential ecological risks associated with the chronic effects of pyrasulfotole in estuarine/marine invertebrates. Estuarine/marine invertebrates (*i.e.*, mysids) are at least 100 times more sensitive to pyrasulfotole on an acute exposure basis than all of the other aquatic animals tested and pyrasulfotole is persistent, however, no chronic data are available for this taxon. Risks to estuarine/marine invertebrates are not expected with the current proposed use on cereal grains, in part because the use sites associated with cereal grains are largely outside of estuarine/marine environments. However, if the uses for pyrasulfotole are expanded beyond cereal grains, the potential risk to estuarine/marine invertebrates will need to be re-assessed. Therefore, we recommend that the toxicity studies for estuarine/marine animals be held '**In Reserve**' at this time.

Additionally, because pyrasulfotole is persistent and has the potential to progressively bind to certain soils through time as it degrades and forms unextractable residues, there is the potential for pyrasulfotole (or residues of concern) to accumulate in the benthos at levels that could result in toxic exposure to benthic and epibenthic aquatic organisms, especially those that consume soil. The potential risk to benthic and epibenthic organisms could not be assessed here, however, because a lack of available toxicity data for these taxa. Due to the lack of data and the potential for adverse effects, we recommend that acute and chronic toxicity data on benthic animals be **requested** by the registrant.

Labeling Recommendations

According to the Label Review Manual, the following label statements are recommended:

Environmental Hazards

> "Do not apply directly to water, or to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwater or rinsate."

Ground Water Advisory

> "Pyrasulfotole is known to leach through soil into ground water under certain conditions as a result of label use. Use of this chemical in areas where soils are permeable, particularly where the water table is shallow, may result in ground-water contamination."

Surface Water Label Advisories

> "This product may contaminate water through drift of spray in wind. This product has a high potential for runoff for several months or more after application after application. Poorly draining soils and soils with shallow water tables are more prone to produce runoff that contains this product. A level, well maintained vegetative buffer strip between areas to which this product is applied and surface water features such as ponds, streams, and springs will reduce the potential for contamination of water from rainfall-runoff. Runoff of this product will be reduced by avoiding applications when rainfall is forecasted to occur within 48 hours."

Table A. 1. Ecological Fate Studies for Pyrasulfotole.

GUIDE-LINE	MRID	STUDY TITLE	EPA CLASSI-FICATION	ARE DATA ADEQUATE FOR RISK ASSESSMENT?	COMMENTS
161-1	46801705	[Pyrazole-3-14C] AE0317309: hydrolytic degradation	Acceptable	Yes	None
161-2	46801706	[^{14}C-UL-Phenyl] and [^{14}C-3-pyrazole] AE0317309: phototransformation in water	Acceptable	Yes	None
161-3	46801707	[Pyrazole-3-^{14}C] AE0317309: phototransformation on soil	Acceptable	Yes	None
162-1	46801709	[Phenyl-U-^{14}C]- and [pyrazole-3-^{14}C]-AE 0317309: aerobic soil metabolism in a loamy sand soil of US origin under laboratory conditions at 25°C	Acceptable	Yes	None
162-1	46801710	[Phenyl-U-^{14}C]- and [pyrazole-3-^{14}C]-AE 0317309: aerobic soil metabolism in a silt loam soil of US origin under laboratory conditions at 25°C	Acceptable	Yes	None
162-1	46801711	[Phenyl-UL-^{14}C] and [pyrazole-3-^{14}C]AE 0317309: aerobic soil metabolism in a European soil	Supplemental	Yes	The study was conducted on a foreign soil; upgradeable
162-2	46801712	[Phenyl-UL-^{14}C] and [pyrazole-3-^{14}C]AE 0317309: anaerobic soil metabolism	Acceptable	Yes	None
162-3	46801714	[Phenyl-UL-^{14}C]AE 0317309: anaerobic aquatic metabolism	Acceptable	Yes	None
162-3	46801715	[Pyrazole-3-^{14}C]AE 0317309: anaerobic aquatic metabolism	Acceptable	Yes	None
162-4	46801713	[Pyrazol-3-^{14}C]AE 0317309 and [phenyl-UL-^{14}C]AE 0317309: aerobic aquatic metabolism	Acceptable	Yes	None
163-1	46801703	Adsorption/desorption of AE 0317309 on five soils and one sediment	Acceptable	Yes	None

GUIDE-LINE	MRID	STUDY TITLE	EPA CLASSI-FICATION	ARE DATA ADEQUATE FOR RISK ASSESSMENT?	COMMENTS
163-1	46801704	[14C]-RPA 203328: Adsorption/desorption in five soils	Acceptable	Yes	None
164-1	46801716	Terrestrial field dissipation of AE 0317309 in Kansas soil, 2004	Acceptable	Yes	None
164-1	46801717	Terrestrial field dissipation of AE 0317309 in North Dakota soil, 2004	Acceptable	Yes	None
164-1	46801718	Terrestrial field dissipation of AE 0317309 in Washington soil, 2004	Acceptable	Yes	None

Table A.2. Ecological Effects Studies for Pyrasulfotole.

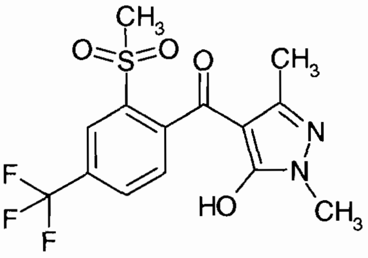
GUIDE-LINE	MRID	STUDY TITLE	EPA CLASSI-FICATION	ARE DATA ADEQUATE FOR RISK ASSESSMENT?	COMMENTS
71-1	468017-29	Technical AE0317309: An Acute Oral LD_{50} with Northern Bobwhite.	Acceptable	Yes	None
71-2	468017-30	Technical AE0317309: A Subacute Dietary LC_{50} with Northern Bobwhite	Acceptable	Yes	None
71-2	468017-31	Technical AE0317309: A Subacute Dietary LC_{50} with Mallards	Acceptable	Yes	None
71-4	468017-32	Effect of Technical AE 0317309 on Northern Bobwhite Reproduction	Acceptable	Yes	None
71-4	468017-33	Effect of Technical AE 0317309 on Mallard Reproduction.	Acceptable	Yes	None
72-1	468017-24	The 96 Hour Acute Toxicity to the Rainbow Trout, *Oncorhynchus mykiss*, in a Static System; AE 0317309 Technical 97.4% w/w (Amended Report).	Acceptable	Yes	None
72-1	468017-25	The 96 Hour Acute Toxicity to the Bluegill Sunfish, *Lepomis macrochirus*, in a Static System, AE 0317309	Acceptable	Yes	None

GUIDE-LINE	MRID	STUDY TITLE	EPA CLASSI-FICATION	ARE DATA ADEQUATE FOR RISK ASSESSMENT?	COMMENTS
		Technical, 98.2% w/w (Amended Report)			
72-2	468017-21	The 48-Hour Acute Toxicity to the Water Flea, *Daphnia magna*, in a Static System AE 0317309 Technical 97.4% w/w	Acceptable	Yes	None
72-3	468017-22	AE 0317309-Acute Toxicity to Eastern Oysters (*Crassostrea virginica*) Under Flow-Through Conditions	Acceptable	Yes	None
72-3	468017-23	AE 0317309- Acute Toxicity to Mysids (*Americamysis bahia*) Under Static Conditions	Acceptable	Yes	None
72-3	468017-26	Acute Toxicity of AE 0317309 Technical to the Sheepshead Minnow (*Cyprinodon variegates*) Under Static Conditions.	Acceptable	Yes	None
72-4	468017-27	Chronic Toxicity of AE 0317309 Technical to the *Daphnia magna* Under Static Renewal Conditions.	Acceptable	Yes	None
72-4	468017-28	Early Life Stage Toxicity of AE 0317309 Technical to the Fathead Minnow (*Primephales promelas*) Under Flow-Through Conditions	Acceptable	Yes	None
141-1	468017-35	Contact toxicity (LD50) to honey bees (*Apis mellifera* L.), Substance technical	Supplemental	Yes	No negative control was tested
850.4400	468017-36	Toxicity of AE 0317309 Technical to Duckweed (*Lemna gibba* G3) Under Static Conditions.	Acceptable	Yes	None
850.5400	468017-38	Toxicity of AE 0317309 Technical to the Freshwater Diatom *Navicula pelliculosa*	Acceptable	Yes	None
850.5400	468017-37	Toxicity of AE 0317309 Technical to the Green Alga	Acceptable	Yes	None

GUIDE-LINE	MRID	STUDY TITLE	EPA CLASSI-FICATION	ARE DATA ADEQUATE FOR RISK ASSESSMENT?	COMMENTS
		Pseudokirchneriella subcapitata (a.k.a. *Selenastrum capricornutum*).			
850.5400	468017-39	Toxicity of AE 0317309 Technical to the Blue-Green Algae *Anabaena flos-aquaea*	Supplemental	Yes	A NOAEC for biomass could not be determined due to significant inhibition at all treatment levels
850.5400	468017-40	Toxicity of AE 0317309 Technical to the Saltwater Diatom *Skeletonema costatum*.	Acceptable	Yes	None
123-1a	468019-26	Non-target terrestrial plants: Seedling emergence and growth test (Tier 2) Suspo-emulsion: 50+12.5 g/L (Code: AE 0317309 02 SE06 A102)	Acceptable	Yes	None
123-1a	468019-36	Non-target terrestrial plants: Seedling emergence and seedling growth test (Tier 2); AE 0.317309+Mefenpyr di-ethyl+Bromoxynil (Code: AE 0317309 03 EC23 A8)	Acceptable	Yes	None
123-1b	468019-27	Non-target terrestrial plants: Vegetative vigor test (Tier 2) AE 0317309 + Mefenpyr di-ethyl (AE F107892); Suspo-emulsion: 50+12.5 g/L (Code: AE 0317309 02 SE06 A102)	Supplemental	Yes	EC_{25} values could not be determined for onion and sugar beet survival, and the reviewer was unable to statistically analyze plant height because the study authors only reported the range of values within each replicate and the treatment mean; no replicate mean values were reported.
123-1b	468019-37	Non-target terrestrial plants: Vegetative Vigor test (Tier 2), AE 0317309+Mefenpyr di-ethyl+Bromoxynil (Code: AE 0317309 03 EC23 A8)	Supplemental	Yes	A NOAEC could not be determined for the most sensitive endpoint, cucumber dry weight. Inhibition in biomass at the lowest treatment level was 18%.

GUIDE-LINE	MRID	STUDY TITLE	EPA CLASSI-FICATION	ARE DATA ADEQUATE FOR RISK ASSESSMENT?	COMMENTS
850.6200	468017-41	AE 0317309, substance, technical (Code: AE 0317309 00 1C96 0001): Acute Toxicity to Earthworms (*Eisenia fetida)* tested in Artificial Soil	Supplemental	Yes	Non-guideline (EPA requires a 28-day test, this is a 14-day test)
850.6200	468017-42	RPA 203328, Acute Toxicity (14-Day) to Earthworms (*Eisenia foetida)*	Supplemental	Yes	Non-guideline (EPA requires a 28-day test, this is a 14-day test)
Non-Guideline	468017-43	Isoxaflutole-RPA 203328 (AE B197555): Reproduction toxicity to the earthworm *Eisenia fetida* in artificial soil	Supplemental	Yes	Non-guideline - This study was based on procedures of the ISO Guideline 11268-2 "Soil quality-Effects of pollutants on earthworms (*Eisenia fetida*) Part 2: Determination of effects on reproduction" (July 1998).
Non-Guideline	468017-34	Oral toxicity (LD50) to honey bees (*Apis mellifera* L.), Substance technical	Supplemental	Yes	Non-guideline

Environmental Fate and Ecological Risk Assessment for the Registration of the New Chemical Pyrasulfotole (AE 0317309)



Pyrasulfotole
(5-hydroxy-1,3-dimethyl-1*H*-pyrazol-4-yl)[2-(methylsulfonyl)-4-(trifluoromethyl)phenyl]methanone
CAS No. 365400-11-9

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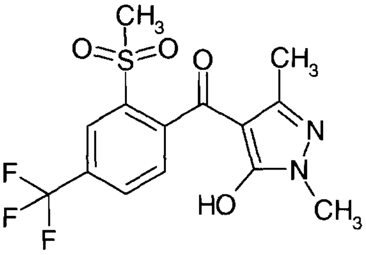
Environmental Fate and Ecological Risk Assessment for the Registration of the New Chemical Pyrasulfotole (AE 0317309)



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I. EXECUTIVE SUMMARY

A. Nature of Chemical Stressor

Pyrasulfotole is a new herbicide that is proposed for registration by the registrant Bayer CropScience for use on wheat, barley, oats and triticale. Pyrasulfotole is a systemic herbicide that inhibits the enzyme 4-hydroxyphenylpyruvate dioxygenase (4-HPPD) and causes bleaching symptoms, necrosis, and ultimately death in susceptible plants. The two pyrasulfotole (AE 0317309) end-use products being proposed for registration are AE 0317309 + Bromo Herbicide (an emulsifiable concentrate with 3.3% pyrasulfotole,13.4% bromoxynil octanoate, and 12.9% bromoxynil heptanoate) and AE 0317309 SE06 Herbicide [a suspo-emulsion (consisting of suspension concentrates and oil-in-water emulsions) containing 4.4% pyrasulfotole]. Pyrasulfotole would be applied as a post-emergent foliar spray once a year via ground, aerial, or sprinkler irrigation at a maximum rate of 0.045 lb a.i./acre according to the proposed label.

B. Conclusions - Exposure Characterization

Pyrasulfotole is highly soluble in water, has a low vapor pressure and low octonal-water partitioning coefficient. Therefore, volatilization from water and soil surfaces is not expected to be an important route of environmental dissipation and bioaccumulation is unlikely. Pyrasulfotole is stable to hydrolysis and photolysis and moderately susceptible to microbial degradation under aerobic conditions in soils. Pyrasulfotole is expected to be persistent under certain conditions and moderately mobile to mobile (FAO classification) in the environment. Major routes of dissipation include microbial degradation in soils, formation of unextractable residues in soils and sediments, and dilution. Depending on soil, site and meteorological conditions pyrasulfotole may be transported off-site via runoff, leaching and spray drift. There was one major degradate, pyrasulfotole-benzoic acid (RPA 203328, AE B197555), detected in the aerobic soil metabolism and terrestrial field dissipation studies. Based on available ecological effects data, exposure to pyrasulfotole-benzoic acid is not of risk concern, and, therefore, it is not assessed here.

C. Conclusions - Effects Characterization

Pyrasulfotole is classified as practically nontoxic to fish and freshwater invertebrates, slightly toxic to freshwater nonvascular plants, moderately toxic to marine nonvascular plants, highly toxic to estuarine/marine invertebrates, and very highly toxic to aquatic vascular plants on an acute exposure basis. A freshwater fish early life-cycle reproductive study on fathead minnows resulted in a NOAEC of 0.58 mg a.i./L based on a reduction in total length. A chronic test for *Daphnia* resulted in a NOAEC of 12.8 mg a.i./L, based on the most sensitive endpoint, survival.

Pyrasulfotole is classified as practically nontoxic to avian species on an acute oral basis and is practically nontoxic to slightly toxic to avian species on a subacute dietary-exposure basis. The lowest NOAEC in an avian reproduction study was for the mallard duck (167 mg a.i./kg diet), based on reduced male weight gain. Pyrasulfotole is classified as practically nontoxic to mammals on an acute oral basis. A two generation reproduction study on rats resulted in a NOAEL of 2.5 mg/kg-bw/day based on delayed maturation and corneal opacity. Pyrasulfotole is classified as 'practically nontoxic' to non-target terrestrial insects.

Results of the Tier II seedling emergence studies with the AE 0317309 02 SE06 and AE 0317309 + Bromo formulations showed no measurable effects to monocots at any of the tested treatment levels. For dicots, the AE 0317309 + Bromo formulation is more toxic than the AE 0317309 02 SE06 formulation, however, because it is a mixture of different active ingredients, the results from the studies using this formulation cannot be used to specifically assess the risks of pyrasulfotole to plants. Therefore, the results from the AE 0317309 02 SE06 study (*i.e.*, a NOAEC of 0.00039 lb a.i./A and an EC_{25} of 0.0011 lb a.i./A based on tomato dry weight) are used to assess the effects of exposure to pyrasulfotole on seedling emergence in non-listed and listed dicots.

Results of the Tier II vegetative vigor studies identify onion as the most sensitive monocot with decreased dry weight as the most sensitive endpoint affected (with the AE 0317309 02 SE06 formulation). The NOAEC and EC_{25} values for onion dry weight were 0.0125 lbs a.i./A and 0.017 lbs a.i./A, respectively. No effects were seen in monocots in the vegetative vigor study with the AE 0317309 + Bromo formulation. For dicots, although the AE 0317309 + Bromo formulation (with a mixture of a.i.'s) is more toxic than the AE 0317309 02 SE06 formulation, the results from the SE06 formulation (*i.e.*, a NOAEC of 0.0.000797 lb a.i./A and an EC_{25} of 0.00081 lb a.i./A, based on tomato dry weight) are used to assess the effects of exposure to pyrasulfotole on vegetative vigor in non-listed and listed terrestrial dicots.

D. Potential Risks to Non-target Organisms

The results of this screening-level risk assessment indicate that the proposed uses of pyrasulfotole have the potential for direct adverse effects for terrestrial and semi-aquatic dicotyledonous plants, some small mammals less than 35 g (chronic exposure), and listed freshwater vascular plants. Risks to listed aquatic plants and mammals (listed and non-listed), however, are not expected at application rates ≤0.040 lb a.i./acre and ≤0.023 lb a.i./acre, respectively. Therefore, if the proposed maximum application rate for pyrasulfotole was reduced to 0.023 lb a.i./acre, direct adverse effects from pyrasulfotole use would only be expected for terrestrial and semi-aquatic dicotyledonous plants. 'Listed' species are those which are currently on the Federal list of endangered and threatened wildlife and plants.

For dicots, the RQs ranged from 0.01 to 22.5 and from 0.56 to 62 for non-listed and listed species, respectively. Predictions based on the AgDRIFT model indicate that dicots more than 390 ft (using the AE 0317309 02 SE06 formulation) and 2,126 ft (using the AE 0317309 + Bromo formulation) from the treated use area may be exposed by spray drift to pyrasulfotole at levels above the EC_{25}. The mammalian RQs calculated for chronic exposure range from 0.01 to 1.87 for dose-based RQs using upper 90th percentile Kenaga values. The RQs for three mammalian body-size/dietary categories exceed the Agency's LOC for chronic exposure: 15 g and 35 g mammals that eat short grass (RQs = 1.87 and 1.6, respectively) and 15 g mammals that eat broadleaf plants/small insects (RQ = 1.05). All mammalian chronic RQs drop to <1 at application rates of ≤0.023 lb a.i./acre.

The non-listed species LOC for aquatic vascular plants was not exceeded in any of the use scenarios modeled, however, the listed species LOC was exceeded (RQ = 1.05; based on exposure estimates using the TX Wheat scenario), indicating the potential for risk to listed aquatic vascular plants exposed to pyrasulfotole. The RQ for listed aquatic vascular plants drops to <1 at application rates of ≤0.040 lb a.i./acre.

None of the aquatic animal RQs for chronic exposure exceeded the Agency's LOC, however, chronic toxicity data are not available for the most acutely sensitive aquatic animal taxon (*i.e.*, estuarine/marine invertebrate). Although the chronic toxicity of pyrasulfotole to estuarine/marine invertebrates is uncertain, given that: (1) the potential use sites for the proposed uses largely fall outside of estuarine/marine environments, with the possible exceptions of California and the mid-Atlantic states; (2) the aquatic EECs used in this assessment are based on a static water-body with no outlet, and, thus, are likely higher than concentrations expected in estuarine/marine environments; and (3) estuarine/marine invertebrates would need to be 1,293 times more sensitive to pyrasulfotole than freshwater invertebrates on a chronic-exposure basis to exceed the Agency's chronic risk LOC, risks to estuarine/marine invertebrates from chronic exposure to pyrasulfotole are not expected.

Regarding listed species, EFED's screening level analysis shows the possibility of direct effects to listed aquatic vascular plants, terrestrial and semi-aquatic dicotyledonous plants, and mammals (chronic exposure). For indirect effects, all other taxa will be considered since there is a potential for indirect effects to taxa that might rely on plants and/or mammals for some stage of their life-cycle. Therefore, at this time, no Federally-listed taxa can be excluded from the potential for direct and/or indirect effects from the proposed uses of pyrasulfotole (see **Table 1**). LOCATES identified a total of 817 listed species that overlapped at the county-level with areas where wheat, barley, oats, and/or triticale are grown. Among these species, 318 are dicots, 13 are aquatic monocots, and 59 are mammals. Therefore, at the county-level, there is the potential for a total of 390 listed species to be directly affected by pyrasulfotole use, while 427 species may be indirectly affected by the use of the chemical.

TABLE 1. Listed Species Risks Associated with Potential Direct or Indirect Effects Due to the Proposed Applications of Pyrasulfotole on Cereal Grains.

LISTED TAXON	DIRECT EFFECTS	INDIRECT EFFECTS
Terrestrial and semi-aquatic plants - monocots	No	Yes[1]
Terrestrial and semi-aquatic plants - dicots	Yes	Yes[1]
Insects	No	Yes[1]
Birds	No	Yes[1]
Terrestrial phase amphibians	No	Yes[1]
Reptiles	No	Yes[1]
Mammals	Yes (chronic)	Yes[1]
Aquatic plants	Yes	Yes[1]
Freshwater fish	No	Yes[1]
Aquatic phase amphibians	No	Yes[1]
Freshwater crustaceans	No	Yes[1]
Mollusks	No	Yes[1]
Marine/estuarine fish	No	Yes[1]
Marine/estuarine crustaceans	No	Yes[1]

[1] The nonlisted LOC was exceeded for terrestrial and semi-aquatic plants (dicots), the listed LOC was exceeded for aquatic vascular plants, and the chronic risk LOC was exceeded for some small mammals ($\leq$35 g) . Therefore, the potential for adverse effects to those species that rely either on a specific plant or animal species (specifically aquatic vascular plants, terrestrial/semi-aquatic dicots, or mammals) or multiple plant or animal species (specifically terrestrial/semi-aquatic dicots and mammals) cannot be precluded. Indirect effects may include general habitat modification, host plant loss, and food supply disruption.

E. Uncertainties and Data Gaps

There is no evidence of pyrasulfotole degradation in aquatic environments. As such, pyrasulfotole was assumed stable in the ecological pond used to estimate aquatic exposure concentrations. Since the ecological pond (used in our modeling) has no outlet, there was a modeled accumulation of pyrasulfotle in the pond throughout the 30 year simulations. In the case of persistent compounds, a 1-in-10 year EEC does not reflect varying meteorological conditions that are expected once every ten years, since the yearly peaks are not independent but are actually correlated to the previous year's peak concentration. This results in acute and chronic exposure concentrations that are very similar (*i.e*, < 2% difference between peak and 90-day average EECs). Pyrasulfotle concentrations in flowing water bodies are not expected to accumulate from year to year because of downstream dilution. Risk to aquatic plants resulting from accumulation of pyrasulfotle from multiple years of application is not likely in flowing systems.

Even though pyrasulfotole is very soluble and moderately mobile to mobile based on the results of batch equilibrium studies, in aerobic soil metabolism studies unextractable residues were identified at maximums of 35-62% of applied radioactivity in three soils. The unextractable residues are uncharacterized and it is uncertain whether they consist of degradates of risk concern. Under sterile conditions these unextractable residues were not formed suggesting that the formation of them is microbially mediated. Aerobic soil metabolism half-lives were estimated based on parent concentrations alone (excluding unextractable residues). To the extent that these unextractable residues are of risk concern, the estimated half-lives will be underestimated compared to a total toxic residue approach for estimating half-lives. However, given the persistence of pyrasulfotle parent only, a total toxic residue approach for calculating aerobic soil metabolism half-life would not impact PRZM/EXAMS modeled EECs appreciably.

Because pyrasulfotole is persistent and has the potential to progressively bind to certain soils through time as it degrades and forms unextractable residues, there is the potential for pyrasulfotole (or residues of concern) to accumulate in the benthos at levels that could result in toxic exposure to benthic and epibenthic aquatic organisms, especially those that consume soil. The potential risk to benthic and epibenthic organisms could not be assessed here, however, because a lack of available toxicity data for these taxa.

Additionally, estuarine/marine invertebrates (*i.e.,* mysids) are considerably more sensitive to pyrasulfotole on an acute exposure basis than the other aquatic animals tested, however, no toxicity data for chronic exposure are available for estuarine/marine invertebrates. Because there is the potential for pyrasulfotole to accumulate in the benthos, as discussed above, the chemical could pose a chronic risk to benthic and epibenthic organisms (including some estuarine/marine invertebrates). However, given that: (1) the potential use sites for pyrasulfotole largely fall outside of estuarine/marine environments; (2) the aquatic EECs used in this assessment are likely higher than the concentrations expected in most estuarine/marine environments because they are based on a static water-body with no outlet; and (3) estuarine/marine invertebrates would need to be 1,293 times more sensitive to pyrasulfotole than freshwater invertebrates to exceed the Agency's chronic risk LOC, risks to estuarine/marine invertebrates from chronic exposure to pyrasulfotole are not expected. However, the lack of data on the chronic toxicity of pyrasulfotole to estuarine/marine invertebrates adds uncertainty to this risk assessment.

II PROBLEM FORMULATION

The purpose of this assessment is to evaluate the environmental fate and ecological risks for the registration of the new chemical pyrasulfotole (also known as AE 0317309; (5-hydroxy-1,3-dimethyl-1H-pyrazol-4-yl)(2-mesyl-4-trifluoromethylphenyl)methanone) (PC Code: 000692). As a new herbicide being proposed for use in the United States, EPA is required under the Federal Insecticide Fungicide and Rodenticide Act (FIFRA) to ensure that pyrasulfotole does not have the potential to cause unreasonable adverse effects to the environment. Potential effects to listed species (*i.e.*, species on the Federal list of endangered and threatened wildlife and plants) are also considered under the Endangered Species Act in order to ensure that the registration of pyrasulfotole is not likely to jeopardize the continued existence of such listed species or adversely modify their habitat. To these ends, this assessment follows EPA guidance on conducting ecological risk assessments (USEPA 1998) and the Office of Pesticide Program's policies for assessing risk to non-target and listed organisms (USEPA 2004).

Among the end products of the EPA pesticide registration process is a determination of whether a product is eligible for registration and, if so, a description of how the product may be used. A label represents the legal document which stipulates how and where a given pesticide may be used. End-use labels describe the formulation type, acceptable methods of application, where the product may be applied, and any restrictions on how applications may be conducted. Thus, the use, or potential use, described by the pesticide's labels is considered "the action" being assessed. This assessment is in support of the new chemical registration of pyrasulfotole.

A. Stressor Source and Distribution

1. Source and Intensity

Pyrasulfotole, a systemic herbicide, is a new chemical that is undergoing registration (as the active ingredient in two end-use products) by the registrant Bayer CropScience. The two pyrasulfotole (AE 0317309) end-use products being proposed for registration in the United States are AE 0317309 + Bromo Herbicide [with the following active ingredients (a.i.): 3.3% pyrasulfotole, 13.4% bromoxynil octanoate, and 12.9% bromoxynil heptanoate] and AE 0317309 SE06 Herbicide [the only a.i. is pyrasulfotole (4.4%)]. According to the proposed labels, both products would be used to control broadleaf weeds in wheat, barley, oats and triticale (an artificial hybrid of rye and wheat). Pyrasulfotole would be applied as a post-emergent foliar spray via ground, aerial, or sprinkler irrigation application (limited to AE 0317309 + Bromo Herbicide for application to wheat and barley).

2. Physical/Chemical/Fate and Transport Properties

Pyrasulfotole is expected to be persistent under certain conditions and mobile to moderately mobile (FAO classification) in the environment. There is no evidence of degradation in aquatic environments. Major routes of dissipation include microbial degradation in soils, formation of non-extractable residues in soils and sediments, and dilution.

3. Pesticide Type, Class, and Mode of Action

Pyrasulfotole is a phenyl pyrazolyl ketone herbicide. According to a risk assessment conducted by Bayer CropScience (MRID 468019-47), pyrasulfotole inhibits the enzyme 4-hydroxyphenylpyruvate dioxygenase (4-HPPD), and, thus, blocks the phenylquinone biosynthesis pathway in plants which leads to a decrease in carotenoids. Therefore, pyrasulfotole inhibits photosynthesis and pigment synthesis and causes bleaching symptoms, necrosis, and ultimately death in susceptible plants, especially those with young and still expanding leaves. Pyrasulfotole is mobile in the symplast (phloem) and apoplast (xylem) plant transport systems, and plant exposure is primarily through leaf uptake and translocation to the target site; only low amounts are taken up via the root system. Pyrasulfotole is intended to target dicotyledonous plants. The tolerance of cereal crops to pyrasulfotole is likely related to the faster metabolic degradation of the herbicide when compared to susceptible dicots.

4. Overview of Pesticide Usage

Since this is a new chemical, the Agency does not have any usage information for pyrasulfotole. The proposed registration is for wheat, barley, oats, and triticale. Pyrasulfotole is a post emergence herbicide that is applied as a foliar spray (via ground, aerial, or sprinkler irrigation) one time a year at a maximum application rate of 0.045 lb a.i./A. There are two pyrasulfotole end-use products being proposed for registration in the United States for use on wheat, barley, oats, and triticale. The two proposed formulations are AE 0317309 + Bromo Herbicide (an emuslsifiable concentrate containing 3.3% pyrasulfotole) and AE 0317309 SE06 Herbicide (a suspo-emulsion containing 4.4% pyrasulfotole).

B. Receptors

1. Aquatic and Terrestrial Effects

Table 2 gives examples of taxonomic groups and species tested to help understand potential ecological effects of pesticides to non-target organisms. Within each of these very broad taxonomic groups, a measure of effect from either acute or chronic exposure is selected from the available test data.

TABLE 2. Taxonomic Groups and Test Species Evaluated for Ecological Effects in Screening-Level Risk Assessments.

Taxonomic Group	Example(s) of Representative Species
Birds[1]	Mallard duck (*Anas platyrhynchos*) Bobwhite quail (*Colinus virginianus*)
Mammals	Laboratory rat (*Rattus norvegicus*)
Insects	Honey bee (*Apis mellifera L.*)
Freshwater fish[2]	Bluegill sunfish (*Lepomis macrochirus*) Rainbow trout (*Oncorhynchus mykiss*)
Freshwater invertebrates	Water flea (*Daphnia magna*)
Estuarine/marine fish	Sheepshead minnow (*Cyprinodon variegatus*)
Terrestrial plants[3]	Monocots – corn (*Zea mays*) Dicots – soybean (*Glycine max*)
Aquatic plants and algae	Duckweed (*Lemna gibba*) Green algae (*Selenastrum capricornutum*)

[1] Birds represent surrogates for amphibians (terrestrial phase) and reptiles.

[2] Freshwater fish may be surrogates for amphibians (aquatic phase).

[3] Four species of two families of monocots, of which one is corn; six species of at least four dicot families, of which one is soybeans.

2. Ecosystems Potentially at Risk

The ecosystems potentially at risk include the areas adjacent to the application sites and water bodies adjacent to the application sites and downstream. In addition, organisms that use the application site as part of their habitat (*e.g.*, birds foraging for insects within application areas) are also considered to be part of the ecosystems potentially at risk.

C. Assessment Endpoints

FIFRA Part 158 guideline toxicity tests (CFR 40 §158.202, 2002) are intended to determine pesticidal effects on a variety of organisms, including birds, mammals, fish, terrestrial and aquatic invertebrates, and plants. These tests include both short-term and long-term exposure periods and evaluate the survival, reproduction, and/or growth of laboratory species. The studies, when available, are used to evaluate the potential of a pesticide to cause adverse effects, to determine whether further testing is required, and to determine the need for precautionary label statements to minimize the potential adverse effects to non-target animals and plants (CFR 40 §158.202, 2002).

Assessment endpoints are intended to represent valued attributes of the environment that, if detrimentally altered, could pose a risk to the environment. The assessment endpoints of this ecological risk assessment include terrestrial and aquatic animal and plant mortality following acute exposure to pyrasulfotole and terrestrial and aquatic animal reproduction, growth and survival effects from chronic exposure to pyrasulfotole. Surrogate species are used to represent all freshwater fish (2000+) and bird (680+) species in the United States. For mammals, acute studies are usually limited to the Norway rat or the house mouse. Usually data from estuarine/marine testing is limited to a crustacean, a mollusk, and a fish. The assessment of risk or hazard makes the assumption that avian toxicity is similar to terrestrial-phase amphibians and reptiles, unless more appropriate data are available. The same assumption is made for fish and aquatic-phase amphibians. The most sensitive toxicity endpoints are used from surrogate test species to estimate treatment-related direct effects on mortality and reproductive and growth assessment endpoints.

For terrestrial and semi-aquatic plants, the screening assessment endpoints for non-target species (crops and non-crop plant species) are based on the emergence of seedlings and vegetative vigor of annuals. Measures of effect for this assessment focus on impacts on plant emergence and/or on active growth.

For aquatic plants, the assessment endpoint is the maintenance and growth of standing crop or biomass. Measures of effect for this assessment focus on nonvascular, *e.g.*, algae, and vascular plant, *e.g.*, duckweed (*Lemna gibba*), growth rates and biomass measurements.

The Agency acknowledges that pesticides have the potential to exert indirect effects upon listed organisms by, for example, perturbing forage or prey availability, altering the extent of nesting habitat, and creating gaps in the food chain. In conducting a screen for indirect effects, the endpoints for each taxonomic group are used to make inferences concerning the potential for indirect effects upon listed species that rely upon non-listed organisms as resources critical to their life cycle.

The endpoints are typically derived from registrant-submitted studies which have undergone review and were classified as "acceptable" (conducted under guideline conditions and considered to be scientifically valid) or "supplemental" (conditions deviated from guidelines but the results are considered to be scientifically valid). For more details on EFED's study classification system and study guidelines, see USEPA 2004.

Assessment endpoints can also be derived from the open literature. Guidelines for incorporation of open literature into ecological risk assessments are described in USEPA (2004). Toxicity data from the open literature are identified via the ECOTOX search engine, maintained by EPA/ORD. In order to be included in the ECOTOX database, papers must meet several criteria (again, see USEPA 2004 for details). Data that pass the ECOTOX screen are evaluated relative to the data provided by the registrant, and may be incorporated qualitatively or quantitatively into the risk assessment. Specific studies may warrant inclusion in the risk assessment when:

(1) tested endpoints are more sensitive than those in registrant data;
(2) the test data are based on under represented taxa;
(3) the data include ecologically relevant endpoints not normally evaluated in registrant studies

ECOTOX identified a total of four pyrasulfotole studies from the open literature, all of which were rejected by ECOTOX because they were not written in English (*i.e.*, they were written in German) (see **APPENDIX A**). Therefore, no open literature studies were reviewed for assessment endpoints.

Although all endpoints are measured at the individual level, they can provide some insight about the potential for adverse effects at higher levels of biological organization (*e.g.* populations and communities). For example, pesticide effects on individual survivorship have important implications for both population rates and habitat carrying capacity.

D. Conceptual Model

The conceptual model used to depict the potential ecological risk associated with pyrasulfotole is fairly generic and assumes that as a systemic herbicide, pyrasulfotole is capable of affecting terrestrial and aquatic organisms (animals and plants) provided environmental concentrations are sufficiently elevated as a result of proposed label uses. Additionally, based on a preliminary risk screening indicating that pyrasulfotole is highly toxic to some plants, the hypothesis for the risks of pyrasulfotole to non-target organisms (depicted in **Figure 1**) focuses on aquatic and terrestrial environments. Therefore, we will consider potential exposure as a result of direct applications, spray drift, and runoff.

1. Risk Hypotheses

For this assessment, the risk to non-target organisms is based on potential effects from the application of pyrasulfotole to the environment. The Agency presumes the following risk hypothesis for this screening level assessment:

> *Based on mode of action and the sensitivity of non-target aquatic and terrestrial species (especially plants), the proposed agricultural uses of pyrasulfotole have the potential to reduce survival, reproduction, and/or growth in terrestrial and aquatic animals and plants through direct application, spray drift and/or runoff.*

In order for a chemical to pose an ecological risk, it must reach non-target organisms at concentrations found to cause adverse effects. The assessment of ecological exposure pathways in this assessment includes an examination of the source and potential migration pathways to pyrasulfotole exposure, and the determination of potential adverse effects on non-target species.

2. Diagram

Application methods for pyrasulfotole involve foliar spray applications via ground, aerial, and sprinkler irrigation. Ecological receptors that may potentially be exposed to pyrasulfotole include terrestrial and semi-aquatic wildlife (*i.e.*, mammals, birds, amphibians, terrestrial invertebrates, and reptiles) and plants. In addition, aquatic receptors (*e.g.*, freshwater and estuarine/marine fish and invertebrates, amphibians, and plants) may also be exposed as a result of potential movement of pyrasulfotole via spray drift and/or runoff from the site of application to aquatic environments. The assessment following the process depicted in **Figure 1** forms the basis for identifying potential endpoints, stressors, and ecological effects associated with pyrasulfotole use.

This assessment does not take into account atmospheric transport in estimating environmental concentrations, nor does it account for ingestion of pyrasulfotole residues by animals in drinking water or contaminated grit, ingestion through preening activities, or uptake through inhalation or dermal absorption by terrestrial animals. Exposure to terrestrial animals is based primarily on dietary consumption of foliar residues while aquatic assessments assume that all major potential routes of direct exposure are accounted for.

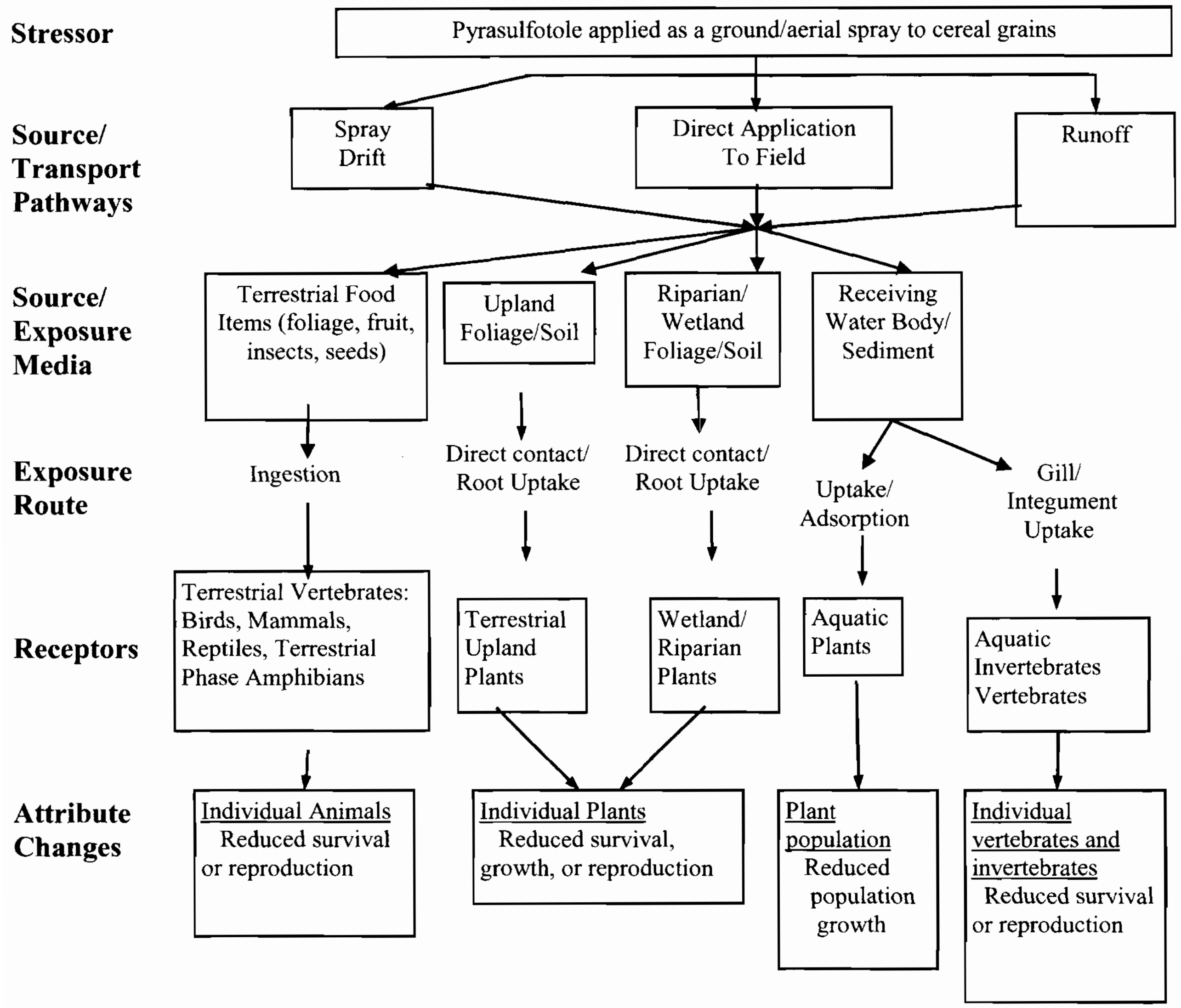

FIGURE 1: Conceptual Plan Diagram Depicting Sources of Exposure, Potential Receptors and Adverse Effects from the Proposed Uses of Pyrasulfotole.

E. Analysis Plan

As with any pesticide, there is concern regarding the potential effects pyrasulfotole use may pose to non-target animals and plants. This document characterizes the environmental fate of pyrasulfotole to assess whether proposed label uses of pyrasulfotole on wheat, barley, oats and triticale provide a means of exposure to non-target species. Additionally, the toxicity of pyrasulfotole is characterized, then both potential exposure and effects are integrated to estimate the likelihood of adverse effects (risk) to non-target Federally listed (endangered or threatened) and non-listed animals and plants that could potentially impact the registration decision of pyrasulfotole under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), the Food Quality Protection Act (FQPA), and the Endangered Species Act (ESA).

The maximum proposed label application rates for use of pyrasulfotole on wheat, barley, oats, and triticale were selected for modeling environmental concentrations for this screening-level deterministic (risk-quotient based) assessment. The most sensitive toxicity endpoints from surrogate test species are used to estimate treatment-related effects on growth, and survival. Estimated environmental concentrations (EECs) used in terrestrial and aquatic ecological risk assessments are based solely on pyrasulfotole parent compound, although the potential effects of the degradate RPA 203328 are considered (see page 37).

In the following sections, we characterize the use, environmental fate, and ecological effects of pyrasulfotole and, using a risk quotient (ratio of exposure concentration to effects concentration) approach, we estimate the potential for adverse effects on non-target terrestrial and aquatic animals and plants. Although risk is often defined as the likelihood and magnitude of adverse ecological effects, the risk quotient-based approach does not provide a quantitative estimate of likelihood and/or magnitude of an adverse effect. Such estimates may be possible through a more refined, probabilistic assessment; however, they are beyond the scope of this screening-level assessment.

1. Preliminary Identification of Data Gaps and Methods

No preliminary data gaps or method issues that would preclude a risk assessment were identified.

2. Measures to Evaluate Risk Hypotheses and Conceptual Model

a. Measures of Exposure

Measures of exposure are based on terrestrial and aquatic models that estimate environmental concentrations of the chemical being assessed using labeled application rates and methods. The measure of exposure for aquatic species is the estimated environmental concentration (EEC) expected once every ten years based on 30 years of simulations. The 1-in-10 year peak concentration is used for estimating acute effects to aquatic vertebrate and invertebrate species; the 1-in-10 year 21-day mean concentration is used for assessing aquatic invertebrate chronic exposure; and the1-in-10 year 60-day mean concentration is used for assessing chronic exposure for fish (and aquatic-phase amphibians). The terrestrial measure of exposure for vertebrate and invertebrate animals is the upper 90th percentile concentration normalized for application rates on various dietary items.

Exposure for terrestrial plants inhabiting dry and semi-aquatic areas (*i.e.*, low-lying wet areas that may dry up at times throughout the year) is based on the following:

(1) the pesticide's water solubility and the amount of pesticide present on the soil surface and its top one centimeter,
(2) potential "sheet runoff" (one treated acre to an adjacent acre) for dry areas,

(3) potential "channel runoff" (10 acres to a distant low-lying acre) for semi-aquatic or wetland areas,
(4) fraction runoff values of 0.01, 0.02, and 0.05 for water solubilities of <10, 10-100, and <100 ppm, respectively, and
(5) an assumption of 1% spray drift for ground application and 5% for aerial, airblast, forced air, and spray chemigation applications.

The registrant has provided a suite of studies pertinent to most Subdivision N guidelines, which provide environmental fate data for these measures of exposure.

b. Measures of Effect

Measures of effect are obtained from a suite of registrant-submitted guideline studies conducted with a limited number of surrogate species. The test species are not intended to be representative of the most sensitive species but rather are selected based on their ability to thrive under laboratory conditions. The acute measures of effect routinely used for listed and non-listed animals in screening level assessments are the LD_{50}, LC_{50} or EC_{50}, depending on taxa (see **Table 3**). LD stands for "Lethal Dose", and LD_{50} is the amount of a material, given all at once, that is estimated to cause the death of 50% of a group of test organisms. LC stands for "Lethal Concentration" and LC_{50} is the concentration of a chemical that is estimated to kill 50% of a sample population. EC stands for "Effective Concentration" and the EC_{50} is the concentration of a chemical that is estimated to produce some measured effect in 50% of the test population. Endpoints for chronic measures of exposure for listed and non-listed animals are the NOAEL or NOAEC. NOAEL stands for "No Observed-Adverse-Effect-Level" and refers to the highest tested dose of a substance that has been reported to have no harmful (adverse) effects on a test population. The NOAEC (*i.e.*, "No-Observed-Adverse-Effect-Concentration") is the highest test concentration at which none of the observed results were statistically different from the control. For non-listed plants, only acute exposures are assessed (*i.e.*, EC_{25} for terrestrial plants and EC_{50} for aquatic plants). For listed terrestrial plants the Agency uses the EC_5 or NOAEC (see **Table 3**).

Consistent with EPA test guidelines, the registrant has provided a suite of ecological effect data that comply with good laboratory testing requirements.

TABLE 3. Acute and Chronic Measures of Effect.

TAXA	ASSESSMENT	MEASURE OF EFFECT
Aquatic Animals (*Freshwater fish and inverts. and estuarine/marine fish and inverts.*)	Acute	Lowest tested EC_{50} or LC_{50} (acute toxicity tests)
	Chronic	Lowest NOAEC (early life-stage or full life-cycle tests)
Terrestrial Animals *Birds*	Acute/Subacute	Lowest LD_{50} (single oral dose) and LC_{50} (subacute dietary)
	Chronic	Lowest NOAEC (21-week reproduction test)
Terrestrial Animals *Mammals*	Acute	Lowest LD_{50} (single oral dose test)
	Chronic	Lowest NOAEC (two-generation reproduction test)
Plants *Terrestrial non-listed (monocots and dicots)*	Acute	Lowest EC_{25} (seedling emergence and vegetative vigor)
Plants *Terrestrial listed (monocots and dicots)*	Acute	Lowest EC_5 or NOAEC (seedling emergence and vegetative vigor)
Plants *Aquatic (vascular and algae)*	Acute	Lowest EC_{50}

III. ANALYSIS

A. Use Characterization

The proposed pyrasulfotole registration is for wheat, barley, oats, and triticale. Based on National Agricultural Statistics Service (NASS) 2006 data, approximately 3,500,000 acres of barley; 57,900,000 acres of wheat; and 4,300,000 acres of oats are planted each year in the United States (see **Figs. 2**, **3**, and **4**). The most recent NASS report available for triticale is from 2002 (no map is available). According to this report, a total of 20,292 acres of tricale was grown in 27 U.S. states in 2002. The state with the most acreage grown was Kansas (6,588 acres) followed by Washington (2,288 acres), Texas (2,032 acres), Oregon (1,869 acres) and Nebraska (1,563 acres). The remaining states each grew less than 1,000 acres of triticale. These represent potential markets for pyrasulfotole in the United States.

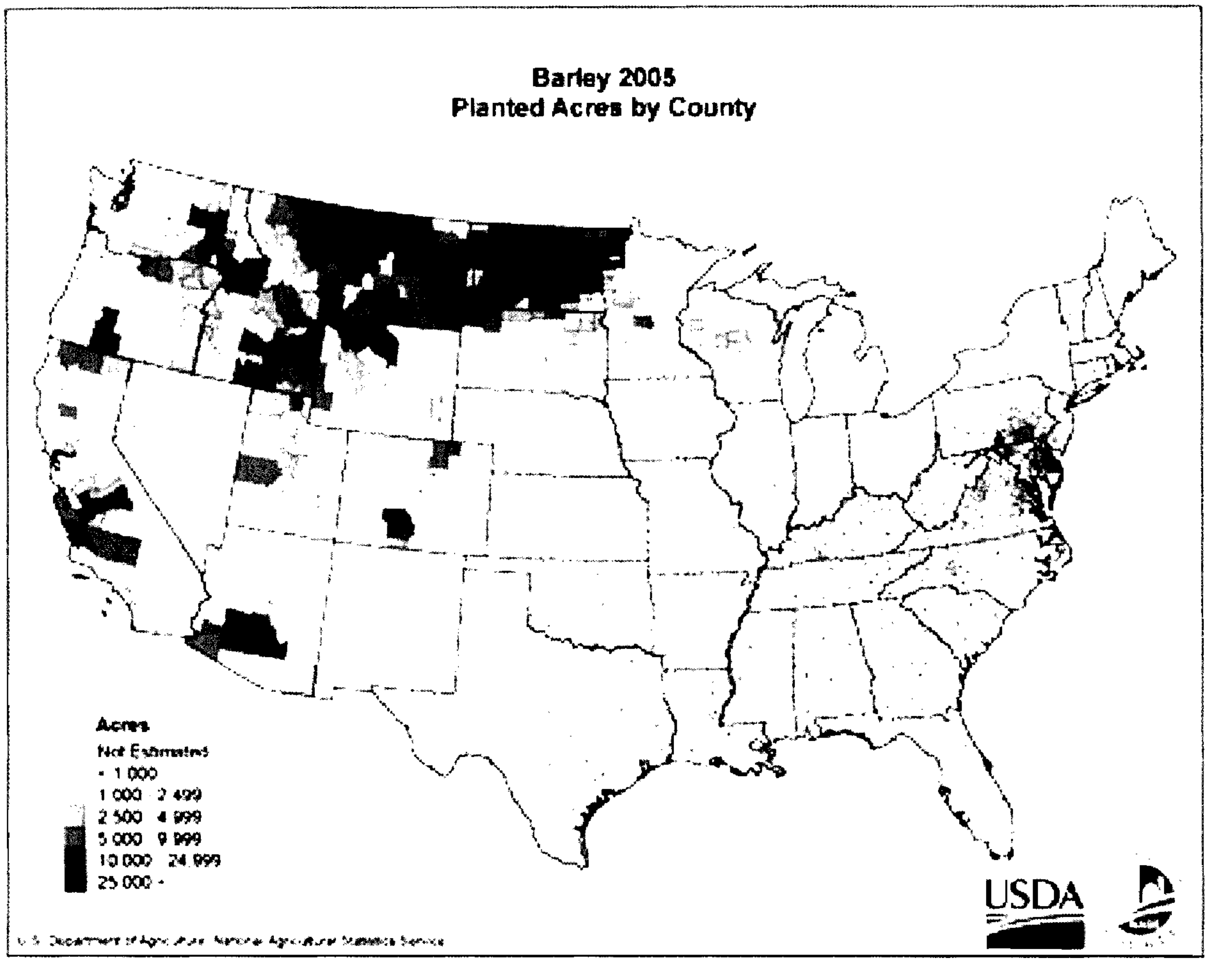

FIGURE 2. Acres of Barley Grown By County in the United Stated in 2005 (based on information from USDA-NASS).

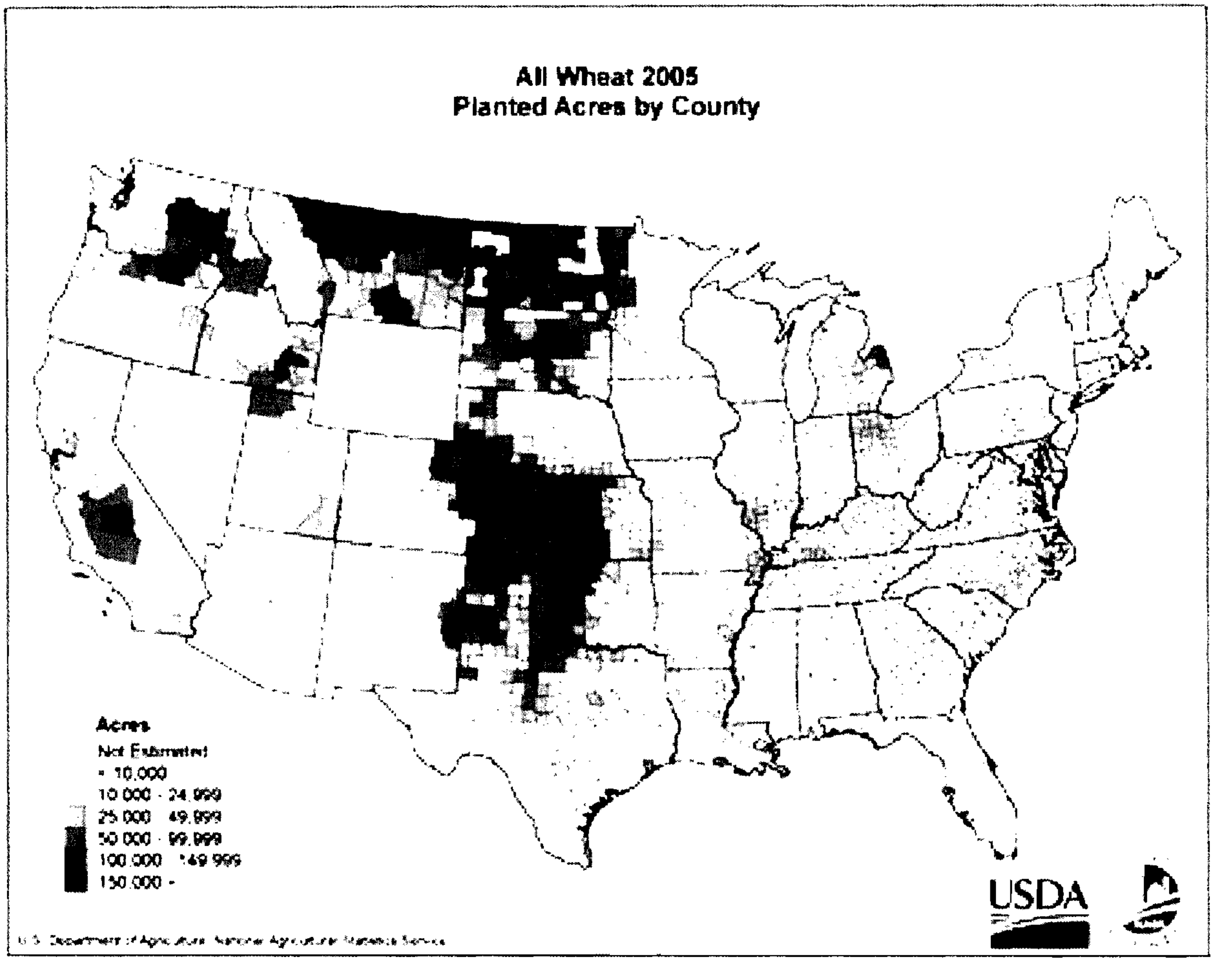

FIGURE 3. Acres of Wheat Grown By County in the United Stated in 2005 (based on information from USDA-NASS).

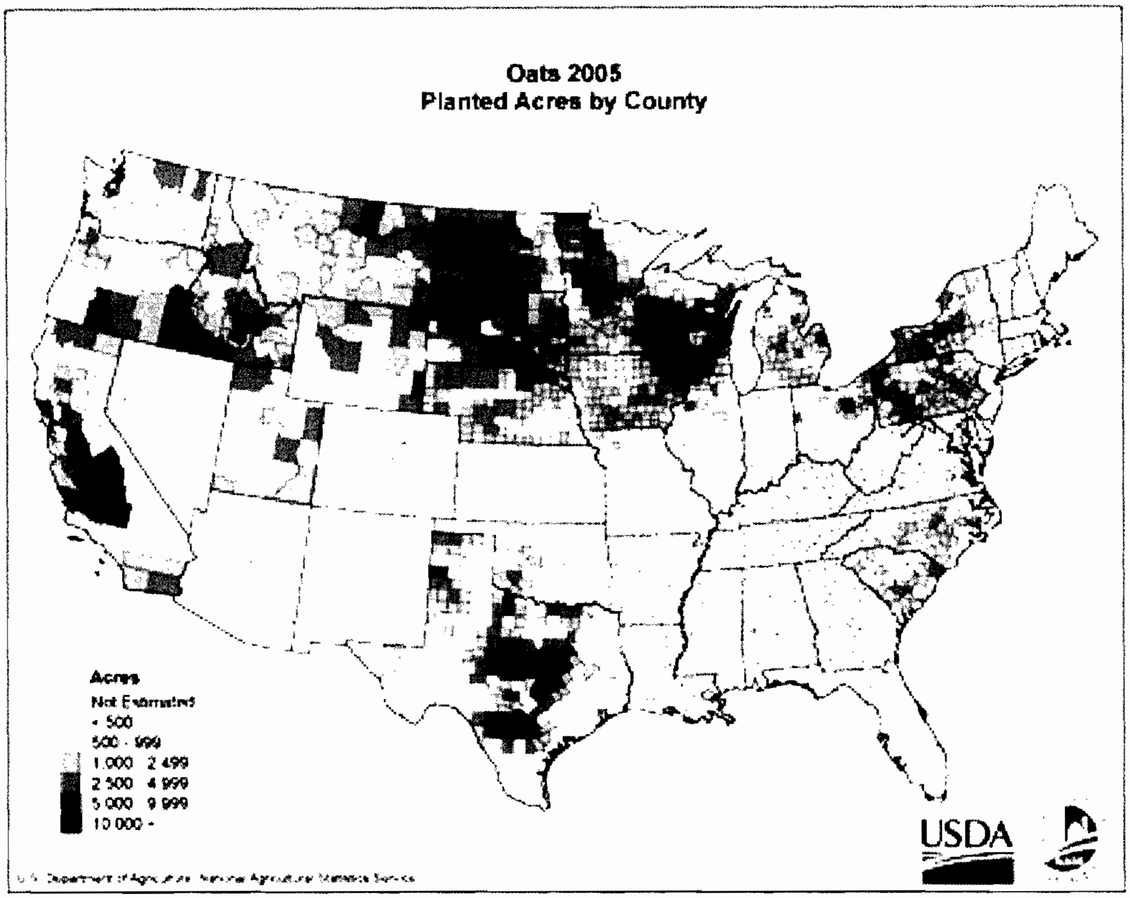

FIGURE 4. Acres of Oats Grown By County in the United Stated in 2005 (based on information from USDA-NASS).

Pyrasulfotole, a post emergence herbicide, is applied as a foliar spray (via ground, aerial, or sprinkler irrigation) to actively growing cereal crops from one leaf up to flag leaf emergence (approximately 7-45 days post emergence for spring wheat and 7-210 days post emergence for winter wheat). There are two pyrasulfotole end-use products being proposed for registration in the United States: AE 0317309 + Bromo Herbicide (an emuslsifiable concentrate with the following a.i.: 3.3% pyrasulfotole, 13.4% bromoxynil octanoate, and 12.9% bromoxynil heptanoate) and AE 0317309 SE06 Herbicide (a suspo-emulsion containing 4.4% pyrasulfotole, and no other active ingredients). According to the proposed labels, pyrasulfotole can be applied at a single maximum application rate/year of 0.045 lb a.i./acre for ground and aerial applications and 0.037 lb a.i./acre for sprinkler irrigation application (limited to use on wheat and barley) (see **Table 4**). Only one application per year is allowed.

TABLE 4. Application Information from the Proposed Pyrasulfotole Labels.

PRODUCT (% a.i.)	USES	APPLICATION METHODS	MAX. APPLICATION RATE/ YEAR	MAX. NUMBER OF APPLICATIONS/ YEAR
AE 0317309 + Bromo Herbicide (3.3%)	Wheat	Ground Aerial Sprinkler Irrigation	0.037 lb a.i./acre[1]	1
	Barley	Ground Aerial Sprinkler Irrigation		
	Oats	Ground Aerial		
	Triticale	Ground Aerial		
AE 0317309 SE06 Herbicide (4.4%)	Wheat	Ground Aerial	0.045 lb a.i./acre[2]	1
	Barley	Ground Aerial		
	Oats	Ground Aerial		
	Triticale	Ground Aerial		

[1] The application rate on the label was converted to lbs a.i./acre based on the following: The formulated product density = 1.1417 g/cc; the formulation is 3.3% pyrasulfotole and a max application rate of 15 oz of formulated product/acre is allowed.

[2] The application rate on the label was converted to lbs a.i./acre based on the following: The formulated product density = 1.1411 g/cc; the formulation is 4.4% pyrasulfotole and a max application rate of 13.7 oz of formulated product/acre is allowed.

B. Exposure Characterization

1. Environmental Fate and Transport Characterization

Pyrasulfotole is highly soluble in water (69 g/L), has a low vapor pressure (6.8×10^{-7} Pa) and low octonal-water partitioning coefficient (0.04). Therefore, volatilization from water and soil surfaces is not expected to be an important route of environmental dissipation and bioaccumulation is unlikely. Pyrasulfotole is stable to hydrolysis and photolysis and moderately susceptible to microbial degradation under aerobic conditions in soils. Pyrasulfotole is expected to be persistent under certain conditions and moderately mobile to mobile (FAO classification) in the environment. Major routes of dissipation include microbial degradation in soils, formation of unextractable residues in soils and sediments, and dilution. Depending on soil, site and meteorological conditions pyrasulfotole may be transported off-site via runoff, leaching and spray drift. **Table 5** summarizes the environmental chemistry, fate and transport properties of pyrasulfotole. Further details on the environmental fate and transport studies are found in **APPENDIX B**.

TABLE 5. Summary of Environmental Chemistry, Fate and Transport Properties of Pyrasulfotole.

<table>
<tr><th>PARAMETER</th><th>VALUE</th><th>REFERENCE/ COMMENTS</th></tr>
<tr><td colspan="3">Selected Physical/Chemical Parameters</td></tr>
<tr><td>PC code</td><td>000692</td><td></td></tr>
<tr><td>CAS No.</td><td>365400-11-9</td><td></td></tr>
<tr><td>Chemical name</td><td>(5-hydroxy-1,3-dimethylpyrazol-4-yl)(α,α,α-trifluoro-2-mesyl-p-tolyl)methanone</td><td></td></tr>
<tr><td>Chemical formula</td><td>$C_5H_{13}Cl_2N$</td><td></td></tr>
<tr><td>Molecular weight</td><td>362.3 g/mol</td><td></td></tr>
<tr><td>Water solubility (20 °C)
pH 4
pH 7
pH 9</td><td>
4.2 g/L
69 g/L
49 g/L</td><td>Product chemistry; very soluble</td></tr>
<tr><td>Vapor pressure</td><td>2.7×10^{-7} Pa (20°C)
6.8×10^{-7} Pa (25°C)</td><td>Product chemistry; non-volatile</td></tr>
<tr><td>K_{OW} (log K_{OW})
pH 4
pH 7
pH 9</td><td>
1.89 (0.276)
0.044 (-1.36)
0.026 (-1.58)</td><td>Product chemistry; not likely to bioaccumulate</td></tr>
<tr><td colspan="3">Persistence</td></tr>
<tr><td>Hydrolysis</td><td>Stable (pH = 5, 7, 9)</td><td>MRID 46801705</td></tr>
<tr><td>Photolysis in water</td><td>Stable</td><td>MRID 46801706</td></tr>
<tr><td>Photolysis in soil</td><td>$t_{1/2}$ = 227 d</td><td>MRID 46801707
Environmental phototransformation half-life based on sunlight expected in Pheonix, AZ (33.26° N)</td></tr>
<tr><td>Aerobic soil metabolism</td><td><table>
<tr><th>Soil Texture</th><th>DT_{50} (d)</th><th>DT_{90} (d)</th><th>R^2</th></tr>
<tr><td>Loamy sand</td><td>5.8</td><td>749</td><td>0.977</td></tr>
<tr><td>Silt loam</td><td>63</td><td>1424</td><td>0.998</td></tr>
<tr><td>Sandy loam</td><td>23</td><td>208</td><td>0.990</td></tr>
</table></td><td>MRIDs 46801709, 46801710, 46801711
2 compartment, 4 parameter exponential model (DFOP)</td></tr>
<tr><td>Anaerobic soil metabolism</td><td>Stable</td><td>MRID 46801712</td></tr>
<tr><td>Aerobic aquatic metabolism</td><td>Stable</td><td>MRID 46801713</td></tr>
<tr><td>Anaerobic aquatic metabolism</td><td>Stable</td><td>MRIDs 46801714, 46801715</td></tr>
<tr><td colspan="3">Mobility</td></tr>
<tr><td>Batch equilibrium</td><td><table>
<tr><th>Soil Texture</th><th>K_f[1]</th><th>1/N</th><th>K_{oc}[2]</th></tr>
<tr><td>Silt loam</td><td>0.98</td><td>0.93</td><td>21</td></tr>
<tr><td>Loamy sand</td><td>1.2</td><td>0.91</td><td>100</td></tr>
</table></td><td>MRID 46801703</td></tr>
</table>

PARAMETER	VALUE				REFERENCE/ COMMENTS
	Clay loam	0.34	0.98	20	
	Sandy loam	0.39	0.95	35	
	Silt loam	3.2	0.93	213	
	Sandy loam	16	0.83	345	
Laboratory volatility	NA				Volatility not likely based on low vapor pressure
Field Dissipation					
Terrestrial field dissipation	**Location**	**DT_{50}**	**DT_{90}**	**% carry over**	MRIDs 46801716, 46801717, 46801718, 46801719 2 compartment, 4 parameter exponential model (DFOP)
	Kansas	8.9 d	45 d	4.7	
	North Dakota	5.7 d	44 d	7.7	
	Washington	5.7 d	213 d	11	
	Saskatchewan	10 d	260 d	37	
	Manitoba	9.2 d	531 d	19	
	Ontario	18 d	178 d	8.9	
Bioaccumulation					
Accumulation in fish, BCF	No data				Bioaccumulation is not expected based on low log K_{ow}

1. Units of (mg/kg)/(mg/L)$^{1/N}$, where 1/N is the Freundlich exponent.
2. Approximation calculated from the Freundlich coefficient, per standard EFED guidance.

a. Degradation

Under aerobic conditions pyrasulfotole degraded in 3 soils (Goldsboro loamy sand, LaDelle silt loam, sandy loam from Germany) according to an apparent bi-phasic pattern with observed DT_{50}s ranging from 4-65 d and observed DT_{90}s ranging from >120->358 d. A 2-compartment, 4-parameter exponential model, also known as Double First Order in Parallel (DFOP), was used to fit the data and resulted in modeled DT_{50}s ranging from 6-63 d and DT_{90}s ranging from 208-1424 d (MRIDs 46801709, 406801710, 46801711). The DFOP model was used to fit the data because it appeared to describe the data better than alternative models (see Appendix B for details). Degradation products included pyrasulfotole-benzoic acid (AE B197555), CO_2 and unextractable residues. Unidentified extractable residues were identified at maximums of ≤2.6-14%. Soil samples were extracted using one solvent system [acetonitrile: water (2:1, v:v)] with an Accelerated Solvent Extraction (ASE) system, which conducted a two-phase ["mild" (40°C, 103 bar) and "aggravated" (100°C, 103 bar) conditions] extraction. Unextractable residues were identified at maximums of 35-62% of applied radioactivity in the 3 soils. The unextractable residues are uncharacterized and it is uncertain whether they consist of degradates of risk concern. Under sterile conditions, however, the formation of unextractable residues (as well as the formation of CO_2 and the benzoic acid degradate) were negligible. In terrestrial field dissipation studies pyrasulfotole dissipated from the whole soil profile with modeled (DFOP) DT_{90}s ranging 44-531 d and the amount of total residue (excluding unextractable residues which are not measured in these studies) carry over to the following growing season ranged from 4.7 to 37% (MRIDs 46801716, 46801717, 46801718, 46801719).

In aquatic systems, pyrasulfotole is stable to hydrolysis and photolysis (MRIDs 46801705, 46801706). In aerobic aquatic metabolism studies, pyrasulfotole variably partitioned to the sediment and formed unextractable residues but there was no evidence of degradation. In a pond water-sandy loam sediment (water pH 4.8, sediment pH 4.5), pyrasulfotole residues partitioned from the water layer to the sediment with water:sediment ratios of 100:1 at day 0, 2:1 at day 55, 1:4 at day 88 and were 1:>10 thereafter. Unextractable residues were identified at a maximum of 73% at study termination. In a pond water-silty clay sediment (water pH 7.5, sediment pH 6.9), pyrasulfotole residues partitioned from the water layer to the sediment with water:sediment ratios of 100:1 at day 0, 3:1 at days 21, and were 2:1 thereafter. Unextractable residues were identified at maximums of 13 % at day 104 and were 11% at study termination. The more acidic pond water-sandy loam sediment resulted in substantially more partitioning to the sediment and formation of unextractable residues than the less acidic pond water-silty clay sediment system. The pH of the more acidic system approaches the pKa from pyrasulfotole (pKa = 4.2). Pyrasulfotole is considered stable to microbial degradation in aquatic systems (MRID 46801713). Under anaerobic conditions pyrasulfotole is also stable (MRIDs 46801712, 4681714, 46801715).

b. Mobility and Transport

Batch equilibrium studies resulted in organic carbon sorption coefficients (K_{oc}) ranging from 20 to 345 ml/g_{oc} with a median value of 68 ml/g_{oc} (MRID 46801703). There is some evidence the pyrasulfotle may become less mobile as it undergoes microbial degradation under certain conditions. In a supplementary experiment during the aerobic soil metabolism studies, the potential mobility of pyrasulfotole appeared to decrease with time from moderately mobile (K_{oc} values of 276-357) at 50 days posttreatment to slightly mobile (K_{oc} values of 2,090-2,183) at 358 days in the Goldsboro loamy sand (pH = 5.6) (MRID 46801709). However, in the LaDelle silt loam (pH = 7.0), the potential mobility of pyrasulfotle appeared to remain mobile (K_{oc} of 88) after one year posttreatment (MRID 46801710).

In terrestrial field dissipation studies, pyrasulfotole showed variable downward migration in the soil profile under bare soil conditions. In some studies, pyrasulfotle was confined to 0-15 cm whereas in others, it was detected at quantifiable levels as deep as 75-90 cm (MRIDs 46801716, 46801717, 46801718, 46801719).

Since pyrasulfotole has a K_d less than 5 in most soils and is persistent (stable to hydrolysis, phtolysis and only moderately susceptible to aerobic degradation in soils), is not volatile (Henry's Law constant of 3.5×10^{-14} atm-m^{-3}/mol), and shows movement to 90 cm during some field dissipation studies, there is potential for groundwater contamination (Cohen, 1984).

c. Field Studies

The soil dissipation/accumulation of pyrasulfotole under bare ground and cropped (wheat) conditions was studied in Kansas, North Dakota, and Washington in the United States (MRIDs 46801716, 46801717, 46801718), and under bare ground conditions in Saskatchewan, Manitoba, and Ontario in Canada (MRID 46801719). Under bare ground conditions, pyrasulfotole dissipated from the entire soil profile with DT_{50}s and DT_{90}s (DFOP) ranging from 5.7 -18 d and 44 – 531 d, respectively. Carryover of total residues (excluding unextractable residues which are not measured in these studies) in the soil column to the following growing season was 4.7 – 37 % in the various studies.

Pyrasulfotole was not detected (above LOQ) below 15 cm at the Kansas, North Dakota and Ontario sites. Pyrasulfotole was detected (above LOQ) as deep as 75-90 cm at the Washington site and as deep as 30-45 cm at the Saskatchewan and Manitoba sites. The major transformation product, pyrasulfotole-benzoic acid (AE B197555), was not detected (above LOQ) below 15 cm at the Kansas, North Dakota and Manitoba sites. It was detected (above LOQ) as deep as 45-60 cm at the Washington site, and as deep as 15-30 cm at the Saskatchewan and Ontario sites.

d. Degradates

There was one major degradate, pyrasulfotole-benzoic acid (2-mesyl-4-trifluoromethylbenzoic acid; RPA 203328; AE B197555), detected in the aerobic soil metabolism and terrestrial field dissipation studies. Pyrasulfotole-benzoic acid is highly mobile with measured K_{oc} of 0.9 – 1.5 ml/g_{oc} (MRID 4681704). Based on available ecological effects data (see page 37), exposure to pyrasulfotole-benzoic acid is not assessed because it is not of risk concern.

Unextractable residues were identified at maximums of 35-62% of applied radioactivity in the aerobic soil metabolism studies. The unextractable residues are uncharacterized and it is uncertain whether they consist of degradates of risk concern or of parent pyrasulfotole. Under sterile conditions, however, the formation of unextractable residues (as well as the formation of CO_2 and the benzoic acid degradate) were negligible.

2. Measures of Aquatic Exposure

a. Aquatic Exposure Modeling

Tier II modeling for selected scenarios representing proposed uses was used to generate estimated environmental concentrations (EECs). For Tier II, two models are used in tandem: the Pesticide Root Zone Model, (PRZM, Carsel *et al.*, 1997) and the Exposure Analysis Modeling System (EXAMS, Burns, 1997). PRZM (3.12 beta dated May 24, 2001) simulates fate and transport on the agricultural field, and EXAMS (2.98.04, dated July 18, 2002) simulates the fate and resulting daily concentrations in the water body. Simulations are carried out with the linkage program shell, PE4V01.pl (dated August 13, 2003), which incorporates the standard crop and orchard scenarios developed by EFED. Simulations are run for multiple (usually 30) years, and the EECs represent peak values that are expected once every ten years based on the thirty years of daily values generated during the simulation. Additional information on these models can be found at: http://www.epa.gov/oppefed1/models/water/index.htm.

For aquatic endpoints, the exposure is estimated for the maximum application pattern to a 10-ha field bordering a 1-ha pond, 2-m deep (20,000 m^3) with no outlet. Exposure estimates generated using this standard pond are intended to represent a wide variety of vulnerable water bodies that occur at the top of watersheds including prairie pot holes, playa lakes, wetlands, vernal pools, man-made and natural ponds, and intermittent and first-order streams. As a group, there are factors that make these water bodies more or less vulnerable than the standard surrogate pond. Static water bodies that have larger ratios of pesticide-treated drainage area to water body volume would be expected to have higher peak EECs than the standard pond. These water bodies will be either smaller in size or have large drainage areas. Smaller water bodies have limited storage capacity and thus may overflow and carry pesticide in the discharge, whereas the standard pond has no discharge. As watershed size increases beyond 10-ha, it becomes increasingly unlikely that the entire watershed is planted with a non-major single crop that is all treated simultaneously with the pesticide. For major crops like cereal grains, however, this may not be the case. Headwater streams can also have peak concentrations higher than the standard pond, but they likely persist for only short periods of time and are then carried and dissipated downstream.

OPP standard PRZM crop scenarios, which consist of location-specific soils, weather, and cropping practices, were used in the simulations to represent proposed labeled uses of pyrasulfotole. These scenarios were developed to represent high-end exposure sites in terms of vulnerability to runoff and erosion and subsequent off-site transport of pesticide. Pyrasulfotole is being proposed for use on wheat, barley, oats and triticale. All available OPP standard PRZM scenarios for wheat were modeled, ND wheat, OR wheat OP, and TX wheat OP. These wheat scenarios are also considered surrogates for the other cereal grain uses on the label (oats, barley and triticale). The Texas and Oregon scenarios were developed for the organophosphate (OP) cumulative drinking water assessment and as such were developed to be vulnerable to cumulative OP exposure and may not be vulnerable for single chemicals or other chemical classes on a national scale. A summary of the crop scenarios used to estimate pyrasulfotole concentrations in the aquatic systems for ecological risk assessment are listed in **Table 6**.

TABLE 6. Summary of Crop Scenarios Used in Aquatic Exposure Modeling.

PYRASULFOTOLE USE	CROP SCENARIO	MLRA/ MET STATION	SCENARIO CHARACTERIZATION
Wheat, oats, barley, triticale	**ND wheat**: Cass County, Bearden silty clay loam	MLRA 56; W14914	Spring wheat
	OR wheat: Willamette Valley, Bashaw clay	MLRA 2; W24232	Winter wheat, OP scenario
	TX wheat: Blacklands prairie, Crockett fine sandy loam	MLRA 87; W13958	Winter wheat, OP scenario

PRZM/EXAMS modeling was done using the proposed maximum label rate. Input parameters are listed in **Table 7**. Pesticide applications were simulated as aerial spray applications. The proposed label recommends applying pyrasulfotole between 1^{st} leaf and flag leaf (approximately 7-45 days post emergence for spring wheat and 7-210 days post emergence for winter wheat). The first date of application was chosen to be one week post-emergence, although applications are expected anytime during the application window.

Since PRZM/EXAMS require first order half-lives (rate constants), they were estimated by dividing the DFOP-modeled DT_{90} by 3.32 (the ratio between DT_{50} and DT_{90} for first order reactions). Modeling inputs were selected according to EFED's Input Parameter Guidance (USEPA 2002). An aerobic soil metabolism first order half-life of 439 d (the upper 90th percentile confidence bound on the mean) was used. A soil organic carbon partitioning coefficient (K_{oc}) of 122 ml/g_{oc}, the mean of six soils, was used.

TABLE 7. PRZM/EXAMS Input Parameters for Aerial Application of Pyrasulfotole to Cereal Grains.

INPUT PARAMETER	VALUE	SOURCE	COMMENT
Application rate lbs a.i./A (kg a.i./ha)	0.045 (0.05)	AE 0317309 SE06 Herbicide (4.4%)	Label maximum
Applications per year	1	AE 0317309 SE06 Herbicide (4.4%)	Label maximum
Date of application ND Wheat OR Wheat TX Wheat	 May 22nd September 8th October 17th		7 days post emergence
Chemical application method (CAM)	2	AE 0317309 SE06 Herbicide (4.4%)	Foliar application
IPSCND Input	1	Assumption	pesticide remaining on foliage after harvest is converted to surface application
Spray drift fraction	0.05	Input parameter guidance[1]	Aerial spray default
Application efficiency	0.95	Input parameter guidance[1]	Aerial spray default
Molecular mass (g/mol)	362.3	Product chemistry	
Vapor pressure (Torr)	5.1×10^{-9}	Product chemistry	
Henry's law constant (atm-m^3/mol)	3.5×10^{-14}	Calculated	
Water solubility (mg/L)	6.9×10^4	Product chemistry	Not multiplied by 10
Organic carbon-water partition coefficient (K_{OC}, ml/g_{oc})	122	MRID 46801703	Mean of six values.[1]
Aerobic soil metabolism $t_{1/2}$ (d)	439	MRIDs 46801709, 46801710, 46801711	90th percentile upper confidence bound on the mean where $t_{1/2}$ is estimated by DT90/3.32
Aerobic aquatic metabolism $t_{1/2}$ (d)	0	MRID 46801713	stable
Anaerobic aquatic metabolism $t_{1/2}$ (d)	0	MRIDs 46801714, 46801715	stable
Hydrolysis $t_{1/2}$ (d)	0	MRID 46801705	stable
Photolysis $t_{1/2}$ (d)	0	MRID 46801706	stable

1. EFED input parameter guidance is located at: http://www.epa.gov/oppefed1/models/water/input_guidance2_28_02.htm.

The EECs listed in **Table 8** reflect maximum 1-in-10 year surface water concentrations based on the proposed maximum application rates for aerial applications to wheat, barley, oats, and triticale (see **APPENDIX C** for the output data from the ND Wheat, OR Wheat, and TX Wheat scenarios).

Table 8. Tier II Surface Water 1-in-10-Year Estimated Environmental Concentrations (EECs) of Pyrasulfotole from Cereal Grain Use (ppb).

PRZM SCENARIO	APP. RATE (lbs a.i./A/yr)	PEAK	4-DAY	21-DAY	60-DAY	90-DAY
ND wheat	0.045	7.7	7.7	7.7	7.7	7.6
OR wheat	0.045	6.5	6.5	6.5	6.5	6.4
TX wheat	0.045	10	10	10	9.9	9.9

The ecological pond modeled with EXAMS is a static water body of fixed volume with no outlet. Since pyrasulfotole is persistent in aquatic environments and since the ecological pond has no outlet, there was a modeled accumulation of pyrasulfotle in the pond throughout the 30 year simulations. Exposure endpoints, in this assessment, are based on yearly peak concentrations. In the case of persistent compounds, a 1-in-10 year EEC does not reflect varying meteorological conditions that are expected once every 10 years, since the yearly peaks are not independent but are actually correlated to the previous year's peak concentration.

b. Aquatic Exposure Monitoring and Field Data

There were no national-scale monitoring data for pyrasulfotole available for this assessment.

3. Measures of Terrestrial Exposure

a. Terrestrial Exposure Modeling

The application method for the proposed pyrasulfotole use on cereal grains is limited to foliar spray (ground, aerial, and sprinkler irrigation), therefore, for this terrestrial exposure assessment, we consider only foliar applications. The EEC values used for terrestrial animal exposure are derived from the Kenaga nomograph, as modified by Fletcher *et al.* (1994), based on a large set of actual field residue data. The upper limit values from the nomograph represent the 95th percentile of residue values from actual field measurements (Hoerger and Kenaga, 1972). The Fletcher *et al.* (1994) modifications to the Kenaga nomograph are based on measured field residues from 249 published research papers, including information on 118 species of plants, 121 pesticides, and 17 chemical classes. These modifications represent the 95th percentile of the expanded data set. Risk quotients are based on the most sensitive LC_{50} and NOAEC for birds (bobwhite quail and mallard duck) and LD_{50} for mammals (based on lab rat studies).

We derive terrestrial estimated environmental concentrations (**Table 9**) for pyrasulfotole using the maximum proposed single application rates. Terrestrial exposure estimates for avian and mammalian risk assessments were derived using the T-REX model (version 1.3.1, December 22, 2006). A complete description of the input parameters and output is contained in **APPENDIX D**. Exposure to upland and wetland plants is estimated using the TerrPlant (v1.2.1) screening model. TerrPlant estimates potential exposure from a single application using default assumptions for runoff and spray drift (**Table 10**). See **APPENDIX E** for more information.

TABLE 9. EECs on Potential Food Items Following Label-Specified Applications (0.045 lbs a.i./Acre) of Pyrasulfotole Using the T-REX Model (ppm).

DIETARY-BASED EECs	KENAGA VALUES	
	Upper Bound	Mean
Short Grass	10.8	3.83
Tall Grass	4.95	1.62
Broadleaf Plants/Small Insects	6.08	2.03
Fruits/Pods/Seeds/Large Insects	0.68	0.32

TABLE 10. EECs on Plants Following Label-Specified Applications (0.045 lbs a.i./Acre) of Pyrasulfotole Using the TerrPlant Model (lbs a.i./A).

RATE	APPLICATION METHOD	ADJACENT UPLAND LOADING[1]	ADJACENT WETLAND LOADING	DRIFT ONLY
0.045 lbs ai/A	Ground	0.0027	0.0230	0.0005
	Aerial	0.0045	0.0248	0.0023

[1] Loading is runoff plus drift (lbs ai/A)

C. Ecological Effects Characterization

APPENDIX F lists the ecological effect studies considered for this assessment (*i.e.*, studies submitted by the registrant). Citations for all of the ECOTOX references identified for pyrasulfotole are found in **APPENDIX A**. All of the studies identified by ECOTOX failed the ECOTOX screening, and were rejected because they were in a foreign language. Therefore, all of the toxicity endpoints used here are from registrant-submitted studies.

Based on the available data, pyrasulfotole is practically nontoxic to fish and freshwater invertebrates, slightly toxic to freshwater nonvascular plants, moderately toxic to estuarine/marine nonvascular plants, highly toxic to estuarine/marine invertebrates, and very highly toxic freshwater vascular plants. Chronic exposure resulted in reduced growth in fish and reduced survival in freshwater aquatic invertebrates. Pyrasulfotole is practically nontoxic to birds and mammals on an acute oral exposure basis. Chronic exposure resulted in reduced male weight gain in birds and delayed maturation and corneal opacity in mammals. Monocots were the least sensitive group of terrestrial plants tested in both seedling emergence and vegetative vigor studies. See **Table 11** for the assessment endpoints considered in this assessment.

TABLE 11. Summary of Specific Assessment Endpoints for Animals and Plants Considered in this Assessment.

TAXA	**MEASURE OF EFFECT**		
Survival, growth and/ or reproduction of:	**Species**	**Toxicity**	**Endpoint**
Freshwater Fish	***Acute***		
	Oncorhychus mykiss Rainbow trout	LC_{50} = >96 mg/L[1]	Mortality
	Chronic		
	Pimephales promelas Fathead minnow	NOAEC = 0.58 mg a.i./L	Reduction in total length
Freshwater Invertebrates	***Acute***		
	Daphnia magna	EC_{50} = >95.8 mg/L[1]	Mortality
	Chronic		
	Daphnia magna	NOAEC = 12.8 mg a.i./L	Mortality
Estuarine/Marine Fish	***Acute***		
	Cyprinodon variegates Sheepshead minnow	LC_{50} = >100 mg./L[1]	Mortality
	Chronic		
	Not Available	Not Available	N/A
Estuarine/Marine Invertebrates	***Acute***		
	Americamysis bahia Mysid	LC_{50} = 1.1 mg/L	Mortality
	Chronic		
	Not Available	Not Available	N/A
Aquatic Plants	***Acute***		
	Lemna gibba Duckweed	EC_{50} = 28 µg a.i./L	Reduction in frond dry weight
	Listed		
	Lemna gibba Duckweed	NOAEC = 9.57 µg a.i./L	Reduction in frond dry weight
	Acute		
	Pseudokirchneriella subcapitata Freshwater algae	EC_{50} = 11 mg a.i./L	Reduction in cell density and biomass
	Listed		
	Pseudokirchneriella subcapitata Freshwater algae	NOAEC = 2.6 mg a.i./L	Reduction in cell density, growth rate, and biomass
	Acute		
	Skeletonema costatum Marine diatom	EC_{50} = 8.3 mg a.i./L	Reduction in biomass
	Listed		
	Skeletonema costatum Marine diatom	NOAEC = 2.53 mg a.i./L	Reduction in biomass
Birds	***Acute***		
	Colinus virginianus Northern bobwhite quail	LC_{50} = >4,911 mg/kg-diet[1] LD_{50} = >2,000 mg/kg-bw[1]	Mortality
	Anas platyrhynchos Mallard duck	LC_{50} = >5,089 mg/kg-diet[1]	
	Chronic		
	Anas platyrhynchos Mallard duck	NOAEC = 167 mg a.i./kg-diet	Decreased male body weight gain

TAXA	MEASURE OF EFFECT		
Survival, growth and/ or reproduction of:	**Species**	**Toxicity**	**Endpoint**
Mammals	***Acute***		
	Wistar rat	LD_{50} = >2,000 mg a.i./kg-bw[1]	Mortality
	Chronic		
	Wistar rat	NOAEL = 2.5 mg a.i./kg-bw	Delayed balano-preputial separation (an indicator of the onset of puberty) in F_1 pups and diffuse and reticulate corneal opacity in both generations
Terrestrial Invertebrates	***Acute***		
	Apis mellifera Honey Bee	LD_{50} = >75 μg/bee (contact)[1]	Mortality
Terrestrial Plants	***Acute (Seedling Emergence)***		
	Monocot: N/A	EC_{25} = >0.0249 lb a.i./acre	N/A
	Dicot: Tomato	EC_{25} = 0.0011 lb a.i./A	Decreased dry weight
	Listed (Seedling Emergence)		
	Monocot: N/A	NOAEC = 0.0249 lb a.i./acre	N/A
	Dicot: Tomato	NOAEC = 0.000399 lb a.i./A	Decreased dry weight
	Acute (Vegetative vigor)		
	Monocot: Onion	EC_{25} = 0.017 lbs a.i./A,	Decreased dry weight
	Dicot: Tomato	EC_{25} = 0.00081 lb a.i./A	Decreased dry weight
	Listed (Vegetative vigor)		
	Monocot: Onion	NOAEC = 0.0125 lbs a.i./A	Decreased dry weight
	Dicot: Tomato	EC05 = 0.000797 lb a.i./A	Decreased dry weight

[1] This endpoint used to calculate RQs in the 'Risk Description' section of this assessment.

1. Aquatic Effects Characterization

a. Aquatic Animals

Studies were submitted for three freshwater fish [rainbow trout (*Oncorhychus mykiss*), bluegill sunfish (*Lepmis macrochirus*), and fathead minnow (*Pimephales promelas*)], one freshwater invertebrate (*Daphnia magna*), one estuarine/marine fish [sheepshead minnow (*Cyprinodon variegates*)], one estuarine/marine mollusk [Eastern oyster (*Crassostrea virginica*)], and one estuarine/marine crustacean [mysid shrimp (*Americamysis bahia*)], all exposed to technical grade pyrasulfotole.

Acute toxicity tests for *Daphnia* (MRID: 468017-21), sheepshead minnow (MRID: 468017-26), mollusk (MRID: 468017-22), rainbow trout (MRID: 468017-24) and bluegill sunfish (MRID: 468017-25) all resulted in no effects, including sublethal effects, to the species at the highest treatment level tested. The mysid study (MRID: 468017-23) resulted in an EC_{50} of 1.1 mg a.i./L. At the 24-hour observation interval, lethargy was observed in the mean-measured 1.5, 2.9 and 6.2 mg ai/L treatment levels and erratic swimming was observed in the mean-measured 6.2 and 12 mg ai/L treatment levels. At the 48-hour observation interval, one mysid in the mean-measured 1.5 mg ai/L treatment level was lethargic and on the bottom of the test vessel, several mysids were lethargic in the mean-measured 6.2 mg ai/L treatment level and all surviving mysids in the mean-measured 12 mg ai/L treatment level were swimming erratically. At 72- and 96-hours, no sub-lethal effects were observed in the control or any of the treatment levels. Therefore, for acute effects, the following endpoints will be used to assess the risk of pyrasulfotole to aquatic animals: freshwater fish – LC_{50} = >96 mg a.i./L; freshwater invertebrate – EC_{50} = >95.8 mg a.i./L; estuarine/marine fish - LC_{50} = >100 mg a.i./L; and estuarine/marine invertebrate - EC_{50} = 1.1 mg a.i./L.

A chronic test for *Daphnia* resulted in a 21-day NOAEC of 12.8 mg a.i./L (MRID: 468017-27), based on reduced survival/immobility (and other clinical signs of toxicity). A freshwater fish early life-stage/reproductive study on fathead minnow resulted in a NOAEC of 0.58 mg a.i./L (MRID: 468017-27). The most sensitive endpoint for this 35-day test was a reduction in total length. Therefore, for chronic effects, a NOAEC of 12.8 mg a.i./L and a NOAEC of 0.58 mg a.i./L will be used to assess the risk of pyrasulfotole to freshwater invertebrates and freshwater fish, respectively.

Based on these submitted studies, pyrasulfotole is classified as practically nontoxic to fish and freshwater invertebrates but is highly toxic to estuarine/marine invertebrates on an acute exposure basis. There were no mortality or sublethal effects at the highest treatment levels tested in most of the acute studies (*i.e.*, all of the LC_{50} or EC_{50} endpoints are 'greater than' values except for the EC_{50} value for the mysid). These 'greater than' endpoints were not used to calculate RQ values here; however, they are used to help characterize the risk in the 'Risk Description' section of this assessment.

b. Aquatic Plants

Studies were submitted for a freshwater vascular plant [duckweed (*Lemna gibba*)], blue-green algae (*Anabaena flos-aquae)*, a freshwater diatom (*Navicula pelliculosa*), a green algae (*Pseudokirchneriella subcapitata* formerly known as *Selenastrum capricornutum*), and a marine alga (*Skeletonema costatum*) exposed to technical grade pyrasulfotole.

Pyrasulfotole is very highly toxic to duckweed based on reductions in frond dry weight in a 7-day toxicity study (MRID: 468017-36). In this study an EC_{50} value of 28 µg a.i./L was reported; the associated NOAEC was 9.57 µg a.i./L. Therefore, an EC_{50} value of 28 µg a.i./L and a NOAEC of 9.57 µg a.i./L will be used to assess the risk of pyrasulfotole to aquatic macrophytes.

Acute toxicity tests in freshwater nonvascular plants resulted in 96-hour EC_{50} values ranging from 11 mg a.i./L for reductions in cell density and biomass in green algae (MRID: 468017-37) to 53 mg a.i./L based on reductions in biomass in freshwater diatoms (MRID: 468017-38). The lowest EC_{50} value of 11 mg a.i./L based on decreased cell density and biomass and the associated NOAEC of 2.6 mg a.i./L for reductions in cell density, growth rate, and biomass in *Pseudokirchneriella subcapitata* will be used to assess the risk of pyrasulfotole to freshwater nonvascular plants.

An acute (96-hour) toxicity test with a marine diatom resulted in an EC_{50} value of 8.3 mg a.i./L based on a reduction in biomass in *Skeletonema costatum* (MRID: 468017-40). The EC_{50} value of 8.3 mg a.i./L and the associated NOAEC of 2.53 mg a.i./L for reductions in biomass in *Skeletonema costatum* will be used to help assess the risk of pyrasulfotole to marine plants.

Based on the data, pyrasulfotole is classified as very highly toxic to vascular aquatic plants, slightly toxic to freshwater nonvascular plants, and moderately toxic to marine plants on an acute exposure basis.

2. Terrestrial Effects Characterization

a. Terrestrial Animals

Birds

Based on the LD_{50} value for the northern bobwhite quail (*Colinus virginianus*) of >2,000 mg/kg-bw, pyrasulfotole is characterized as "practically nontoxic" to avian species on an acute oral-exposure basis (MRID: 468017-29). Pyrasulfotole is "practically nontoxic" to "slightly toxic" to avian species on a subacute dietary-exposure basis, with the lowest LC_{50} of >4,911 mg/kg-diet reported for northern bobwhite quail (MRID: 468017-30). The LC_{50} for the mallard duck (*Anas platyrhychos*) is >5,089 mg a.i./kg diet (MRID: 46017-31). In this assessment, an LC_{50} value of >4,911 mg/kg-diet and an LD_{50} of >2,000 mg/kg-bw will be used to assess the risk of pyrasulfotole to birds. In all of the avian acute toxicity studies submitted, there were no mortality or sublethal effects at the highest treatment levels tested (*i.e.*, all of the LD_{50} and LC_{50} endpoints are 'greater than' values), therefore, these endpoints are not used to calculate RQ values here. They are, however, used to help characterize risk in the 'Risk Description' section of this assessment.

Avian reproduction studies were performed for pyrasulfotole in two species, mallard duck and northern bobwhite quail. The lowest LOAEC was for the mallard duck (557 mg/kg-diet) based on decreased male body weight gain at the highest treatment level (MRID: 468017-33). The lowest NOAEC was also for the mallard duck (167 mg a.i./kg diet) (MRID: 468017-33). In the northern bobwhite quail study there were slight, but statistically significant, reductions (3 – 9%) in ratios of eggs set to eggs laid, number hatched to eggs laid, number hatched to live 3-week embryos, and hatchling weights at the highest treatment level which resulted in a LOAEC and NOAEC of 594 mg a.i./kg diet and 205 mg a.i./kg diet, respectively. For the purposes of this risk assessment, 167 mg/kg-diet serves as the toxicological endpoint for evaluating chronic effects in birds.

Mammals

Based on the LD_{50} value for the Wistar rat of >2,000 mg/kg-bw, pyrasulfotole is characterized as "practically nontoxic" to mammalian species on an acute oral-exposure basis (MRID: 46801836). In the acute oral study, involving a single dose/animal and a 14-day observation period, there were no mortalities at any of the treatment levels. Additionally, there were no indications of neurotoxic effects or effects on body weight gain or food consumption at any treatment level. There were, however, increased incidents of corneal opacity and corneal neovascularization in females and retinal degeneration in males at the 500 mg/kg-bw treatment level. The corneal effects are believed to be the result of increased tyrosinemia from HPPDase inhibition (the biochemical mechanism of action of pyrasulfotole). Because there were no mortalities at the highest treatment levels tested (*i.e.*, the LD_{50} endpoint is a 'greater than' value), this endpoint (>2,000 mg/kg-bw) is not used to calculate RQ values here. It is, however, used to help characterize risk in the 'Risk Description' section of this assessment.

In a two generation reproductive toxicity study with the Wistar rat (MRID: 46801907), the reproductive NOAEL was 2.5 mg/kg bw/day based on delays of balano-preputial separation (an indicator of the onset of puberty) in F_1 males at the LOAEL of 26.3 mg/kg bw/day. In a neurotoxicity study in the Wistar rat (MRID: 46801917), the NOAEL was 3.8 mg/kg-bw/day based on ocular opacities in dams at $\geq$37 mg/kg-bw/day; and decreased postnatal weights, delayed preputial separation, decreased brain weights and retinal degeneration in offspring at the highest treatment levels ($\geq$37 mg/kg-bw/day). For the purposes of this risk assessment, a NOAEL of 2.5 mg/kg-bw/day serves as the toxicological endpoint for evaluating chronic effects in mammals.

Terrestrial Invertebrates

The registrant submitted one guideline (acute honey bee-contact) and two non-guideline (acute honey bee-oral and acute earthworm) terrestrial invertebrate toxicity studies for pyrasulfotole. These studies resulted in the following: a honey bee oral LD_{50} of >120 µg a.i./bee (MRID: 468017-34); a honey bee contact LD_{50} of >75 µg a.i./bee (MRID: 468017-35); and an EC_{50} and NOAEC of >1,000 mg a.i./kg for earthworms (MRID: 468017-41). Therefore, pyrasulfotole is classified as 'practically nontoxic' to non-target terrestrial insects on an acute oral and contact exposure basis. In all of the terrestrial invertebrate studies there was no mortality or sublethal effects at the highest treatment levels tested (*i.e.*, all of the LD_{50} and EC_{50} endpoints are 'greater than' values).

b. Terrestrial Plants

The effects of the proposed North American pyrasulfotole formulations, AE 0317309 + Bromo Herbicide (3.3% pyrasulfotole, 13.4% bromoxynil octanoate, and 12.9% bromoxynil heptanoate) and AE 0317309 SE06 Herbicide (4.4% pyrasulfotole), were tested on various monocots and dicots in Tier II seedling emergence and vegetative vigor studies.

Results of the Tier II seedling emergence studies with the AE 0317309 02 SE06 and AE 0317309 + Bromo formulations showed no measurable effects to monocots at any of the tested treatment levels [the highest treatment levels for monocots were 0.0249 to 0.0994 lbs a.i./acre – depending on the species – for the AE 0317309 02 SE06 formulation, and 0.029 lbs a.i.(pyrasulfotole only)/acre for the AE 0317309 + Bromo formulation]. For dicots, tomato was the most sensitive species in the seedling emergence studies for both formulations, with decreased dry weight as the most sensitive endpoint affected. The NOAEC and EC_{25} values were 0.000399 lb a.i./A and 0.0011 lb a.i./A, respectively, for tomato dry weight in the study with the AE 0317309 02 SE06 formulation. In the seedling emergence study with the AE 0317309 + Bromo formulation, the NOAEC and EC_{25} were 0.00022 lb a.i.(pyrasulfotole only)/A and 0.00025 lb a.i. (pyrasilfotole only)/A, respectively. Although the AE 0317309 + Bromo formulation is more toxic to dicots than the AE 0317309 02 SE06 formulation based on the seedling emergence studies, the results from the SE06 formulation are used to calculate RQs since the AE 0317309 + Bromo formulation includes other active ingredients. Because AE 0317309 + Bromo formulation is a mixture of different active ingredients, the results from the studies using this formulation cannot be used to specifically assess the risks of pyrasulfotole to plants. Results from the AE 0317309 + Bromo formulation, however, are incorporated into the Risk Description section of this assessment. Therefore, a NOAEC of 0.00039 lb a.i./A and an EC_{25} of 0.0011 lb a.i./A are used to assess the effects of exposure to pyrasulfotole on seedling emergence in non-listed and listed terrestrial plants (see **Table 12**).

Results of the Tier II vegetative vigor studies identify onion as the most sensitive monocot with decreased dry weight as the most sensitive endpoint affected (with the AE 0317309 02 SE06 formulation). The NOAEC and EC_{25} values for onion dry weight were 0.0125 lbs a.i./A and 0.017 lbs a.i./A, respectively. No effects were seen in monocots in the vegetative vigor study with the AE 0317309 + Bromo formulation [the highest treatment level tested was 0.030 lbs a.i. (pyrasulfotole only)/acre]. For dicots, tomato was the most sensitive species with the AE 0317309 02 SE06 formulation (NOAEC =

0.000797 lb a.i./A; EC_{25} = 0.00081 lb a.i./A for dry weight), while cucumber was the most sensitive dicot with the AE 0317309 + Bromo formulation [NOAEC <0.00012 lb a.i. (pyrasulfotole only)/A; EC_{25} = 0.00017 lb a.i. (pyrasulfotole only)/A for dry weight]. Therefore, a NOAEC of 0.0125 lbs a.i./A and an EC_{25} of 0.017 lbs a.i./A, for onion dry weight, are used to assess the effects of exposure to pyrasulfotole on vegetative vigor in monocot plants.

For dicots, although the AE 0317309 + Bromo formulation is more toxic than the AE 0317309 02 SE06 formulation based on the vegetative vigor studies, the results from the SE06 formulation are used to calculate RQs since the AE 0317309 + Bromo formulation includes other active ingredients. Results from the AE 0317309 + Bromo formulation are incorporated into the Risk Description section of this assessment. Therefore, a NOAEC of 0.0.000797 lb a.i./A and an EC_{25} of 0.00081 lb a.i./A (based on tomato dry weight) are used to assess the effects of exposure to pyrasulfotole on vegetative vigor in non-listed and listed terrestrial dicots (see **Table 12**).

TABLE 12. Terrestrial Monocot and Dicot Endpoints (lbs a.i./acre) from the Pyrasulfotole Seedling Emergence and Vegetative Vigor Studies.

		SEEDLING EMERGENCE		VEGETATIVE VIGOR	
		AE 0317309 02 SE06 Formulation (Max. Application Rate = 0.045 lb a.i./acre)	**AE 0317309 + Bromo Formulation [Max. Application Rate = 0.037 lb a.i. (pyrasulfotole only)/acre]**	**AE 0317309 02 SE06 Formulation (Max. Application Rate = 0.045 lb a.i./acre)**	**AE 0317309 + Bromo Formulation [Max. Application Rate = 0.037 lb a.i. (pyrasulfotole only)/acre]**
EC_{25}	**Monocots**	**> 0.0249***	> 0.029	**0.017***	> 0.030
	Dicots	**0.0011**	0.00025*	**0.00081**	0.00017*
NOAEC	**Monocots**	**0.0249*, [1]**	0.029	**0.0125***	0.030[1]
	Dicots	**0.000399**	0.00022*	**0.000797**	0.000016*, [2]

* The most sensitive endpoint

[1] These represent the highest concentrations tested.

[2] The NOAEC for the most sensitive species is below the lowest tested concentrations (<0.00012 lbs a.i./A), therefore, this number is the EC_{05} value.

Bolded nimbers are used to calculate RQs in this assessment.

3. Toxicity of the Degradate Pyrasulfotole-Benzoic Acid

One major degradate, pyrasulfotole-benzoic acid (RPA 203328, AE 197555), was detected in the aerobic soil metabolism and terrestrial field dissipation studies. The toxicity data for RPA 203328 indicate that this degradate is less toxic (or at least not more toxic, in the case of limit tests) to fish, aquatic invertebrates, aquatic vascular plants, birds, earthworms, and terrestrial plants, and is equitoxic to freshwater algae when compared to the parent chemical on an acute exposure basis (see **Table 13**). No comparative chronic toxicity data are available for any taxa. There are no data to indicate that RPA 203328 is of toxicological concern (which is in agreement with HED), and, therefore, it will not be included in this assessment.

TABLE 13. RPA 203328 Acute Toxicity Data for aVariety of Animals and Plants.

SPECIES	ENDPOINT	DURATION	MRID	CLASSIFICATION	COMMENTS
Animals					
Rainbow trout *Oncorhynchus mykiss*	LC$_{50}$ = 160 ppm a.i.	96 hrs	439048-25	Acceptable	Flow-through; NOAEC = 130
Mysid *Mysidopsis bahia*	LC$_{50}$ = 145 ppm a.i.	96 hrs	447188-01	Acceptable	Static; NOAEC = 25 ppm a.i.
Daphnid *Daphnia magna*	EC$_{50}$ = >150 mg a.i./L	48 hrs	435732-41	Acceptable	Flow-through test; NOAEC = 150 mg a.i./L
Northern bobwhite quail *Olinus virginianus*	LC$_{50}$> 5265 ppm a.i.	8 days	446935-01	Acceptable	NOAEC = 5265 ppm a.i.
Earthworms *Eisenia foetida*	EC$_{50}$ = >1000 mg a.i./kg	14 days	468017-42	Supplemental	Non-guideline; NOAEC = 556 mg a.i./kg
Earthworms *Eisenia foetida*	EC$_{50}$ = >1000 mg a.i./kg	56 days	468017-43	Supplemental	Non-guideline; NOAEC = ≥ 1000 mg a.i./kg
Plants					
Freshwater green algae *Selenastrum capricornutum*	EC$_{50}$ = 5.9 ppm a.i. NOAEC = 2.4 ppm a.i.	120 hrs	439048-26	Acceptable	NOAEC = 2.4 ppm a.i.
Duckweed *Lemna gibba*	EC$_{50}$ = > 9.8 ppm a.i.	14 days	443999-10	Acceptable	NOAEC = 9.8 ppm a.i.
Various species; Vegetative Vigor	Monocot: N/A Dicot: N/A	14 days	443999-06	Acceptable	Limit test – NOAEC 0.13 lbs a.i./acre (highest level tested)
Various species; Seedling Emergence	Monocot: N/A Dicot: N/A	14 days	443999-07	Acceptable	Limit test – NOAEC 0.14 lbs a.i./acre (highest level tested)

IV. Risk Characterization

A. Risk Estimation - Integration of Exposure and Effects Data

Toxicity data and exposure estimates are used to evaluate the potential for adverse ecological effects on non-target species. For this screening-level assessment of pyrasulfotole, the deterministic risk quotient method is used to provide a metric of potential risks. The RQ is a comparison of exposure estimates to toxicity endpoints; estimated exposure concentrations are divided by acute and chronic toxicity values. The resulting unitless RQs are compared to the Agency's levels of concern (LOCs) (see **Table 14**), which are the Agency's interpretive policy such that when LOCs are exceeded, the need for regulatory action may be considered. These criteria are used to indicate when the use of a pesticide, as directed on the label, has the potential to cause adverse effects on non-target organisms.

TABLE 14. Agency Levels of Concern (LOC).

Risk	Description	RQ	Taxa
Acute	Potential for acute risk to non-target organisms which may warrant regulatory action in addition to restricted use classification	acute RQ > 0.5	aquatic animals, mammals, birds
Acute Restricted Use	Potential for acute risk to non-target organisms, but may be mitigated through restricted use classification	acute RQ > 0.1	aquatic animals
		acute RQ > 0.2	mammals and birds
Acute Listed Species	Listed species may be potentially affected by use	acute RQ > 0.05	aquatic animals
		acute RQ > 0.1	mammals and birds
Chronic	Potential for chronic risk may warrant regulatory action, listed species may potentially be affected through chronic exposure	chronic RQ > 1	all animals
Non-Listed and Listed Plant	Potential for effects in non-listed and listed plants	RQ > 1	all plants

1. Non-target Aquatic Animals and Plants

Table 15 lists the RQs calculated for aquatic animals for exposure to pyrasulfotole, based on the EECs from PRZM modeling scenarios. Pyrasulfotole is classified as 'practically nontoxic' to fish and freshwater invertebrates on an acute exposure basis. The only acute RQ we calculated for aquatic animals was for estuarine/marine invertebrates, since all other aquatic animals showed no effects as the highest treatment levels tested. Pyrasulfotole is classified as 'highly toxic' to estuarine/marine invertebrates, however, the acute RQs for estuarine/marine invertebrates range from 0.006 (for the OR Wheat scenario) to 0.009 (for the TX Wheat scenario). Therefore, no RQs for aquatic animals exceed the Agency's LOC for acute risk.

The highest calculated chronic exposure RQ for aquatic animals is 0.017 (rainbow trout), and is below the Agency's LOC for chronic exposure to animals. However, there are no chronic toxicity data available for estuarine/marine invertebrates, which are the most sensitive of all of the aquatic animals tested. Estuarine/marine invertebrates ($EC_{50} = 1.1$ mg a.i./L) are more than 87 times (95.8/1.1) more sensitive to pyrasulfotole on an acute exposure basis than freshwater invertebrates (EC_{50} >95.8 mg a.i./L). Using an acute to chronic ratio and comparing the daphnid and mysid data results in a NOAEC for mysids of < 0.147 mg a.i./L [(95.8/12.8) = 7.8; 1.1/7.8 = 0.147]. To trigger the Agency's chronic LOC, however, the estuarine/marine invertebrate NOAEC would need to be at least 9.9 µg a.i./L (using the 21-day peak value from the TX Wheat scenario and an LOC of 1). In other words, estuarine/marine invertebrates would need to be at least 1,293 times more sensitive to pyrasulfotole than freshwater invertebrates [NOAEC – 12.8 mg a.i./L; (12.8 mg a.i./L)/(0.0099 mg a.i./L) = 1,293] on a chronic exposure basis to exceed the Agency's chronic LOC for listed and non-listed species.

TABLE 15. Aquatic Animal RQ Values for Exposure to Pyrasulfotole.

TAXA	EXPOSURE	CALCULATED RQ		
		ND Wheat	OR Wheat	TX Wheat
Estuarine/Marine Invertebrates	Acute	0.007	0.006	0.009
Freshwater Fish	Chronic	0.013	0.011	0.017
Freshwater Invertebrates	Chronic	< 0.001	< 0.001	< 0.001

Pyrasulfotole is classified as 'slightly toxic' to freshwater algae, 'moderately toxic' to marine diatoms, and 'very highly toxic' to aquatic vascular plants on an acute exposure basis. The Agency's LOC for listed plants is exceeded for aquatic vascular plants (RQ = 1.045) with the TX Wheat scenario. All other aquatic plant RQs are below the Agency's level of concern (**Table 16**).

TABLE 16. Aquatic Plant RQ Values for Exposure to Pyrasulfotole.

TAXA		CALCULATED RQ		
		ND wheat	OR wheat	TX wheat
Aquatic vascular plants	Non-Listed	0.275	0.232	0.357
	Listed	0.805	0.679	**1.045**
Freshwater algae	Non-Listed	< 0.001	< 0.001	< 0.001
	Listed	0.003	0.003	0.004
Marine diatom	Non-Listed	< 0.001	< 0.001	0.001
	Listed	0.003	0.002	0.004

Bolded numbers indicate RQs that exceed the Agency's LOC for aquatic plants

2. Non-target Terrestrial Animals

Birds

Pyrasulfotole is classified as 'practically nontoxic' to birds on an acute and sub-acute exposure basis. The RQs calculated for chronic exposure range from 0 to 0.06 using upper 90th percentile Kenaga values (see **Table 17**). Therefore, none of the avian RQs calculated for chronic exposure exceed the Agency LOC.

TABLE 17. Avian RQ Values for Chronic Exposure to Pyrasulfotole.

DIETARY CATEGORY	RQ
	Upper 90th Percentile Kenaga
Short Grass	0.06
Tall Grass	0.03
Broadleaf Plants/Small Insects	0.04
Fruits/Pods/Seeds/Large Insects	0.00

Mammals

Pyrasulfotole is classified as 'practically nontoxic' to mammals on an acute oral exposure basis. The RQs calculated for chronic exposure range from 0.01 to 0.22 for dietary exposure and 0.01 to 1.87 for dose-based RQs using upper 90th percentile Kenaga values (see **Table 18**). The RQs for three body-size/dietary categories exceed the Agency's LOC for chronic exposure: 15 g and 35 g mammals that eat short grass (RQs = 1.87 and 1.6, respectively) and 15 g mammals that eat broadleaf plants/small insects (RQ = 1.05).

TABLE 18. Mammalian RQ Values for Chronic Exposure to Pyrasulfotole.

	Upper 90th Percentile Kenaga		
DIETARY CATEGORY	**BODY SIZE**	**DIETARY-BASED RQ**	**DOSE-BASED RQ**
Short Grass	**15 g**	0.22	**1.87**
	35 g		**1.60**
	1,000 g		0.86
Tall Grass	**15 g**	0.10	0.86
	35 g		0.73
	1,000 g		0.39
Broadleaf Plants/Small Insects	**15 g**	0.12	**1.05**
	35 g		0.9
	1,000 g		0.48
Fruits/Pods/Seeds/Large Insects	**15 g**	0.01	0.12
	35 g		0.10
	1,000 g		0.05
Granivore	**15 g**	N/A	0.03
	35 g		0.02
	1,000 g		0.01

Bolded numbers indicate RQs that exceed the Agency's chronic risk LOC for mammals

Terrestrial Invertebrates

Pyrasulfotole is classified as 'practically nontoxic' to non-target terrestrial insects on an acute exposure basis. Potential risk to terrestrial invertebrates from chronic exposure to pyrasulfotole could not be assessed due to a lack of data. Screening-level risk assessments do not typically evaluate risks to terrestrial invertebrates; however, toxicity information for beneficial insects is used to develop precautionary label language where necessary. Based on the available data, precautionary label language for bees does not appear necessary.

3. Non-target Terrestrial and Semi-aquatic Plants

Table 19 lists the terrestrial and semi-aquatic plant RQs for the maximum proposed application rate for pyrasulfotole based on results from the TerrPlant v. 1.2.1. Based on this analysis, none of the RQs for monocots, which range from 0.04 to 0.99, exceed the Agency's LOC of >1 for plants. The RQs for semi-aquatic monocots for aerial and ground applications did approach the Agency's LOC for listed plants, and, therefore, the potential for risks to this taxon will be explored further in the 'Risk Description' section.

All of the RQs for listed and nonlisted terrestrial and wetland dicots in areas adjacent to pyrasulfotole use sites do exceed the Agency's LOC. Additionally, the LOC is exceeded for listed dicots based on drift alone for aerial applications. The RQs for nonlisted dicots based on ground applications range from 0.01 (drift only) to 20.86 (adjacent wetland), while those for aerial applications range from 0.06 (drift only) to 22.5 (adjacent wetland). For listed dicots, the RQs range from 0.56 (drift only) to 57.52 (adjacent wetland) for ground applications and 2.82 (drift only) to 62.03 (adjacent wetland) for aerial applications.

TABLE 19. RQ Values for Terrestrial and Semi-Aquatic Plants Exposed to Pyrasulfotole.

TAXA	APPLICATION METHOD	ADJACENT UPLAND[1]		ADJACENT WETLAND[1]		DRIFT ONLY	
		Monocot	**Dicot**	**Monocot**	**Dicot**	**Monocot**	**Dicot**
Nonlisted Species	Ground	N/A	**2.45**[2]	N/A	**20.86**	0.03	0.01
	Aerial	N/A	**4.09**	N/A	**22.5**	0.13	0.06
Listed Species	Ground	0.108	**6.77**	**0.92**[3]	**57.52**	0.04	0.56
	Aerial	0.18	**11.28**	**0.99**[3]	**62.03**	0.18	**2.82**

[1] Both the 'Adjacent Upland' and 'Adjacent Wetland' values are based on seedling emergence data; since no EC_{25} values could be determined for monocots in the pyrasulfotole seedling emergence studies, only the results for the listed monocots are presented here.

[2] Bolded numbers indicate RQs that exceed the Agency's LOC for plants.

[3] Although this is below the Agency LOC of 1, it is close enough that we will consider it further.

B. Risk Description

The results of this screening-level risk assessment indicate that the proposed uses of pyrasulfotole have the potential for direct adverse effects for listed freshwater vascular plants, listed and non-listed terrestrial and semi-aquatic dicotyledonous plants, and listed and non-listed mammals (chronic exposure). Therefore, the hypothesis from p. 14 [... *the proposed agricultural uses of pyrasulfotole have the potential to reduce survival, reproduction, and/or growth in terrestrial and aquatic animals and plants through spray drift and/or runoff*] is supported. These results are based on a modeled spray application rate of 0.045 lbs a.i./A per year, which represents the proposed maximum application rate for cereal grains. Although direct adverse effects to non-mammalian animals (aquatic and terrestrial) from pyrasulfotole use are not expected, given the potential for effects on terrestrial and aquatic plant species and mammals, indirect effects to all animals are possible. Since plants are vital components of most habitats and ecosystems, alterations in the abundance of plants or in the composition of plant communities could result in adverse effects to non-plant species. Potential effects include, but are not limited to, reduction in food resources, decrease in cover (*e.g.*, for predator avoidance), change in water parameters (*e.g.*, increases or decreases in temperature and pH), and loss of breeding/nesting habitat.

Reducing the proposed application rate from 0.045 lb a.i./acre to 0.040 lb a.i./acre results in an RQ of <1 for listed aquatic vascular plants, and reducing the application rate to 0.023 lb a.i./acre results in chronic RQs of <1 for all mammalian size/dietary categories. Therefore, RQs for listed aquatic vascular plants and listed and non-listed mammals (from chronic exposure) could be reduced to below Agency LOCs if the maximum proposed application rate for pyrasulfotole was reduced to 0.04 lb a.i./acre and 0.023 lb a.i./acre, respectively. Agency LOCs for listed and non-listed terrestrial and semi-aquatic dicotyledonous plants, however, are still exceeded at an application rate of 0.023 lb a.i./acre, indicating potential risks to dicots even at this rate.

1. Risks to Aquatic Organisms

a. Animals

No aquatic animal acute or chronic risk LOCs are exceeded for any of the proposed uses of pyrasulfotole. The acute RQs for aquatic animals for estuarine/marine invertebrates ranged from 0.006 to 0.009, depending on the scenario modeled. The calculated RQ values for chronic exposure to pyrasulfotole ranged from <0.001 to 0.017 for all modeled use scenarios.

Because there was no mortality or sublethal effects at the highest treatment levels tested in most of the acute aquatic animal studies submitted (with the exception of estuarine/marine invertebrates), RQ values for acute exposure were not calculated for most aquatic animals in the Risk Characterization section of this assessment. In order to gain a better understanding of how the EECs for the maximum proposed pyrasulfotole application rate relate to the toxicity data currently available for fish and aquatic invertebrates, RQ calculations were made using the highest level tested as the endpoint value, as a conservative assumption [*i.e.*, LC_{50} = 100 mg a.i./L (the actual highest concentrations tested in the aquatic animal studies ranged from 95.8 mg a.i./L to 104 mg a.i./L)]. In this exercise all of the acute RQs calculated were less than 0.001 for all aquatic animals. The actual RQs would likely be much lower than these since no effects were actually identified at the 100 mg a.i./L. Therefore, direct risk to aquatic animals from acute exposure to pyrasulfotole is unlikely.

None of the aquatic animal RQs for chronic exposure exceeded the Agency's LOC. Chronic toxicity data, however, are not available for the most acutely sensitive aquatic animal taxon (*i.e.*, estuarine/marine invertebrate). Even though pyrasulfotole is very soluble and moderately mobile to mobile based on the results of batch equilibrium studies, in aquatic systems (based on laboratory data) it does variably partition to the sediment and form unextractable residues and persist as parent. Additionally, there is some evidence that pyrasulfotle may become less mobile as it it is exposed to viable microbs under certain conditions. Since PRZM/EXAMS modeling requires one input for soil-water partitioning coefficient that is constant throughout the simulation (K_{oc} = 122 ml/g_{oc} for pyrasulfotole), the modeled partitioning to the sediment may be underestimated relative to the aerobic aquatic metabolism studies. Therefore, there is the potential for pyrasulfotole to accumulate in the benthos under certain conditions and to be a risk to benthic and epibenthic organisms (including some estuarine/marine invertebrates). Although the chronic toxicity of pyrasulfotole to estuarine/marine invertebrates is uncertain, given that: (1) the potential use sites for the proposed uses largely fall outside of estuarine/marine environments, with the possible exceptions of California and the mid-Atlantic states (see **Figs. 2, 3,** and **4**); (2) the aquatic EECs used in this assessment are based on a static water-body with no outlet, and, thus, are likely higher than concentrations expected in estuarine/marine environments; and (3) estuarine/marine invertebrates would need to be 1,293 times more sensitive to pyrasulfotole than freshwater invertebrates on a chronic-exposure basis to exceed the Agency's chronic risk LOC, risks to estuarine/marine invertebrates from chronic exposure to pyrasulfotole are not expected.

Therefore, the likelihood of adverse effects on aquatic animals due to acute or chronic exposure to pyrasulfotole is considered low for the proposed uses based on the available toxicity data. Given the potential for effects on terrestrial and aquatic vascular plant species associated with the use of pyrasulfotole, however, indirect effects on aquatic animals are possible.

b. Plants

Based on the predicted EECs for the modeled pyrasulfotole use and available toxicity data, the LOC for listed species is exceeded for vascular aquatic plants using the TX Wheat scenario (RQ = 1.045). This indicates the potential for direct effects to listed aquatic vascular plants and indirect effects to listed species that rely on aquatic vascular plants for at least some part of their life cycle (*i.e.*, aquatic vascular plant species obligates). Reducing the proposed application rate from 0.045 lb a.i./acre to 0.040 lb a.i./acre, however, results in a peak EEC of 8.9 ppb using the TX Wheat scenario. Therefore, at a maximum application rate of 0.040 lb a.i./acre, risks to listed aquatic vascular plants are not expected.

There is no evidence of pyrasulfotole degradation in aquatic environments. As such, pyrasulfotole was assumed stable in the ecological pond used to estimate aquatic exposure concentrations. Since the ecological pond (used in our modeling) has no outlet, there was a modeled accumulation of pyrasulfotle in the pond throughout the 30 year simulations. In the case of persistent compounds, a 1-in-10 year EEC does not reflect varying meteorological conditions that are expected once every ten years, since the yearly peaks are not independent but are actually correlated to the previous year's peak concentration. This results in acute and chronic exposure concentrations that are very similar (*i.e*, < 2% difference between peak and 90-day average EECs). Estimated peak concentrations in the ecological pond are only high enough to result in an exceedance of the listed species LOC for vascular plants after 26 years of annual applications of pyrasulfotole assuming no dissipation whatsoever in the pond (**APPENDIX C**). Pyrasulfotle concentrations in flowing water bodies are not expected to accumulate from year to year because of downstream dilution. Risk to aquatic plants resulting from accumulation of pyrasulfotle from multiple years of application is not likely in flowing systems.

2. Risks to Terrestrial Organisms

a. Animals

Birds

The avian chronic risk LOC (which is the same for listed and non-listed species) is not exceeded for any pyrasulfotole use indicating that the likelihood of adverse effects on birds due to chronic exposure is low. Because there was no mortality or sublethal effects at the highest treatment levels tested in the acute oral and sub-acute dietary avian studies submitted, standard RQ values for acute and sub-acute exposure were not calculated in the Risk Characterization section of this assesssment. In order to gain a better understanding of how the EECs for the maximum proposed pyrasulfotole application rate relate to the toxicity data currently available for birds, we used T-REX to calculate RQs using the conservative assumption that the highest values tested in the avian studies represent endpoints (*i.e.*, acute: LD_{50} = 2,000 mg/kg-bw; sub-acute: LC_{50} = 4,911 mg/kg diet). In this exercise all of the acute and sub-acute RQs calculated using upper bound Kenaga values were between 0 and 0.01 for all size and dietary classes. The actual RQs would be much lower than these since no effects were actually identified at the 2,000 mg/kg-bw and the 4,911 mg/kg diet levels. Therefore, direct risk to birds from acute, sub-acute, or chronic exposure to pyrasulfotole is low. Given the potential for effects on terrestrial and aquatic plant species associated with the use of pyrasulfotole, however, indirect effects on birds are possible.

Mammals

Because there was no mortality at the highest treatment levels tested in the acute oral-exposure mammalian study submitted, standard RQ values for acute exposure were not calculated in the Risk Characterization section of this assessment. In order to gain a better understanding of how the EECs for the maximum proposed pyrasulfotole application rate relate to the toxicity data currently available for mammals, we used T-REX to calculate RQs using the conservative assumption that the highest values tested in the avian studies represent endpoints (*i.e.*, acute: LD_{50} = 2,000 mg/kg-bw). In this exercise all of the acute RQs calculated using upper bound Kenaga values were 0 for all size and dietary classes. Using the the effect level of 500 mg/kg-bw in for increased incidents of corneal opacity and corneal neovascularization in females and retinal degeneration in males results in dose-based RQs from T-REX between 0 and 0.01 for all size/dietary categories. Therefore, direct risk to mammals from acute exposure to pyrasulfotole is low.

The Agency's chronic risk LOC was exceeded for three body size/diet categories [15 g and 35 g mammals that eat short grass (RQs = 1.87 and 1.6, respectively) and 15 g mammals that eat broadleaf plants/small insects (RQ = 1.05)], based on a reproductive NOAEL of 2.5 mg/kg bw/day. This NOAEL is based on delays in maturation (specifically delayed balano-preputial separation) and diffuse and reticulate corneal opacity in pups (LOAEL = 26.3 mg/kg bw/day in males and 32.6 mg/kg-bw/day in females). Similar effects were seen in a 21-day Wistar rat developmental neurotoxicity study [NOAEL = 3.8 mg/kg-bw/day based on decreased food consumption during lactation and ocular opacities in dams; and decreased postnatal weights, delayed preputial separation, decreased brain weights and retinal degeneration in offspring at the highest treatment levels (37 and 354 mg/kg-bw/day)]. A supplemental 24-month chronic toxicity study with Wistar rats failed to establish a NOAEC because of effects at the lowest treatment level (25 mg/kg-diet), including increased incidences of corneal opacity and neovascularization of the cornea.

It is unclear specifically how decreases in vision resulting from corneal opacity and retinal degeneration would affect the viability of mammals. Additionally, some of the eye effects (specifically the corneal effects) observed in the rat studies are believed to be the result of increased tyrosinemia from HPPDase inhibition. Since different species are known to differ in their metabolism of tyrosine, it is unclear if rats are more susceptible to these eye abnormalities than other animals exposed to pyrasulfotole. For example, no eye disorders were observed in a submitted teratogenicity test in rabbits (MRID: 46801906). The delayed maturation exhibited by the delays in balano-preputial separation, however, can be more clearly linked to potential adverse reproductive effects. Therefore, some mammals, specifically smaller-bodied (<35 g) mammals that eat short grass, broadleaf plants, or small insects, are potentially at risk from chronic exposure to pyrasulfotole (based on the maximum proposed application rate for cereal grains).

Reducing the maximum application rate for pyrasulfotole to 0.023 lb a.i./acre results in chronic RQs of <1 for all mammalian size/dietary categories. Based on T-REX, the highest RQ for effects to mammals from chronic exposure to pyrasulfotole is 0.96 for 15g mammals that eat short grass (see **APPENDIX D**). Therefore, potential risks to listed and non-listed mammals (from chronic exposure to pyrasulfotole) are not expected at application rates ≤0.023 lb a.i./acre.

Terrestrial Invertebrates

EFED does not currently estimate risk quotients for terrestrial non-target invertebrates. However, a label statement is required to protect foraging honeybees when the LD_{50} is < 11 µg/bee. Based on the acute contact toxicity study to honeybees, the LD_{50} for pyrasulfotole is >75 µg/bee. This classifies pyrasulfotole as practically non-toxic to honeybees on an acute contact exposure basis. Additionally, in all of the terrestrial invertebrate studies there was no mortality or sublethal effects in any of the treatment levels tested. Therefore, the risk for direct adverse effects to terrestrial invertebrates is considered low; however, due to the risk to plants, the potential for indirect effects to terrestrial invertebrates from pyrasulfotole use cannot be discounted.

b. Plants

Tier II plant studies demonstrate the potential for pyrasulfotole to affect terrestrial dicot plants. In the vegetative vigor studies, the exposure levels equivalent to a 25% effect level were 0.017 lbs a.i./A for monocots and 0.00081 lbs a.i./A for dicots, based on the study with the AE 0317309 SE06 formulation. Results from the seedling emergence study indicated that a 25% effect level was 0.0011 lbs a.i./a for dicots (no effects were seen in monocots). None of the RQs for monocots, which range from 0.03 to 0.99, exceed the Agency's LOC of >1 for plants. However, the RQs for semi-aquatic monocots approached the Agency's LOC of 1 for listed species (RQs = 0.92 and 0.99 for ground and aerial applications, respectively). These RQs were calculated based on the NOAEC for ryegrass which showed no effects at the highest treatment level tested (0.0249 lb a.i./acre; approximately half of the proposed maximum application rate) in a seedling emergence study. Therefore, the actual no effect level would likely be higher, which would result in a lower RQ. Furthermore, pyrasulfotole showed no adverse effects on the other monocot species tested in the seedling emergence studies at rates up to 0.10 lbs a.i./acre (more than twice the proposed maximum application rate). Therefore, the potential risk to listed semi-aquatic monocot species is considered low.

All of the RQs for listed and nonlisted terrestrial and wetland dicots in areas adjacent to pyrasulfotole use sites do exceed the Agency's LOC. Additionally, the LOC is exceeded for the RQ for listed dicots based on drift alone for aerial applications.

Regarding the AE 0317309 + Bromo formulation [which contains three active ingredients: 3.3% pyrasulfotole, 13.4% bromoxynil octanoate, and 12.9% bromoxynil heptanoate], monocots are less sensitive and dicots are more sensitive when compared to the AE 0317309 SE06 formulation [which contains only one active ingredient: 4.4% pyrasulfotole]. Because AE 0317309 + Bromo formulation is a mixture of different active ingredients, the results from the studies using this formulation cannot be used to assess the risks to plants from pyrasulfotole use specifically, although the results are reported as lbs of pyrasulfotole/acre. The results, however, can be used to help assess the risk of the formulated product to plants. **Table 20** compares the RQs for dicots for the AE 0317309 SE06 and AE 0317309 + Bromo formulations based on TerrPlant v. 1.2.1. Since monocots are less sensitive to the AE 0317309 + Bromo formulation than to the AE 0317309 SE06 formulation, only the results for dicots are presented below.

TABLE 20. Comparison of RQ Values for Terrestrial and Semi-Aquatic Dicots Exposed to the AE 0317309 SE06 and AE 0317309 + Bromo formulations.

TAXA	APPLICATION METHOD	ADJACENT UPLAND		ADJACENT WETLAND		DRIFT ONLY	
		AE 0317309 + Bromo	**AE 0317309 SE06**	**AE 0317309 + Bromo**	**AE 0317309 SE06**	**AE 0317309 + Bromo**	**AE 0317309 SE06**
Nonlisted Species	Ground	**10.8**	**2.45**[1]	**91.8**	**20.86**	**2.65**	0.01
	Aerial	**18**	**4.09**	**99**	**22.5**	**13.24**	0.06
Listed Species	Ground	**10.09**	**6.77**	**85.77**	**57.52**	**23.13**	0.56
	Aerial	**16.82**	**11.28**	**92.5**	**62.03**	**115.63**	**2.82**

[1] Bolded numbers indicate RQs that exceed the Agency's LOC for plants.

To gain a better understanding of the potential for spray drift to affect terrestrial dicots, AgDRIFT (v. 2.01) Tier III aerial modeling was used to determine how far off-field pyrasulfotole levels would remain above the EC_{25} for vegetative vigor of dicotyledonous plants. AgDRIFT® utilizes empirical data to estimate off-site deposition of aerial and ground applied pesticides. Details concerning the specifics and uncertainties of AgDRIFT are available online at www.agdrift.com. The default 'Maximum Downwind Distance' for AgDRIFT is 2,608 ft, however, this parameter can be changed to 1 mile in Tier III modeling with the understanding that any calculations beyond 2,608 ft increases the uncertainty associated with the results. For the AE 0317309 SE06 formulation, assuming the maximum single application rate of 0.045 lbs a.i./A, ASAE Fine to Medium droplet size distribution (an ASAE Medium droplet size distribution is stipulated on the label), 10 mph winds, and 10 ft application height, dicots 390 ft or closer to the treated use area may be exposed to pyrasulfotole levels above the EC_{25} (0.0011 lbs a.i./acre) (for specific input parameters, see **APPENDIX G**). If droplet size distribution was increased to ASAE Medium to Coarse, the distance from the treated site where spray drift might exceed the EC_{25} is 203 ft. For the AE 0317309 + Bromo formulation, assuming the maximum single application rate of 0.037 lbs a.i. (pyrasulfotole only)/A, ASAE Fine to Medium droplet size distribution (an ASAE Medium droplet size distribution is stipulated on the label), 10 mph winds, and 10 ft application height, dicots 2,126 ft or closer to the treated use area may be exposed to pyrasulfotole levels above the EC_{25} [0.00025 lbs a.i. (pyrasulfotole only)/acre]. For listed dicot species, these distances would be greater.

For ground applications (Tier I), high boom, ASAE Fine to Medium/Coarse droplet size distribution, 90th data percentile, dicots within 23 ft and 105 ft to the treatment site (for the AE 0317309 SE06 and AE 0317309 + Bromo formulation, respectively) are predicted to be exposed to pyrasulfotole levels above the EC_{25}. Again, for listed dicot plant species, the distances would be greater.

Therefore, the potential for adverse effects of pyrasulfotole use to listed and non-listed dicotyledonous plants extend well beyond the treatment site for both aerial and ground applications.

3. Review of Incident Data

There are no reports of ecological incidents for pyrasulfotole in the EIIS (Environmental Incident Information System) database. Because this is a new chemical that has not been registered for use in the United States, the existence of such incident reports would be unlikely.

4. Federally Threatened and Endangered (Listed) Species Concerns

a. Action Area

For listed species assessment purposes, the action area is considered to be the area affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. At the initial screening-level, the risk assessment considers broadly described taxonomic groups and conservatively assumes that listed species within those broad groups are located on or adjacent to the treated site and aquatic organisms are assumed to be located in a surface water body adjacent to the treated site. The assessment also assumes that the listed species are located within an assumed area that has the relatively highest potential exposure to the pesticide, and that exposures are likely to decrease with distance from the treatment area.

If the assumptions associated with the screening-level action area result in RQs that are below the listed species LOCs, a "no effect" determination conclusion is made with respect to listed species in that taxa, and no further refinement of the action area is necessary. Furthermore, RQs below the listed species LOCs for a given taxonomic group indicate no concern for indirect effects upon listed species that depend upon the taxonomic group covered by the RQ as a resource. However, in situations where the screening assumptions lead to RQs in excess of the listed species LOCs for a given taxonomic group, a potential for a "may affect" conclusion exists and may be associated with direct effects on listed species belonging to that taxonomic group or may extend to indirect effects upon listed species that depend upon that taxonomic group as a resource. In such cases, additional information on the biology of listed species, the locations of these species, and the locations of use sites could be considered to determine the extent to which screening assumptions regarding an action area apply to a particular listed organism. These subsequent refinement steps could consider how this information would impact the action area for a particular listed organism and may potentially include areas of exposure that are downwind and downstream of the pesticide use site.

b. Taxonomic Groups Potentially at Risk

The Level I screening assessment process for listed species uses the generic taxonomic group-based process to make inferences on direct effect concerns for listed species. The first iteration of reporting the results of the Level I screening is a listing of pesticide use sites and taxonomic groups for which RQ calculations reveal values that meet or exceed the listed species LOCs (for more information see, USEPA 2004).

(1). Discussion of Risk Quotients

None of the Agency's acute listed species LOCs or chronic listed species LOCs were exceeded for any group of terrestrial or aquatic non-mammalian animal for any pyrasulfotole use. Additionally, the listed species LOC for plants was not exceeded for monocots or for any non-vascular aquatic plant. The Agency's listed species LOC, however, was exceeded for freshwater vascular plants, the listed species and acute risk LOCs were exceeded for dicots, and the chronic risk (for listed and non-listed species) was exceeded for some mammals at the maximum proposed application rate for pyrasulfotole. This indicates a potential risk for direct adverse effects to Federally-listed dicots, freshwater vascular plants, and mammals and indirect adverse effects to any listed species that rely on these taxa as resources critical to their life cycle.

(2). Probit Dose Response Relationship

Although no acute LOCs were exceeded for any animal, indicating a low acute risk to these taxa, the probit slope response relationship can be used to calculate the chance of an individual event corresponding to the listed species acute LOCs and/or RQs. The analysis uses the EFED spreadsheet IECv1.1.xls. It is important to note that the IEC model output can go as high as 1 x 10^{16} or as low as 1 x 10^{-16} in estimating the event probability for animals. This cut-off is a limit in the Excel spreadsheet environment and is not to be interpreted as an agreed upon upper or lower bound threshold for concern for individual effects in any given listed species.

If information is unavailable to estimate a slope from a study, a default slope assumption of 4.5 is used as per original Agency assumptions of typical slope cited in Urban and Cook (1986). Slopes were not available for the acute toxicity studies on freshwater fish, freshwater invertebrates, estuarine/marine fish, birds, mammals, and terrestrial invertebrates. Therefore, probit-dose analyses were done based on the taxon-specific acute listed species LOCs and a default slope of 4.5 to estimate an individual effects probability for freshwater fish, freshwater invertebrates, estuarine/marine fish, birds, mammals, and terrestrial invertebrates. This resulted in a chance of 1 in 418,000,000 for freshwater fish, freshwater invertebrates, estuarine/marine fish, and terrestrial invertebrates, and 1 in 1 in 294,000 for birds and mammals. To explore possible bounds to such an estimate, slopes of 2 and 9 were used to calculate upper and lower estimates of the effects probability associated with the listed species LOC. The chance of individual effects with these slopes ranged from 1 in 44 to 1 in 1 in 1.75E+31 for the various taxa (see **Table 21**).

The only animal taxonomic group for which a probit slope is available is estuarine/marine invertebrates [based on an EC_{50} of 1.1 mg a.i./L for the mysid (*Americamysis bahia*) (MRID: 468017-23)]. The probit slope in this study was 2.23 with a 95% confidence limit of 1.66 and 2.8. The corresponding estimated chance of individual mortality associated with a slope of 2.23 and the listed species LOC of 0.05 is 1 in 538. To explore possible bounds to such an estimate, the upper and lower 95% confidence limits for the probit slope estimate (1.66 and 2.8) were used to calculate upper and lower estimates of the effects probability associated with the listed species LOC. These values are 1 in 65 and 1 in 7,420, respectively (see **Table 21**).

TABLE 21. Chance of an Individual Effect Corresponding to the Listed Species Acute LOCs Using a Probit Slope Response Relationship.

TAXA	LOC	PROBIT SLOPE		CHANCE OF AN INDIVIDUAL EFFECT
- Freshwater Fish **- Freshwater Invertebrates** **- Estuarine/Marine Fish** **- Terrestrial Invertebrates**[1]	0.05	**Slope**	4.5[2]	1 in 418,000,000
		Upper Bound	2	1 in 216
		Lower Bound	9	1 in 1.75E+31
- Estuarine/Marine Invertebrates	0.05	**Slope**	2.23	1 in 538
		Upper Bound	1.66	1 in 64.9
		Lower Bound	2.8	1 in 7,420
- Birds **- Mammals**	0.1	**Slope**	4.5[2]	1 in 294,000
		Upper Bound	2	1 in 44
		Lower Bound	9	1 in 8.86E+18

[1] The Agency does not currently have a listed-species LOC for terrestrial invertebrates; for our purposes here, we use the aquatic invertebrate acute listed-species LOC (RQ > 0.05).

[2] This is the deafault slope.

(3). Indirect Effects Analysis

The Agency acknowledges that pesticides have the potential to exert indirect effects upon listed organisms by, for example, perturbing forage or prey availability, altering the extent of nesting habitat, and creating gaps in the food chain. In conducting a screen for indirect effects, direct effect LOCs for each taxonomic group are used to make inferences concerning the potential for indirect effects upon listed species that rely upon non-listed organisms in these taxonomic groups as resources critical to their life cycle.

The Agency's listed species LOC was exceeded for freshwater vascular plants, the listed species and acute risk LOCs were exceeded for dicots, and the chronic risk LOC (for listed and non-listed species) was exceeded for some mammals $\leq$ 35 g at the maximum proposed application rate for pyrasulfotole. Therefore, EFED's screening level analysis shows that the possibility of indirect effects from the proposed use of pyrasulfotole on cereal grains to listed species (generalists and obligates) that may depend on dicots and/or mammals and obligates that rely on aquatic vascular plants for survival cannot be precluded. Therefore, at this time, no Federally-listed taxa can be excluded from the potential for direct and/or indirect effects from the proposed uses of pyrasulfotole (see **Table 22**). Species-specific concerns for indirect effects to listed organisms will require a determination of the coincidence of pyrasulfotole use with locations of listed species and the biologically based resources upon which they depend.

TABLE 22. Listed Species Risks Associated with Potential Direct or Indirect Effects Due to the Proposed Applications of Pyrasulfotole on Cereal Grains.

LISTED TAXON	DIRECT EFFECTS	INDIRECT EFFECTS
Terrestrial and semi-aquatic plants - monocots	No	Yes[1]
Terrestrial and semi-aquatic plants - dicots	Yes	Yes[1]
Insects	No	Yes[1]
Birds	No	Yes[1]
Terrestrial phase amphibians	No	Yes[1]
Reptiles	No	Yes[1]
Mammals	Yes (chronic)	Yes[1]
Aquatic plants	Yes	Yes[1]
Freshwater fish	No	Yes[1]
Aquatic phase amphibians	No	Yes[1]
Freshwater crustaceans	No	Yes[1]
Mollusks	No	Yes[1]
Marine/estuarine fish	No	Yes[1]
Marine/estuarine crustaceans	No	Yes[1]

[1] The nonlisted LOC was exceeded for terrestrial and semi-aquatic plants (dicots), the listed LOC was exceeded for aquatic vascular plants, and the chronic risk LOC was exceeded for some small mammals (≤35 g) . Therefore, the potential for adverse effects to those species that rely either on a specific plant or animal species (specifically aquatic vascular plants, terrestrial/semi-aquatic dicots, or mammals) or multiple plant or animal species (specifically terrestrial/semi-aquatic dicots and mammals) cannot be precluded. Indirect effects may include general habitat modification, host plant loss, and food supply disruption.

(4). Critical Habitat

In the evaluation of pesticide effects on designated critical habitat, consideration is given to the physical and biological features (constituent elements) of a critical habitat identified by the U. S. Fish and Wildlife and National Marine Fisheries Services (the

Services) as essential to the conservation of a listed species and which may require special management considerations or protection. The evaluation of impacts for a screening level pesticide risk assessment focuses on the biological features that are constituent elements and is accomplished using the screening-level taxonomic analysis (RQs) and levels of concern (LOCs) that are used to evaluate direct and indirect effects to listed organisms.

The screening-level risk assessment has identified potential concerns for indirect effects on listed species for those organisms dependant upon plants and some mammals. In light of the potential for indirect effects, the next step for EPA and the Services is to identify which listed species and their designated critical habitat(s), if applicable, are potentially implicated. Analytically, the identification of such species and their critical habitat can occur by determining whether the action area overlaps designated critical habitat or the occupied range of any listed species. If so, EPA would examine whether the pesticide's potential impacts on non-listed species would affect the listed species indirectly, or directly affect a constituent element of the critical habitats. At present, the information reviewed by EPA does not permit use of this analytical approach to make a definitive identification of species that are potentially impacted indirectly or designated critical habitats that are potentially impacted directly by the proposed uses of pyrasulfotole.

This screening-level risk assessment for critical habitats provides a listing of potential biological features that, if they are constituent elements of one or more critical habitats, would be of potential concern. These correspond to the taxa identified above (*i.e.*, dicots, aquatic vascular plants, and mammals) as being of potential concern for adverse effects. This should serve as an initial step in problem formulation for further assessment of designated critical habitat impacts outlined above, should additional work be necessary.

(5). Co-occurrence Analysis

The goal of the analysis for co-location is to determine whether sites of pesticide use are geographically associated with known locations of listed species [following the convention of the Services, the word 'species' in this assessment may actually apply to a 'species', 'subspecies', or an Evolutionary Significant Unit (ESU)]. At the screening level, this analysis is accomplished using the LOCATES (version 2.10.3) database. The database uses location information for listed species at the county level and compares it to agricultural census data (from 2002) for crop production at the same county level of resolution. The product is a listing of Federally-listed species that are located within counties known to produce the crops upon which the pesticide will be used, in this case cereal grains (*i.e.*, wheat, barley, oats, and triticale). For direct effects, only listed dicots, aquatic vascular plants, and mammals will be considered, since they were the only taxa to have RQs above the listed species LOC. For indirect effects, all other taxa will be considered since there is a potential for indirect effects to taxa that might rely on plants and/or mammals for some stage of their life-cycle.

LOCATES identified a total of 817 listed species that overlapped at the county-level with areas where wheat, barley, oats, and/or triticale are grown. Among these species, 318 are dicots, 13 are aquatic monocots, and 59 are mammals (see **APPENDIX H** for a complete species list). Therefore, at the county-level, there is the potential for a total of 390 listed species to be directly affected by pyrasulfotole use, while 427 species may be indirectly affected by the use of the chemical. The number of county co-occurrences by taxa per state can be found in **Table 23.**

This preliminary analysis indicates that there is a potential for pyrasulfotole use to overlap with listed species and that a more refined assessment is warranted. The more refined assessment should involve clear delineation of the action area associated with proposed uses of pyrasulfotole and best available information on the temporal and spatial co-location of listed species with respect to the action area. This analysis has not been conducted for this assessment.

TABLE 23. Tabulation by State and Taxonomic Group of Listed Species that Occur in Counties with Potential Pyrasulfotole Use Sites.

STATE	Amphibians	Arachnid	Birds	Bivalve	Conifer/cycads	Crustacean	Dicot	Ferns & allies	Fish	Gastropod	Insect	Lichen	Mammal	Monocot	Reptiles	TOTAL
Alabama	2		4	30		1	**10**	3	15	10			**4**	**3**	5	87
Alaska								1					**1**			2
Arizona	2		8				**14**		15	1			**9**	**3**	2	54
Arkansas			3	6		1	**4**		2	1	1		**3**			21
California	6		15		2	8	**143**		29	2	18		**22**	**15**	8	268
Colorado			3				**8**		6		2		**2**	**1**		22
Connecticut			2	1			**1**		1		1		**1**	**1**	1	9
Delaware			2						1				**1**	**2**	1	7
Florida	1		8	7	1		**27**		2			1	**7**	**1**	8	63
Georgia	1		5	15	1		**11**	2	11		1		**3**	**6**	2	58
Idaho			2				**3**		8	6			**4**			23
Illinois			3	7		1	**7**		1	1	2		**2**	**2**		26
Indiana			3	11			**4**				2		**2**	**1**	1	24
Iowa			3	2			**3**	1	2	1			**1**	**2**		15
Kansas			4				**1**		4		1		**2**	**1**		13
Kentucky			7	22		1	**9**		5		1		**3**			48
Louisiana			6	3			**1**	1	2				**2**		7	22
Maine			3				**1**		2				**1**	**2**		9
Maryland			2	1			**4**		2		2		**2**	**2**	1	16
Massachusetts			4						1		1		**1**	**1**	1	9
Michigan			3	2			**4**	1			4		**3**	**3**	1	21
Minnesota			2	2			**2**		1		1		**2**	**2**		12
Mississippi	1		6	8			**2**	1	3				**3**		7	31
Missouri			3	6		1	**7**		7	1	2		**2**	**1**		30
Montana			4				**2**		5				**3**			14
Nebraska			4				**2**		2		2		**1**	**1**		12
Nevada			3				**8**		23		2			**1**	1	38
New Hampshire			1	1												2
New Jersey			3				**2**		1				**1**	**3**	1	11
New Mexico	1		7			2	**12**		10	5			**5**		1	43
New York			3	1			**4**	1	1	1	1		**1**	**1**	1	15
North Carolina		1	5	8			**20**		4		1	1	**5**	**5**	5	55
North Dakota			4						1					**1**		6
Ohio			2	6			**4**		1		4		**2**	**2**	2	23
Oklahoma			7	2					4		1		**3**	**2**		19
Oregon			5			1	**12**		24		2		**1**	**1**		46
Pennsylvania			2	2									**2**	**2**	1	9
Rhode Island			1				**1**		1		1					4
South Carolina	1		5	1			**12**	1	1			1	**7**	**6**	5	40
South Dakota			4						2		1		**1**	**1**		9
Tennessee		1	4	37		1	**15**	1	15	3		1	**3**	**2**		83
Texas	4	10	13			1	**19**		8	1	9		**4**	**3**	6	78
Utah			3				**20**		8				**2**	**2**	1	36
Vermont			1	1			**1**						**1**	**1**		5
Virginia	1		3	21		2	**12**		7	1	3		**5**	**4**	1	60
Washington			5				**7**		18				**6**			36
West Virginia	1		1	5			**4**			1			**5**	**1**		18
Wisconsin			4	2			**4**				2		**2**	**2**		16
Wyoming	1		1				**2**		1				**4**			9

Bolded/highlighted numbers refer to the number of species that may be directly affected by pyrasulfotole use.

C. Description of Assumptions, Limitations, Uncertainties, Strengths and Data Gaps

A source of uncertainty is the nature of the unextractable residues formed during pyrasulfotole degradation in soils. In aerobic soil metabolism studies unextractable residues were identified at maximums of 35-62% of applied radioactivity in three soils. The unextractable residues are uncharacterized and it is uncertain whether they consist of degradates of risk concern. Under sterile conditions these unextractable residues were not formed suggesting that the formation of them is microbially mediated. Aerobic soil metabolism half-lives were estimated based on parent concentrations alone (excluding unextractable residues). To the extent that these unextractable residues are of risk concern, the estimated half-lives will be underestimated compared to a total toxic residue approach for estimating half-lives. However, given the persistence of pyrasulfotole parent only, a total toxic residue approach for calculating aerobic soil metabolism half-life would not impact PRZM/EXAMS modeled EECs appreciably. In fact, assuming pyrasulftole is completely stable to aerobic soil metabolism results in peak EECs for the TX wheat scenario that are identical (to two significant figures) to those used in this assessment.

The ecological pond modeled with EXAMS is a static water body of fixed volume with no outlet. Since pyrasulfotole is persistent in aquatic environments and since the ecological pond has no outlet, there was a modeled accumulation of pyrasulfotle in the pond throughout the 30 year simulations. Exposure endpoints, in this assessment, are based on yearly peak concentrations. In the case of persistent compounds, a 1-in-10 year EEC does not reflect varying meteorological conditions that are expected once every 10 years, since the yearly peaks are not independent but are actually correlated to the previous year's peak concentration. Estimated peak concentrations in the ecological pond are only high enough to result in an exceedance of the listed species LOC for vascular plants after 26 years of annual applications of pyrasulfotole assuming no dissipation whatsoever in the pond (**APPENDIX C**). Pyrasulfotle concentrations in flowing water bodies are not expected to accumulate from year to year because of downstream dilution. Risk to aquatic plants resulting from accumulation of pyrasulfotle from multiple years of application is not likely in flowing systems.

Even though pyrasulfotole is very soluble and moderately mobile to mobile based on the results of batch equilibrium studies, in aquatic systems it does variably partition to the sediment and forms unextractable residues and persists as parent. Additionally, there is some evidence that pyrasulfotle may become less mobile as it it is exposed to viable microbs under certain conditions. Since PRZM/EXAMS modeling requires one input for soil-water partitioning coefficient that is constant throughout the simulation, the modeled partitioning to the sediment may be underestimated relative to the aerobic aquatic metabolism studies. Therefore, there may be a potential for pyrasulfotole (and/or residues) to accumulate in the benthos at levels that could result in toxic exposure to benthic and epibenthic aquatic organisms, especially those that consume soil (*e.g.*, *Hexagonia* spp.). The potential risk to benthic and epibenthic organisms could not be assessed here, however, because a lack of available toxicity data for these taxa.

Therefore, risks to benthic and epibenthic organisms from the use of pyrasulfotole on cereal grains cannot be precluded at this time.

Related to these issues, estuarine/marine invertebrates (*i.e.*, mysids) are considerably more sensitive to pyrasulfotole on an acute exposure basis than the other aquatic animals tested. The reason(s) for this difference in toxicity is not clear. Because no toxicity data for chronic exposures are available for estuarine/marine invertebrates and toxicity data from a freshwater invertebrate do not appear to be a good surrogate for measures of toxicity in this taxon, there is the potential for adverse effects to estuarine/marine invertebrates from chronic exposure to pyrasulfotole (especially since it could accumulate in the benthos). However, given that: (1) the potential use sites for the proposed uses largely fall outside of estuarine/marine environments, with the possible exceptions of CA and the mid-Atlantic states; (2) the aquatic EECs used in this assessment are based on a static water-body with no outlet, and, thus, would likely be higher than those in estuarine/marine environments; and (3) estuarine/marine invertebrates would need to be 1,293 times more sensitive to pyrasulfotole than freshwater invertebrates on a chronic-exposure basis to exceed the Agency's chronic risk LOC, risks to estuarine/marine invertebrates from chronic exposure to pyrasulfotole are not expected. However, the lack of data on the chronic toxicity of pyrasulfotole to estuarine/marine invertebrates does add uncertainty to this risk assessment.

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APPENDIX B: Environmental Fate and Transport Study Details

Abiotic Degradation

Hydrolysis

In an **acceptable** study (MRID 46801705), the hydrolysis of pyrasulfotole at 0.14 mg a.i./L, was studied in the dark at 24.9 ± 0.02°C in sterile aqueous buffered pH 5, pH 7, and pH 9 solutions for 30 days. [^{14}C]-Pyrasulfotole averaged 98.4-100.4% of the applied in the pH 5 solutions and 98.6-100.3% in the pH 7 solutions throughout the experiment. In the pH 9 solution, [^{14}C]-pyrasulfotole averaged 96.6-98.1% of the applied through 22 days posttreatment and 95.7% at 30 days. Half-lives were not calculated because pyrasulfotole was stable to hydrolysis.

Aqueous Photolysis

In an **acceptable** study (MRID 46801706), the aqueous phototransformation of pyrasulfotole at *ca.* 1 mg a.i./L, was studied in sterile pH 7 buffer (0.01M phosphate) at 25 ± 1°C under continuous irradiation using a UV-filtered xenon arc lamp for 212 hours. [^{14}C]-Pyrasulfotole (both labels) did not degrade in either the irradiated or dark control solutions. In the irradiated solutions, [^{14}C]-pyrasulfotole ranged from an average of 97.7% to 100.7% of the applied with no pattern of decline during the 9-day experiment. In the dark controls, [^{14}C]-pyrasulfotole ranged from an average 99.6% to 102.0% of the applied with no pattern of decline. A half-life was not calculated because pyrasulfotole was stable in both the irradiated and dark control solutions.

Soil Photolysis

In an **acceptable** study (MRID 46801707), the phototransformation of pyrasulfotole, at 0.51 mg/kg (equivalent to 75 g a.i./ha), was studied on silt loam soil [pH 7.4, organic matter 7.1%] from North Dakota that was irradiated continuously using a UV-filtered xenon lamp for 9 days at 25 ± 0.1°C. The intensity of the lamp was 680 W/m^2, and 7.0 hours of irradiation with the artificial light was reported to be equivalent to 1 solar day in late June in Phoenix, Arizona. [^{14}C]-Pyrasulfotole decreased from an average of 104.2% of the applied at time 0 to 87.2% in the irradiated samples and 89.9% in the dark controls at study termination (9 days posttreatment). Concentrations were variable and were affected by overall recoveries of ^{14}C-residues; [^{14}C]-pyrasulfotole comprised 97.9% of the recovered at time 0 and 90.0% and 93.6% in the irradiated and dark controls, respectively, at 9 days posttreatment. No major transformation products were isolated from either the irradiated or dark control soils. No minor transformation products, which averaged ≤1.0% of the applied, were identified in either the irradiated or dark control soils. Based on first order linear regression analysis, pyrasulfotole dissipated with half-lives of 32.5 days in the irradiated samples (continuous irradiation) and 64.2 days in the dark controls. The half-lives are of uncertain value because they are extrapolated well beyond the duration of the study, between replicate variability at some intervals is *ca.* 5% of the applied, and the calculations are based on the assumption that degradation follows a linear pattern. The **phototransformation half-life** for pyrasulfotole, was 66 days based on the continuous irradiation used in the study. The study author stated that 7.0 hours of continuous irradiation with the artificial light was equivalent to 1 day of natural sunlight in Phoenix, Arizona (33.26° N latitude). Therefore, the **environmental phototransformation half-life** is expected to be *ca.* 227 days in Phoenix, AZ.

Metabolism

Aerobic Soil Metabolism

In an **acceptable** aerobic soil metabolism study (MRID 46801709), [^{14}C]-pyrasulfotole dissipated in a Goldsboro loamy sand soil (pH 5.6-6.2, organic carbon 1.2%) from North Carolina following a biphasic pattern decreasing quickly from 96.4-97.5% of the applied at day 0 posttreatment to 53.8-54.8% at 4 days and was 40.0-40.7% at 7 days, then dissipation significantly slowed with [^{14}C]-pyrasulfotole comprising 20.2-22.8% at study termination. The **log-linear half-life** was 240 days (r^2 = 0.4428) and the **nonlinear half-life** was 69 days (r^2 = 0.441). Based on a 2-compartment, 4-parameter exponential model (DFOP) the **DT_{50} and DT_{90}** estimates were 5.8 and 749 days, respectively (r^2 = 0.977). The **observed DT_{50}** and **DT_{90}** values were 4-7 days and >358 days, respectively. Soil samples were extracted using an Accelerated Solvent Extraction (ASE) system, which conducted two-phase ["mild" (40°C, 100 bar) and "aggravated" (100°C, 100 bar) conditions], automated, multi-step extractions with acetonitrile:water (2:1, v:v) as the extraction solvent.

2-Methylsulfonyl-4-trifluoromethylbenzoic acid (AE B197555) was a major transformation product in phenyl-label treated soil detected at a maximum 12.2% of the applied at 7 days posttreatment and was 4.2% at study termination. No minor transformation products were identified for either label. Unextractable ^{14}C-residues increased from 1.7-1.9% at day 0 to maximums of 49.7-50.1% at 100-120 days and were 43.2-44.8% at 358 days. At study termination, volatilized $^{14}CO_2$ totaled 17.3%-18.6% of the applied.

Under **sterile** (autoclaved soil, both labels) conditions, parent pyrasulfotole comprised 94.8-95.4% of the applied at 120 days (final interval), with AE B197555 in phenyl-label treated soil detected at ≤3.2% at any interval. At study termination, extractable and unextractable ^{14}C-residues were 95.6-99.3% and 2.7-3.5% of the applied, respectively, with volatilized $^{14}CO_2$ and volatile ^{14}C-organic compounds ≤0.2%.

In an **acceptable** aerobic soil metabolism study (MRID 46801710), [^{14}C]-pyrasulfotole dissipated in a LaDelle silt loam soil (pH 7.0-7.3, organic carbon 4.7%) from North Dakota following a biphasic pattern with a steady decline during the initial 2 months posttreatment, decreasing from 94.3-97.1% of the applied at day 0 to 47.2-50.0% at 65 days, then dissipation slowed with [^{14}C]-pyrasulfotole comprising 22.0-24.9% at study termination. The **log-linear half-life** for both radiolabels was 161 days (r^2 = 0.8227) and the **nonlinear half-life** was 95 days (r^2 = 0.9144). The **DT_{50} and DT_{90}** estimates based on a 2-compartment, 4-paramter exponential model (DFOP) were 63 and 1424 days, respectively (r^2 = 0.998). The **observed DT_{50} and DT_{90}** and values were 50-

65 days and >358 days, respectively. Soil samples were extracted using an Accelerated Solvent Extraction (ASE) system, which conducted two-phase ["mild" (40°C, 100 bar) and "aggravated" (100°C, 100 bar) conditions], automated, multi-step extractions with acetonitrile:water (2:1, v:v) as the extraction solvent.

2-Methylsulfonyl-4-trifluoromethylbenzoic acid (AE B197555) was a minor transformation product in phenyl-label treated soil detected at a maximum 3.8% of the applied; no other minor or major products were identified for either label. Unextractable ^{14}C-residues increased from 0.4-1.1% at day 0 to maximums of 31.3-35.2% at 155-190 days and were 30.1-30.7% at 358 days. At study termination, volatilized $^{14}CO_2$ totaled 33.5-40.5% of the applied.

Under **sterile** (autoclaved soil, both labels) conditions, parent pyrasulfotole comprised 93.6-94.2% of the applied at 120 days (final interval), with AE B197555 in phenyl-label treated soil detected at a maximum 3.7% at study termination. At 120 days, extractable and unextractable ^{14}C-residues were 93.6-97.9% and 3.8-5.2% of the applied, respectively, with volatilized $^{14}CO_2$ and volatile ^{14}C-organic compounds ≤0.4%.

In a **supplemental** aerobic soil metabolism study (MRID 46817011), phenyl-labeled pyrasulfotole dissipated in a sandy loam soil (pH 5.9-6.6, organic carbon 1.4%) from Germany from a mean 100.0% of the applied at day 0 to 48.0% at 29 days and was 19.0% at 120 days. Pyrazole-labeled pyrasulfotole reached the observed DT_{50} somewhat faster decreasing from 98.4% at day 0 to 48.9% at 21 days and was 17.3% at study termination. The **log-linear half-life** for both radiolabels was 48 days ($r^2 = 0.9127$) and the **nonlinear half-life** was 32.4 days ($r^2 = 0.9503$). The **DT_{50} and DT_{90}** estimates based on a 2-compartment, 4-parameter exponential model (DFOP) were 23 and 208 days, respectively ($r^2 = 0.990$). The **observed DT_{50} and DT_{90}** values were between 14 and 29 and >120 days, respectively. Soil samples were extracted using an Accelerated Solvent Extraction (ASE) system, which conducted two-phase ["mild" (40°C, 103 bar) and "aggravated" (100°C, 103 bar) conditions], automated, multi-step extractions with acetonitrile:water (2:1, v:v) as the extraction solvent.

2-Methylsulfonyl-4-trifluoromethylbenzoic acid (AE B197555) was a minor transformation product in phenyl-label treated soil detected at a maximum 8.9 ± 0.4% of the applied; no other minor or major products were identified for either label. Unextractable ^{14}C-residues increased from 2.1-2.7% at day 0 to 60.1-62.1% at study termination (120 days). At study termination, volatilized $^{14}CO_2$ comprised total means of 16.3-18.0% of the applied, while volatile ^{14}C-organic compounds were ≤0.1% at all intervals.

Table B.a. summarizes the various modeled used to describe the degradation kinetics in the aerobic soil metabolism studies.

Table B.a. Summary of Models Used to Fit Degradation Data in Aerobic Soil Metabolism Studies.

Model	**Half-life (d)**	**Model equation**	**r^2**	**DT$_{50}$ (d)**	**DT$_{90}$ (d)**
Loamy sand, North Carolina (MRID 46801709)					
Log-linear	240	y = -0.0029x + 3.7590	0.443	--	--
Nonlinear	68.6	y = 58.6*exp(-0.0101*x)	0.441	--	--
DFOP	--	y = 69.0*exp(-0.24*x) + 33.1*exp(-0.0016*x)	0.977	5.8	747
Observed DT$_{50/90}$	--	--	--	4-7	>358
Silt loam, North Dakota (MRID 46801710)					
Log-linear	161	y = -0.0043x + 4.2958	0.823	--	--
Nonlinear	95.0	y= 87.2*exp(-0.0073*x)	0.914		
DFOP	--	y= 66.6*exp(-0.019*x)+31.2*exp(-0.0008*x)	0.998	63	1424
Observed DT$_{50/90}$	--	--	--	50-65	>358
Sandy loam, Germany (MRID 46810711)					
Log-linear	47.6	y = -0.01456 + 4.3854	0.913	--	--
Nonlinear	32.4	y = 91.4*exp(-0.0214*x)	0.950	-	-
DFOP	--	y = 58.5*exp(-0.054*x)+37.7*exp(-0.0064*x)	0.990	23	208
Observed DT$_{50/90}$	--	--	--	14-29	>120

Anaerobic Soil Metabolism

In an **acceptable** anaerobic soil metabolism study (MRID 46801712), [^{14}C]-pyrasulftole-residues partitioned between the soil and water layer with mean (n = 2) distribution ratios (water:soil) of 1:22-28 immediately after flooding (30 days posttreatment), decreasing to 1:5 after 33 days (63 days posttreatment) and were 1:7-11 at study termination (150 days posttreatment). The dissipation rate of [^{14}C]-pyrasulfotole significantly slowed with the conversion to anaerobic conditions. [^{14}C]-Pyrasulfotole comprised means of 93.5-97.3% of the applied in the soil at day 0 posttreatment, then at day 0 post-flooding (30 days posttreatment) was detected at 66.0-68.4% in the total system and was 62.2-64.1% at 120 days post-flooding (150 days posttreatment). In the water layer, [^{14}C]-pyrasulfotole increased from means of 2.4-3.1% at day 0 post-flooding (30 days posttreatment) to 11.7-14.2% at 33 days (63 days posttreatment) and was 7.2-7.7% at study termination. In the soil, [^{14}C]-pyrasulfotole decreased from means of 93.5-97.3% at day 0 posttreatment to 62.9-66.0% at day 0 post-flooding (30 days posttreatment) and was 53.3-56.5% at 90-120 days post-flooding (120-150 days posttreatment). **Observed DT$_{50}$** values for pyrasulfotole in the total system were >120 days. Calculated dissipation half-lives for [^{14}C]-pyrasulfotole in the total system could not be determined due to insufficient dissipation post-flooding. Since the degradation rate could not be quantified, pyrasulfotole is assumed to be stable for the purposes of risk assessment.

2-Methylsulfonyl-4-trifluoromethylbenzoic acid (AE B197555) was the sole transformation product detected at maximum means of 5.1% (15 days post-flooding), 7.7% (day 0 post-flood) and 9.9% (15 and 61 days post-flood) of the applied in the water, soil and total system, respectively, of phenyl-label [^{14}C]-pyrasulfotole treated soil and was 4.1%, 5.1% and 9.2%, respectively, at study termination.

Phenyl-label unextractable ^{14}C-residues increased from 0.8% at day 0 to 22.5% at study termination. Pyrazole-label unextractable ^{14}C-residues increased from 2.0% at day 0 to 24.9% at study termination. Maximum mean levels of volatilized $^{14}CO_2$ (identity not confirmed) detected were 2.6% and 6.6% of the applied for the phenyl- and pyrazole-label treated soils, respectively, while volatile ^{14}C-organic compounds were ≤0.1% (both labels) at all sampling intervals.

Aerobic Aquatic Metabolism

In an **acceptable** aerobic aquatic metabolism study (MRID 46801713), the biotransformation of pyrasulfotole was studied in a pond water-sandy loam sediment (water pH 4.8, sediment pH 4.5-5.4, organic carbon 4.1%) from North Carolina and a pond water-silty clay sediment (water pH 7.5, sediment pH 6.9-7.5, organic carbon 0.81%) from Kansas for 131-132 days under aerobic conditions. Sediment samples were extracted two to three times with acetonitrile:water [4:1 (v:v) for 0- and 11-day sandy loam sediments; 9:1 (v:v) for all other sediment samples] via shaking, then further extracted with the acetonitrile:water solvent using an Accelerated Solvent Extraction (ASE) system (2 cycles, 80°C, 1,500 psi).

In sandy loam systems (both labels), following application of [^{14}C]-pyrasulfotole to the water layer, ^{14}C-residues partitioned from the water layer to the sediment with average (n = 2) distribution ratios (water:sediment) of *ca.* 100:1 at day 0, 2:1 at 11-55 days, 1:4 at 81 days and were 1:>10 thereafter. [^{14}C]-Pyrasulfotole in the total system decreased from a mean 97.6% of the applied at day 0 to 44.5% at 81 days and was 16.3-18.2% thereafter. In the water layer, [^{14}C]-pyrasulfotole decreased from a mean 97.6% at day 0 to 61.8-68.3% at 11-55 days, 22.9% at 81 days and was 5.2-5.5% thereafter. In the sediment, [^{14}C]-pyrasulfotole increased from a mean 0.9% at day to 25.0% at 26 days, then decreased to 11.1-12.7% at 109-132 days. **Linear half-life** for pyrasulfotole in the total system was 48 days and **nonlinear half-life** was 69 days. **Observed DT_{50}** values were 55-109 days in the total system. However, these fitted transformation models do not adequately fit the observed dissipation pattern of parent residues. Extractable ^{14}C-residues in the sediment increased from a mean 0.9% of the applied at day 0 to a maximum 25.1% at 26 days, then decreased to 11.1-13.1% at 109-132 days. Unextractable ^{14}C-residues were detected at means of 8.1-15.0% at 11-55 days, then sharply increased to 50.7% at 81 days and were 72.6% at study termination. **Pyrasulfotole does not appear to be transforming in this sandy loam system, but rather rapidly partitions from the water to an unextractable sediment-bound phase between Days 55 – 81. Pyrasulfotole is therefore considered to be stable under conditions of this aerobic aquatic system for the purposes of risk assessment.**

In silty clay loam systems (both labels), following application of [^{14}C]-pyrasulfotole to the water layer, ^{14}C-residues partitioned from the water layer to the sediment with average (n = 2) distribution ratios (water:sediment) of *ca.* 100:1 at day 0, 3:1 at 21 days and were 2:1 thereafter. [^{14}C]-Pyrasulfotole dissipated slowly in the total system decreasing from a mean 101.4% of the applied at day 0 to 82.3-87.8% at 104-131 days. In the water layer, [^{14}C]-pyrasulfotole decreased from a mean 100.9% of the applied at day 0 to 63.9% at study termination, while increasing in the sediment from 0.5% to 23.9% at the same respective intervals. **Observed DT$_{50}$** values were >131 days in the water, sediment and total system. Linear/nonlinear half-lives for pyrasulfotole in the sediment and total system were not determined because levels of parent in the sediment were still increasing at study termination, and there was insufficient dissipation of parent in the total system. Hence there is no evidence of degradation for pyrasulfotole in this aerobic aquatic system. For the purposes of risk assessment it is considered stable. Extractable ^{14}C-residues in the sediment increased from a mean 1.0% of the applied at day 0 to 24.4% at 131 days. Unextractable ^{14}C-residues increased from a mean 0.5% at day 0 to 13.1% at 104 days and were 10.6% at study termination.

Anaerobic Aquatic Metabolism

In an **acceptable** study (MRID 46801714), the biotransformation of phenyl-U-^{14}C-labeled pyrasulfotole was studied in a pond water-silty clay sediment (water pH 7.5, dissolved organic carbon 11.7 mg/L; sediment pH 6.6-7.0, organic carbon 1.1%) systems from Kansas for 365 days under anaerobic (static, nitrogen atmosphere) conditions in darkness at 20 ± 1°C. Following application of [^{14}C]-pyrasulfotole to the water-sediment systems, ^{14}C-residues partitioned from the water layer to the sediment with average ($n = 2$) distribution ratios (water:sediment) of 100:1 at day 0, 4:1 at 3 days, 2:1 at 10 days and were 1:1 thereafter. [^{14}C]-Pyrasulfotole dissipated slowly in the total system decreasing from a mean 99.2% of the applied at day 0 to 65.1% at 31 days and was 60.4%-65.6% thereafter. In the water layer, ^{14}C-pyrasulfotole decreased from a mean 99.2% at day 0 to 49.7% at 31 days and was 38.3-40.0% at 183-365 days. In the sediment, ^{14}C-pyrasulfotole increased to a mean 25.5% at study termination.

Levels of [^{14}C]-pyrasulfotole in the sediment were still increasing at study termination; consequently, calculated half-lives could not be determined. **Observed DT$_{50}$** values of pyrasulfotole were between 22 and 31 days in the water layer and greater than 365 days in the sediment and total system. Non-first order DT50 and DT90 estimates for the total system were estimated at 6000 and 46000 days, respectively using a multi-compartment non-linear regression model ($r^2 = 0.95$). **Pyrasulfotole is considered stable in the whole system under these anaerobic aquatic conditions for the purposes of this risk assessment.**

Extractable and unextractable sediment ^{14}C-residues increased to maximum means of 25.5% and 33.9% of applied, respectively, at 365 days. The maximum level of volatilized $^{14}CO_2$ detected at any sampling interval was 2.8% of the applied, with volatile ^{14}C-organic compounds less than 0.1%.

In an **acceptable** study (MRID 46801715), the biotransformation of pyrazole-3-^{14}C-labeled pyrasulfotole was studied in a pond water-silty clay sediment (water pH 7.5, dissolved organic carbon 11.7 mg/L; sediment pH 7.0, organic carbon 1.1%) systems from Kansas for 365 days under anaerobic (static, nitrogen atmosphere) conditions in darkness at 20 ± 1°C. Following application of [^{14}C]-pyrasulfotole to the water-sediment systems, ^{14}C-residues partitioned from the water layer to the sediment with average (n = 2) distribution ratios (water:sediment) of 100:1 at day 0, 4:1 at 3 days, 1:1 at 14-184 days and were 1:2 thereafter. [^{14}C]-Pyrasulfotole dissipated slowly in the total system decreasing from a mean 100.0% of the applied at day 0 to 54.9% at 275 days and was 59.7% at 365 days. In the water layer, [^{14}C]-pyrasulfotole decreased from a mean 100.0% at day 0 to 49.9% at 17 days and was 37.3% at study termination. In the sediment, [^{14}C]-pyrasulfotole increased to a mean 22.7% at 63 days and was 19.1-22.9% thereafter.

Calculated linear and nonlinear half-lives for pyrasulfotole in the water layer and total system are of limited use given the low correlation coefficient values (r^2 = <0.45), and the half-lives for pyrasulfotole in the total system were extrapolated significantly beyond the final sampling interval. Since concentrations of [^{14}C]-pyrasulfotole in the sediment remained at steady levels from 63 days posttreatment through study termination, calculated half-lives could not be determined. **Observed DT_{50}** values of pyrasulfotole were between 14 and 28 days in the water layer and greater than 365 days in the sediment and total system. Non-first order DT50 and DT90 estimates for the total system were estimated at 722 and 4745 days, respectively using a multi-compartment non-linear regression model (r^2 = 0.95). For the purposes of risk assessment, pyrasulfotole is considered stable in the whole system under these anaerobic aquatic conditions.

Extractable sediment ^{14}C-residues increased to a maximum mean 22.9% of applied at 120 days and were 22.4% at 365 days. Unextractable sediment ^{14}C-residues increased to a maximum mean 36.4% at study termination. Volatilized $^{14}CO_2$ totaled a mean 1.9% of the applied at study termination, with volatile ^{14}C-organic compounds ≤0.1% at any interval.

Mobility and Persistence

Batch Equilibrium

In an **acceptable** study (MRID 46801703), the adsorption/desorption characteristics of pyrasulfotole were studied in definitive experiments using three US soils: a HCB silt loam [pH 7.7, organic carbon 4.7%], a Pikeville loamy sand [pH 6.4, organic carbon 1.2%], and a Carlyle silt loam [pH 5.2, organic carbon 1.5%]; two German soils: a clay loam [CL6S, pH 7.5, organic carbon 1.7%] and a sandy loam [SL2.3, pH 6.7, organic carbon 1.1%]; and a German sediment, Nidda sandy loam [pH 5.8, organic carbon 4.6%], in a batch equilibrium experiment. After 24 hours of equilibration, 55.7-63.3%, 60.3-71.0%, 26.4-32.3%, 30.1-35.2%, 43.9-52.2%, and 50.4-73.5% of the applied [^{14}C]-pyrasulfotole was adsorbed to the HCB silt loam, Pikeville loamy sand, CL6S clay loam, SL2.3 sandy loam, and Carlyle silt loam soils, and the Nidda sandy loam sediment, respectively (reviewer-calculated). Adsorption K_d values averaged 1.32, 1.77, 0.367, 0.47, 4.25, and 32.9 for the HCB silt loam, Pikeville loamy sand, CL6S clay loam, SL2.3 sandy loam, and Carlyle silt loam soils, and the Nidda sandy loam sediment, respectively; corresponding adsorption K_{oc} values averaged 28.1, 148, 21.6, 42.7, 283, and 715. Freundlich adsorption K_F values were 0.980, 1.20, 0.341, 0.386, 3.20, and 15.9 for the HCB silt loam, Pikeville loamy sand, CL6S clay loam, SL2.3 sandy loam, Carlyle silt loam soils, and the Nidda sandy loam sediment, respectively; corresponding Freundlich adsorption K_{Foc} values were 20.8, 100, 20.0, 35.1, 213, and 345. At the end of the desorption phase, 55.0%, 49.7%, 70.4% 69.0% 65.6%, and 61.1% of the applied [^{14}C]pyrasulfotole desorbed from the HCB silt loam, Pikeville loamy sand, CL6S clay loam, SL2.3 sandy loam, and Carlyle silt loam soils, and the Nidda sandy loam sediment, respectively. Desorption K_d values averaged 2.26, 3.67, 0.923, 1.51, 10.4, and 56.6 for the HCB silt loam, Pikeville loamy sand, CL6S clay loam, SL2.3 sandy loam, and Carlyle silt loam soils, and the Nidda sandy loam sediment, respectively; corresponding adsorption K_{oc} values averaged 48.2, 306, 54.3, 137, 696, and 1230. Freundlich desorption K_F values were 1.37, 2.30, 0.678, 1.13, 8.46, and 30.9 for the HCB silt loam, Pikeville loamy sand, CL6S clay loam, SL2.3 sandy loam, and Carlyle silt loam soils, and the Nidda sandy loam sediment, respectively; corresponding Freundlich desorption K_{Foc} values were 29.2, 192, 40, 103, 564, and 672.

Terrestrial Field Dissipation

In an **acceptable** study (MRID 46801716), soil dissipation/accumulation of pyrasulfotole under US field conditions was conducted in three replicate bare plots and three replicate cropped plots (wheat) of Farnum loam soil in Kansas. In the bare test plot, the measured zero-time recovery of pyrasulfotole in the 0-15 cm soil layer was 19.80 ppb or 63.9% of the theoretical based on the target application rate (reviewer-calculated based on a theoretical day-0 recovery of 31 μg/kg). Pyrasulfotole decreased to 11.20 ppb by 7 days, 6.54 ppb by 14 days, 1.36 ppb by 58 days, and was last detected above the LOQ at 0.69 ppb at 257 days post-treatment. Pyrasulfotole was detected at levels below the LOQ in the 15-30 cm soil depth, and was not detected below 30 cm. The major transformation product **AE B197555** was detected in the 0-15 cm soil depth at a maximum concentration of 6.15 ppb at 4 days (which is equivalent to 8.31 ppb parent equivalents or 26.8% of the theoretical applied pyrasulfotole based on the target application rate), then decreased to 3.25 ppb by 14 days, was below the LOQ by 58 days, and was not detected by 257 days post-treatment. AE B197555 was not detected below the 0-15 cm soil depth at any sampling intervals.

Under field conditions in the bare test plot, pyrasulfotole had a calculated half-life DT_{50} and DT_{90} values for pyrasulfotole in the whole soil column using a double first order regression model were 8.9 and 45 days, respectively ($r^2 = 0.97$). Calculated DT_{50} and DT_{90} values for the strongly bi-phasic dissipation pattern of AE B197555 residues in the whole soil column were 17 and 45 days following initial application, respectively ($r^2 = 0.87$). In the bare test plot, residue carryover (i.e., percentage of the total amount of parent equivalent material in the whole soil column relative to Day 0 concentrations) was 4.7% at the beginning of the following growing season (i.e., at 257 days post treatment), and 1.2% at the end of the study (i.e., 526 days post treatment).

In an **acceptable** study (MRID 46801717), soil dissipation/accumulation of pyrasulfotole under US field conditions was conducted in three replicate bare plots and three replicate cropped plots (wheat) of clay loam/loam soil in North Dakota. In the bare test plot, the measured zero-time recovery of pyrasulfotole in the 0-15 cm soil layer was

24.4 ppb or 71.8% of the theoretical based on the target application rate (calculated based on a theoretical day-0 recovery of 34 µg/kg). Pyrasulfotole decreased to 11.9 ppb by 7 days, 4.0 ppb by 27 days, and was last detected above the LOQ at 0.5 ppb at 377 days posttreatment. Pyrasulfotole was not detected above the LOQ in soil below the 0-15 cm soil depth. The major transformation product **AE B197555** was initially detected in the 0-15 cm soil depth at 1.2 ppb at day 0, increased to a maximum of 13.5 ppb by 7 days (which is equivalent to 18.2 ppb parent equivalents or 53.6% of the theoretical applied pyrasulfotole based on the target application rate), then decreased to 5.7 ppb by 27 days, 1.0 ppb by 317 days, and was below the LOQ by 377 days posttreatment. AE B197555 was not detected below the 0-15 cm soil depth.

Under field conditions in the bare test plot, pyrasulfotole had calculated DT_{50} and DT_{90} values for pyrasulfotole in the whole soil column were 6 and 44 days, respectively (two compartment non-linear regression model; $r^2 = 0.96$). The calculated DT_{50} and DT_{90} values for AE B197555 in the whole soil column were 25 and 227 days, respectively (two-compartment, non-linear regression model; $r^2 = 0.81$).Carryover of total residues in the soil column was 7.7 and 1.8% of the applied pyrasulfotole at the beginning of the following growing season (i.e. day 317) and at the end of the study period (i.e. day 498), respectively, based on observed Day 0 concentrations.

In an **acceptable** study (MRID 46801718), soil dissipation/accumulation of pyrasulfotole under US field conditions was conducted in three replicate bare plots and three replicate cropped plots (wheat) of sandy loam soil in Washington. In the bare test plot, the measured zero-time recovery of pyrasulfotole in the 0-15 cm soil layer was 27.18 ppb or 109% of the theoretical based on the target application rate (calculated based on a theoretical day-0 recovery of 25 µg/kg). Pyrasulfotole decreased to 17.51-18.59 ppb by 1-3 days, 12.35 ppb by 7 days, was last detected above the LOQ at 1.10 ppb at 28 days, and was not detected following 175 days posttreatment. Pyrasulfotole moved into deeper soil layers over time, reaching the 45-60 cm layer at 28 days, the 75-90 cm layer at 58 days, and the 105-120 cm layer by 175 days. Pyrasulfotole was detected in the 15-30, 30-45, 45-60, 60-75, and 75-90 cm soil layers at maximum concentrations of 3.26 ppb (28 days), 1.84 ppb (28 days), 1.99 ppb (175 days), 1.24 ppb (58 days), and 0.57 ppb (58 days), respectively; residues were detected below the LOQ in the 90-105 and 105-120 cm soil layers. The major transformation product **AE B197555** was detected in the 0-15 cm soil depth at a maximum of 3.86 ppb at 7 days (which is equivalent to 5.21 ppb parent equivalents or 20.8% of the theoretical applied pyrasulfotole based on the target application rate), then decreased to below the LOQ by 28-58 days, and was not detected by 120 days posttreatment. AE B197555 was detected in the 15-30 cm soil depth at a maximum concentration of 0.94 ppb at 14 days, in the 30-45 cm soil depth at a maximum of 1.59 ppb at 28 days, and in the 45-60 cm soil depth at a maximum of 0.57 ppb at 28 days. AE B197555 was not detected above the LOQ in soil below the 45-60 cm depth; however, residues were detected below the LOQ to 120 cm, the maximum depth analyzed.

Under field conditions in the bare test plot, pyrasulfotole had calculated DT_{50} and DT_{90} values for pyrasulfotole in the whole soil column were 6 and 213 days, respectively (two compartment non-linear regression model; $r^2 = 0.94$). The calculated half-life value for AE B197555 residues in the whole soil column was 42.0 days (first order regression; $r^2 = 0.94$), or an estimated DT_{50} of 49 days following initial application. Carryover of total residues in the soil column was 11.1 and 3.3% of the applied pyrasulfotole at the beginning of the following growing season (i.e. day 269) and at the end of the study period (i.e. day 526), respectively, based on observed Day 0 concentrations.

In an **acceptable** study (MRID 46801719), soil dissipation/accumulation of pyrasulfotole under Canadian field conditions was conducted in four replicate bare plots in Saskatchewan (Site 1), Manitoba (Site 2), and Ontario (Site 3) on clay loam soils.

At Site 1 (Saskatchewan), the measured zero-time recovery of pyrasulfotole in the 0-7.5 cm soil layer was 65.5 ppb or 58.0% of the theoretical based on the target application rate (calculated based on a theoretical day-0 recovery of 113 µg/kg). Pyrasulfotole decreased to 32.8-37.0 ppb by 7-14 days, 20.2-20.8 ppb by 21-30 days, 6.42 ppb by 120 days, and was 1.52-2.13 ppb from 402 to 449 days posttreatment. Pyrasulfotole was detected at ≤2.83 ppb in the 7.5-15 cm soil depth, ≤1.46 ppb in the 15-30 cm depth, and ≤0.65 ppb in the 30-45 cm depth, and was detected only below the LOQ in the 45-60 cm and 60-75 cm depths. The major transformation product **AE B197555** was detected in the 0-7.5 cm soil depth at a maximum of 36. 9 ppb at 14 days (which is equivalent to 49.8 ppb parent equivalents, or 67.3% of the total parent equivalents in the soil column at Day 0 after application), ranged from 32.1 to 34.9 ppb from 21 to 56 days, then decreased to 8.63 ppb by 120 days, and was 0.90 ppb at 449 days posttreatment. AE B197555 was detected in the 7.5-15 cm soil depth at a maximum of 4.63 ppb at 120 days and in the 15-30 cm depth at a maximum of 2.60 ppb at 343 days. AE B197555 was not detected above the LOQ in soil below the 15-30 cm depth.

At Site 2 (Manitoba), the measured zero-time recovery of pyrasulfotole in the 0-15 cm soil layer was 112.99 ppb or 90.4% of the theoretical based on the target application rate (calculated based on a theoretical day-0 recovery of 125 µg/kg). Pyrasulfotole decreased to 44.8-56.2 ppb from 7 to 61 days, 16.9 ppb by 121 days, 8.34 ppb by 349 days, and was 4.60 ppb at 462 days posttreatment. Pyrasulfotole was detected at ≤7.53 ppb in the 7.5-15 cm soil depth, ≤3.51 ppb in the 15-30 cm depth, and ≤1.14 ppb in the 30-45 cm depth, and was only detected below the LOQ in the 45-60 cm depth. The major transformation product **AE B197555** was detected in the 0-7.5 cm soil depth at a maximum of 26.7 ppb at 29 days (which is equivalent to 36.1 ppb parent equivalents, or 29.0% of the total parent equivalents in the soil column at Day 0 after application), decreased to 16.1 ppb by 61 days, and ranged from 1.17 to 1.80 ppb from 121 to 462 days posttreatment. AE B197555 was detected in the 7.5-15 cm soil depth at a maximum of 3.40 ppb at 7 days and was not detected above the LOQ in soil below the 7.5-15 cm depth, but was detected at levels below the LOQ in all soil depths analyzed (0-75 cm) at 462 days posttreatment.

At Site 3 (Ontario), the measured zero-time recovery of pyrasulfotole in the 0-15 cm soil layer was 58.1 ppb or 63.1% of the theoretical based on the target application rate (calculated based on a theoretical day-0 recovery of 92 µg/kg). Pyrasulfotole decreased to 32.4 ppb by 14 days, 20.4 ppb by 30 days, 4.91 ppb by 139 days, and was 0.75 ppb at 458 days posttreatment. Pyrasulfotole was detected at ≤4.10 ppb in the 7.5-15 cm soil depth and was detected below the LOQ in the 15-30, 30-45, 45-60, and 60-75 cm depths. The major transformation product **AE B197555** was detected in the 0-7.5 cm soil depth at a maximum of 27.8 ppb at 14 days (which is equivalent to 37.6 ppb parent equivalents, or 56.7% of the total parent equivalents in the soil column at Day 0 after application), then decreased to 15.7 ppb by 30 days, 5.20 ppb by 56 days, and was last detected above the LOQ at 0.85 ppb at 350 days posttreatment. AE B197555 was detected in the 7.5-15 cm soil depth at a maximum of 2.40 ppb at 7 days and in the 15-30 cm depth at a maximum of 1.01 ppb at 30 days, and was detected at levels below the LOQ in the 30-45, 45-60, and 60-75 cm depths.

Under field conditions at Site 1 (Saskatchewan), pyrasulfotole had a calculated DT_{50} and DT_{90} values for whole-soil column pyrasulfotole residues were 10 and 260 days, respectively (2 compartment non-linear model, $r^2 = 0.86$). The calculated half-life value for AE B197555 residues in the whole soil column was 121.6 days ($r^2 = 0.86$), or an estimated DT_{50} of 136 days following initial application.

Under field conditions at Site 2 (Manitoba), pyrasulfotole had a calculated DT_{50} and DT_{90} values for whole-soil column pyrasulfotole residues were 9.2 and 531 days, respectively (2 compartment non-linear model, $r^2 = 0.89$). The calculated half-life value for AE B197555 residues in the whole soil column was 35.0 days ($r^2 = 0.82$), or an estimated DT_{50} of 64 days following initial application.

Under field conditions at Site 3 (Ontario), pyrasulfotole had a calculated DT_{50} and DT_{90} values for whole-soil column pyrasulfotole residues were 18 and 178 days, respectively (2 compartment non-linear model, $r^2 = 0.96$). The calculated half-life value for AE B197555 residues in the whole soil column was 26.8 days ($r^2 = 0.94$), or an estimated DT_{50} of 41 days following initial application.

Carryover of residues at the start of the following growing season (i.e., at 343-350 days post treatment), was 37.2%, 18.9% and 8.9% of the applied pyrasulfotole for sites in Saskatchewan, Manitoba and Ontario respectively (the majority of residues were detected as parent at all sites; total parent-equivalent residues in the soil column were compared to observed levels at Day 0). By the end of the study period (i.e., 449-462 days post treatment), 13.7, 16.2 and 2.0% of the applied pyrasulfotole was present in the Saskatchewan, Manitoba and Ontario sites, respectively.

APPENDIX C: PRZM/EXAMS Output Data from the ND Wheat, OR Wheat, and TX Wheat Scenarios

ND Wheat

stored as NDwheat.out
Chemical: pyrasulfotole
PRZM environment: NDwheatC.txt modified Satday, 12 October 2002 at 15:15:08
EXAMS environment: pond298.exv modified Thuday, 29 August 2002 at 15:33:30
Metfile: w14914.dvf modified Wedday, 3 July 2002 at 08:05:52
Water segment concentrations (ppb)

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.1961	0.1958	0.1948	0.1927	0.1915	0.104
1962	0.8606	0.8583	0.8538	0.8487	0.8427	0.5763
1963	1.138	1.136	1.132	1.128	1.126	0.9952
1964	1.596	1.594	1.586	1.572	1.57	1.365
1965	1.703	1.703	1.7	1.699	1.698	1.637
1966	1.839	1.839	1.837	1.835	1.835	1.776
1967	2.005	2.004	2.001	1.996	1.994	1.926
1968	2.163	2.163	2.161	2.16	2.159	2.088
1969	2.47	2.469	2.466	2.461	2.458	2.323
1970	2.719	2.718	2.715	2.708	2.705	2.599
1971	3.035	3.034	3.029	3.025	3.021	2.889
1972	3.182	3.181	3.18	3.179	3.178	3.098
1973	3.317	3.317	3.316	3.316	3.315	3.257
1974	3.552	3.552	3.549	3.546	3.544	3.435
1975	4.168	4.166	4.157	4.141	4.132	3.854
1976	4.215	4.215	4.212	4.208	4.206	4.159
1977	4.524	4.523	4.519	4.513	4.509	4.38
1978	4.916	4.915	4.907	4.896	4.89	4.712
1979	5.106	5.105	5.103	5.099	5.097	4.994
1980	5.238	5.238	5.237	5.237	5.236	5.173
1981	5.79	5.788	5.778	5.764	5.756	5.542
1982	5.886	5.886	5.884	5.881	5.879	5.811
1983	6.088	6.088	6.085	6.082	6.08	5.989
1984	6.615	6.612	6.603	6.587	6.578	6.355
1985	6.935	6.934	6.931	6.926	6.923	6.765
1986	7.214	7.213	7.209	7.206	7.203	7.073
1987	7.472	7.472	7.47	7.466	7.464	7.343
1988	7.762	7.761	7.758	7.754	7.751	7.595
1989	7.992	7.991	7.99	7.988	7.987	7.876
1990	8.339	8.338	8.333	8.325	8.322	8.177

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly		
0.032258064516129			8.339	8.338	8.333	8.325	8.322	8.177
0.0645161290322581			7.992	7.991	7.99	7.988	7.987	7.876
0.0967741935483871			7.762	7.761	7.758	7.754	7.751	7.595
0.129032258064516			7.472	7.472	7.47	7.466	7.464	7.343
0.161290322580645			7.214	7.213	7.209	7.206	7.203	7.073
0.193548387096774			6.935	6.934	6.931	6.926	6.923	6.765
0.225806451612903			6.615	6.612	6.603	6.587	6.578	6.355
0.258064516129032			6.088	6.088	6.085	6.082	6.08	5.989
0.290322580645161			5.886	5.886	5.884	5.881	5.879	5.811
0.32258064516129		5.79	5.788	5.778	5.764	5.756	5.542	
0.354838709677419			5.238	5.238	5.237	5.237	5.236	5.173
0.387096774193548			5.106	5.105	5.103	5.099	5.097	4.994
0.419354838709677			4.916	4.915	4.907	4.896	4.89	4.712
0.451612903225806			4.524	4.523	4.519	4.513	4.509	4.38
0.483870967741936			4.215	4.215	4.212	4.208	4.206	4.159

```
0.516129032258065          4.168   4.166   4.157   4.141   4.132   3.854
0.548387096774194          3.552   3.552   3.549   3.546   3.544   3.435
0.580645161290323          3.317   3.317   3.316   3.316   3.315   3.257
0.612903225806452          3.182   3.181   3.18    3.179   3.178   3.098
0.645161290322581          3.035   3.034   3.029   3.025   3.021   2.889
0.67741935483871 2.719     2.718   2.715   2.708   2.705   2.599
0.709677419354839          2.47    2.469   2.466   2.461   2.458   2.323
0.741935483870968          2.163   2.163   2.161   2.16    2.159   2.088
0.774193548387097          2.005   2.004   2.001   1.996   1.994   1.926
0.806451612903226          1.839   1.839   1.837   1.835   1.835   1.776
0.838709677419355          1.703   1.703   1.7     1.699   1.698   1.637
0.870967741935484          1.596   1.594   1.586   1.572   1.57    1.365
0.903225806451613          1.138   1.136   1.132   1.128   1.126   0.9952
0.935483870967742          0.8606  0.8583  0.8538  0.8487  0.8427  0.5763
0.967741935483871          0.1961  0.1958  0.1948  0.1927  0.1915  0.104

0.1     7.733   7.7321  7.7292  7.7252  7.7223  7.5698
                                        Average of yearly averages:  4.12888333333333

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: NDwheat
Metfile:  w14914.dvf
PRZM scenario:    NDwheatC.txt
EXAMS environment file:   pond298.exv
Chemical Name:    pyrasulfotole
Description         Variable Name     Value     Units     Comments
Molecular weight    mwt       362.3     g/mol
Henry's Law Const.henry       3.5e-14   atm-m^3/mol
Vapor Pressure      vapr      5.1e-9    torr
Solubilitysol       6.9e4     mg/L
Kd        Kd                  mg/L
Koc       Koc       122       mg/L
Photolysis half-life kdp      0         days      Half-life
Aerobic Aquatic Metabolism kbacw        0         days      Halfife
Anaerobic Aquatic Metabolism            kbacs     0         days      Halfife
Aerobic Soil Metabolism       asm       439       days      Halfife
Hydrolysis:         pH 7      0         days      Half-life
Method:  CAM        2         integer   See PRZM manual
Incorporation Depth:          DEPI                cm
Application Rate:   TAPP      0.05      kg/ha
Application Efficiency:       APPEFF 0.95         fraction
Spray Drift         DRFT      0.05      fraction of application rate applied to pond
Application Date    Date      22/5      dd/mm or dd/mmm or dd-mm or dd-mmm
Record 17:          FILTRA
          IPSCND 1
          UPTKF
Record 18:          PLVKRT
          PLDKRT
          FEXTRC 0.5
Flag for Index Res. Run       IR        Pond
Flag for runoff calc.         RUNOFFnone          none, monthly or total(average of entire run)
```

OR Wheat

```
stored as OR wheat.out
Chemical: pyrasulfotole
PRZM environment: ORwheatOP.txt     modified Satday, 12 October 2002 at 16:22:28
EXAMS environment: pond298.exv      modified Thuday, 29 August 2002 at 15:33:30
Metfile: w24232.dvf                 modified Wedday, 3 July 2002 at 08:06:10
Water segment concentrations (ppb)
```

Year	Peak	96 hr	21 Day	60 Day	90 Day	Yearly
1961	0.1828	0.1825	0.1818	0.1763	0.1664	0.04935
1962	0.4642	0.4631	0.4589	0.456	0.449	0.2507
1963	0.7163	0.7156	0.7141	0.7097	0.6821	0.5094
1964	0.865	0.8647	0.8637	0.8574	0.8417	0.7396
1965	1.108	1.107	1.105	1.093	1.063	0.9148
1966	1.263	1.262	1.261	1.252	1.238	1.133
1967	1.455	1.454	1.452	1.45	1.435	1.305
1968	1.795	1.795	1.791	1.784	1.77	1.535
1969	2.305	2.304	2.299	2.294	2.29	1.917
1970	2.512	2.512	2.51	2.507	2.498	2.338
1971	2.808	2.807	2.804	2.801	2.789	2.582
1972	2.994	2.993	2.991	2.989	2.978	2.843
1973	3.177	3.177	3.176	3.172	3.166	3.04
1974	3.46	3.46	3.456	3.437	3.387	3.228
1975	3.658	3.657	3.656	3.652	3.628	3.491
1976	3.771	3.77	3.769	3.767	3.765	3.68
1977	3.963	3.962	3.961	3.957	3.946	3.818
1978	4.202	4.202	4.201	4.175	4.153	4.013
1979	4.63	4.629	4.624	4.616	4.561	4.29
1980	4.773	4.773	4.771	4.755	4.739	4.634
1981	5.155	5.154	5.152	5.148	5.144	4.868
1982	5.294	5.293	5.293	5.289	5.285	5.179
1983	5.521	5.52	5.518	5.512	5.475	5.341
1984	5.755	5.755	5.753	5.749	5.723	5.565
1985	5.945	5.944	5.943	5.937	5.918	5.789
1986	6.09	6.09	6.089	6.087	6.082	5.975
1987	6.364	6.363	6.361	6.295	6.262	6.134
1988	6.531	6.53	6.529	6.521	6.5	6.389
1989	6.794	6.793	6.79	6.775	6.743	6.582
1990	7.02	7.019	7.017	7.013	6.985	6.836

Sorted results

Prob.	Peak	96 hr	21 Day	60 Day	90 Day	Yearly		
0.032258064516129			7.02	7.019	7.017	7.013	6.985	6.836
0.0645161290322581			6.794	6.793	6.79	6.775	6.743	6.582
0.0967741935483871			6.531	6.53	6.529	6.521	6.5	6.389
0.129032258064516			6.364	6.363	6.361	6.295	6.262	6.134
0.161290322580645			6.09	6.09	6.089	6.087	6.082	5.975
0.193548387096774			5.945	5.944	5.943	5.937	5.918	5.789
0.225806451612903			5.755	5.755	5.753	5.749	5.723	5.565
0.258064516129032			5.521	5.52	5.518	5.512	5.475	5.341
0.290322580645161			5.294	5.293	5.293	5.289	5.285	5.179
0.32258064516129		5.155	5.154	5.152	5.148	5.144	4.868	
0.354838709677419			4.773	4.773	4.771	4.755	4.739	4.634
0.387096774193548			4.63	4.629	4.624	4.616	4.561	4.29
0.419354838709677			4.202	4.202	4.201	4.175	4.153	4.013
0.451612903225806			3.963	3.962	3.961	3.957	3.946	3.818
0.483870967741936			3.771	3.77	3.769	3.767	3.765	3.68
0.516129032258065			3.658	3.657	3.656	3.652	3.628	3.491
0.548387096774194			3.46	3.46	3.456	3.437	3.387	3.228
0.580645161290323			3.177	3.177	3.176	3.172	3.166	3.04
0.612903225806452			2.994	2.993	2.991	2.989	2.978	2.843
0.645161290322581			2.808	2.807	2.804	2.801	2.789	2.582
0.67741935483871		2.512	2.512	2.51	2.507	2.498	2.338	
0.709677419354839			2.305	2.304	2.299	2.294	2.29	1.917
0.741935483870968			1.795	1.795	1.791	1.784	1.77	1.535
0.774193548387097			1.455	1.454	1.452	1.45	1.435	1.305
0.806451612903226			1.263	1.262	1.261	1.252	1.238	1.133
0.838709677419355			1.108	1.107	1.105	1.093	1.063	0.9148
0.870967741935484			0.865	0.8647	0.8637	0.8574	0.8417	0.7396

```
0.903225806451613           0.7163   0.7156   0.7141   0.7097   0.6821   0.5094
0.935483870967742           0.4642   0.4631   0.4589   0.456    0.449    0.2507
0.967741935483871           0.1828   0.1825   0.1818   0.1763   0.1664   0.04935

0.1      6.5143   6.5133   6.5122   6.4984   6.4762   6.3635
                                             Average of yearly averages:  3.49896166666667

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: OR wheat
Metfile:  w24232.dvf
PRZM scenario:     ORwheatOP.txt
EXAMS environment file:    pond298.exv
Chemical Name:     pyrasulfotole
Description        Variable Name    Value    Units    Comments
Molecular weight   mwt      362.3   g/mol
Henry's Law Const. henry    3.5e-14 atm-m^3/mol
Vapor Pressure     vapr     5.1e-9  torr
Solubilitysol      6.9e4    mg/L
Kd       Kd                 mg/L
Koc      Koc      122       mg/L
Photolysis half-life kdp    0       days     Half-life
Aerobic Aquatic Metabolism kbacw    0        days     Halfife
Anaerobic Aquatic Metabolism        kbacs    0        days     Halfife
Aerobic Soil Metabolism     asm     439      days     Halfife
Hydrolysis:        pH 7     0       days     Half-life
Method:  CAM       2        integer See PRZM manual
Incorporation Depth:        DEPI             cm
Application Rate:  TAPP     0.05    kg/ha
Application Efficiency:     APPEFF  0.95     fraction
Spray Drift        DRFT     0.05    fraction of application rate applied to pond
Application Date   Date     8/9     dd/mm or dd/mmm or dd-mm or dd-mmm
Record 17:         FILTRA
         IPSCND 1
         UPTKF
Record 18:         PLVKRT
         PLDKRT
         FEXTRC 0.5
Flag for Index Res. Run     IR      Pond
Flag for runoff calc.       RUNOFFnone       none, monthly or total(average of entire run)
```

TX Wheat

```
stored as TX wheat.out
Chemical: pyrasulfotole
PRZM environment: TXwheatOP.txt     modified Satday, 12 October 2002 at 16:30:22
EXAMS environment: pond298.exv      modified Thuday, 29 August 2002 at 15:33:30
Metfile: w13958.dvf          modified Wedday, 3 July 2002 at 08:06:24
Water segment concentrations (ppb)

Year     Peak     96 hr    21 Day   60 Day   90 Day   Yearly
1961     0.3997   0.398    0.3913   0.335    0.2451   0.06045
1962     0.5369   0.5365   0.5326   0.5138   0.4821   0.385
1963     0.6539   0.6533   0.6511   0.648    0.6281   0.5507
1964     2.123    2.117    2.093    2.053    1.7      0.9011
1965     2.519    2.518    2.511    2.501    2.398    2.061
1966     2.595    2.594    2.592    2.588    2.569    2.499
1967     3.07     3.068    3.06     3.019    2.9      2.665
1968     3.279    3.278    3.274    3.213    3.167    3.052
1969     3.466    3.465    3.463    3.414    3.381    3.284
1970     3.807    3.805    3.8      3.79     3.723    3.516
```

```
1971    4.059   4.058   4.055   4.038   3.985   3.817
1972    4.687   4.684   4.674   4.66    4.531   4.156
1973    4.853   4.852   4.847   4.84    4.789   4.652
1974    5.113   5.112   5.11    5.106   5.043   4.88
1975    5.738   5.735   5.723   5.703   5.563   5.204
1976    6.014   6.012   6.006   5.997   5.928   5.734
1977    6.179   6.179   6.176   6.171   6.134   6.011
1978    6.785   6.783   6.774   6.737   6.569   6.259
1979    6.876   6.876   6.859   6.833   6.812   6.735
1980    7.429   7.427   7.421   7.355   7.244   6.958
1981    7.51    7.509   7.508   7.505   7.482   7.402
1982    7.742   7.741   7.738   7.719   7.666   7.537
1983    7.873   7.873   7.87    7.868   7.841   7.749
1984    8.575   8.571   8.561   8.54    8.407   7.995
1985    9.321   9.316   9.301   9.278   9.132   8.641
1986    9.628   9.626   9.618   9.608   9.526   9.287
1987    9.88    9.879   9.875   9.855   9.782   9.627
1988    9.978   9.977   9.976   9.971   9.953   9.879
1989    10.3    10.3    10.29   10.28   10.21   10.03
1990    10.73   10.72   10.72   10.68   10.58   10.35

Sorted results
Prob.   Peak    96 hr   21 Day  60 Day  90 Day  Yearly
0.032258064516129       10.73   10.72   10.72   10.68   10.58   10.35
0.0645161290322581      10.3    10.3    10.29   10.28   10.21   10.03
0.0967741935483871      9.978   9.977   9.976   9.971   9.953   9.879
0.129032258064516       9.88    9.879   9.875   9.855   9.782   9.627
0.161290322580645       9.628   9.626   9.618   9.608   9.526   9.287
0.193548387096774       9.321   9.316   9.301   9.278   9.132   8.641
0.225806451612903       8.575   8.571   8.561   8.54    8.407   7.995
0.258064516129032       7.873   7.873   7.87    7.868   7.841   7.749
0.290322580645161       7.742   7.741   7.738   7.719   7.666   7.537
0.32258064516129 7.51   7.509   7.508   7.505   7.482   7.402
0.354838709677419       7.429   7.427   7.421   7.355   7.244   6.958
0.387096774193548       6.876   6.876   6.859   6.833   6.812   6.735
0.419354838709677       6.785   6.783   6.774   6.737   6.569   6.259
0.451612903225806       6.179   6.179   6.176   6.171   6.134   6.011
0.483870967741936       6.014   6.012   6.006   5.997   5.928   5.734
0.516129032258065       5.738   5.735   5.723   5.703   5.563   5.204
0.548387096774194       5.113   5.112   5.11    5.106   5.043   4.88
0.580645161290323       4.853   4.852   4.847   4.84    4.789   4.652
0.612903225806452       4.687   4.684   4.674   4.66    4.531   4.156
0.645161290322581       4.059   4.058   4.055   4.038   3.985   3.817
0.67741935483871 3.807  3.805   3.8     3.79    3.723   3.516
0.709677419354839       3.466   3.465   3.463   3.414   3.381   3.284
0.741935483870968       3.279   3.278   3.274   3.213   3.167   3.052
0.774193548387097       3.07    3.068   3.06    3.019   2.9     2.665
0.806451612903226       2.595   2.594   2.592   2.588   2.569   2.499
0.838709677419355       2.519   2.518   2.511   2.501   2.398   2.061
0.870967741935484       2.123   2.117   2.093   2.053   1.7     0.9011
0.903225806451613       0.6539  0.6533  0.6511  0.648   0.6281  0.5507
0.935483870967742       0.5369  0.5365  0.5326  0.5138  0.4821  0.385
0.967741935483871       0.3997  0.398   0.3913  0.335   0.2451  0.06045

0.1     9.9682  9.9672  9.9659  9.9594  9.9359  9.8538
                                        Average of yearly averages:     5.39590833333333

Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: TX wheat
Metfile:   w13958.dvf
```

PRZM scenario: TXwheatOP.txt
EXAMS environment file: pond298.exv
Chemical Name: pyrasulfotole

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	362.3	g/mol	
Henry's Law Const.	henry	3.5e-14	atm-m^3/mol	
Vapor Pressure	vapr	5.1e-9	torr	
Solubility	sol	6.9e4	mg/L	
Kd	Kd		mg/L	
Koc	Koc	122	mg/L	
Photolysis half-life	kdp	0	days	Half-life
Aerobic Aquatic Metabolism	kbacw	0	days	Halfife
Anaerobic Aquatic Metabolism	kbacs	0	days	Halfife
Aerobic Soil Metabolism	asm	439	days	Halfife
Hydrolysis:	pH 7	0	days	Half-life
Method:	CAM	2	integer	See PRZM manual
Incorporation Depth:	DEPI		cm	
Application Rate:	TAPP	0.05	kg/ha	
Application Efficiency:	APPEFF	0.95	fraction	
Spray Drift	DRFT	0.05	fraction of application rate applied to pond	
Application Date	Date	17/10	dd/mm or dd/mmm or dd-mm or dd-mmm	
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0.5		
Flag for Index Res. Run	IR	Pond		
Flag for runoff calc.	RUNOFF	none	none, monthly or total(average of entire run)	

APPENDIX D: Input Parameters and Results from T-REX

BIRDS:

Table D.a. Input Parameters for T-REX

Chemical Name:	**Pyrasulfotole**
Use	**0**
Formulation	**0**
Application Rate	**0.045 lbs a.i./acre**
Half-life	**35 days**
Application Interval	**0 days**
Maximum # Apps./Year	**1**
Length of Simulation	**1 year**

Table D.b. Upper 90th Percentile Kenaga, Chronic Avian Dietary Based Risk Quotients

NOAEC (ppm)	**EECs and RQs**							
	Short Grass		**Tall Grass**		**Broadleaf Plants/ Small Insects**		**Fruits/Pods/ Seeds/ Large Insects**	
	EEC	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**
167	10.80	0.06	4.95	0.03	6.08	0.04	0.68	0.00

Table D.c. Mean Kenaga, Chronic Avian Dietary Based Risk Quotients

NOAEC (ppm)	**EECs and RQs**							
	Short Grass		**Tall Grass**		**Broadleaf Plants/ Small Insects**		**Fruits/Pods/ Seeds/ Large Insects**	
	EEC	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**
167	3.83	0.023	1.62	0.010	2.03	0.012	0.32	0.002

MAMMALS:

Table D.d. Upper 90th Percentile Kenaga, Chronic Mammalian Dietary Based Risk Quotients

NOAEC (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
50	10.80	0.22	4.95	0.10	6.08	0.12	0.68	0.01

Size class not used for dietary risk quotients

Table D. e. Upper 90th Percentile Kenaga, Chronic Mammalian Dose-Based Risk Quotients

Size Class (grams)	Adjusted NOAEL	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	5.49	10.30	1.87	4.72	0.86	5.79	1.05	0.64	0.12	0.14	0.03
35	4.45	7.12	1.60	3.26	0.73	4.00	0.90	0.44	0.10	0.10	0.02
1000	1.92	1.65	0.86	0.76	0.39	0.93	0.48	0.10	0.05	0.02	0.01

Table D. f Mean Kenaga, Chronic Mammalian Dietary Based Risk Quotients

NOAEC (ppm)	EECs and RQs							
	Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects	
	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
50	3.83	0.077	1.62	0.032	2.03	0.041	0.32	0.006

Size class not used for dietary risk quotients

Table D.g. Mean Kenaga, Chronic Mammalian Dose-Based Risk Quotients

Size Class (grams)	Adjusted NOAEL	EECs and RQs									
		Short Grass		Tall Grass		Broadleaf Plants/ Small Insects		Fruits/Pods/ Seeds/ Large Insects		Granivore	
		EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ	EEC	RQ
15	5.49	3.63	0.661	1.54	0.280	1.92	0.350	0.30	0.054	0.07	0.01
35	4.45	2.52	0.568	1.07	0.241	1.34	0.301	0.21	0.047	0.05	0.01
1000	1.92	0.57	0.298	0.24	0.126	0.30	0.158	0.05	0.025	0.01	0.00

Table D.h. Input Parameters for T-REX

Chemical Name:	**Pyrasulfotole**
Use	**0**
Formulation	**0**
Application Rate	**0.023 lbs a.i./acre**
Half-life	**35 days**
Application Interval	**0 days**
Maximum # Apps./Year	**1**
Length of Simulation	**1 year**

Table D.i. Upper 90th Percentile Kenaga, Chronic Mammalian Dietary Based Risk Quotients

NOAEC (ppm)	**EECs and RQs**							
	Short Grass		**Tall Grass**		**Broadleaf Plants/ Small Insects**		**Fruits/Pods/ Seeds/ Large Insects**	
	EEC	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**
0	5.52	0.44	2.53	0.54	3.11	0.06	0.35	0.01

Size class not used for dietary risk quotients

Table D.j. Upper 90th Percentile Kenaga, Chronic Mammalian Dose-Based Risk Quotients

Size Class (grams)	**Adjusted NOAEL**	**EECs and RQs**									
		Short Grass		**Tall Grass**		**Broadleaf Plants/ Small Insects**		**Fruits/Pods/ Seeds/ Large Insects**		**Granivore**	
		EEC	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**	**EEC**	**RQ**
15	23.06	insectivores	0.96	0.00	0.44	Grainvores	0.54	0.00	0.06	0.07	0.01
35	152.78	1000.00	0.82	15.00	0.37	35.00	0.46	1000.00	0.05	0.05	0.01
1000	3.18	1538.32	0.44	4395.66	0.20	3556.56	0.25	1538.32	0.03	0.01	0.01

APPENDIX E: TerrPlant Model

Exposure to Terrestrial Plants including Wetlands (August 8, 2001; version 1.0)

Terrestrial plants inhabiting dry and semi-aquatic (wetland) areas may be exposed to pesticides from runoff and/or spray drift. Semi-aquatic areas are low-lying wet areas that may dry up at times throughout the year.

EFED's runoff scenario is (1) based on a pesticide's water solubility and the amount ot pesticide present on the soil surface and its top one inch, (2) characterized as "sheet runoff" (one treated acre to an adjacent acre) for dry areas, (3) characterized as "channel runoff" (10 acres to a distant low-lying acre) for semi-aquatic or wetland areas, and (4) based on percent runoff values of 0.01, 0.02, and 0.05 for water solubilities of <10, 10-100, and >100 ppm, respectively.

EFED's Spray Drift scenario is assumed as (1) 1% for ground application, and (2) 5% for aerial, airblast, forced air, and spray chemigation applications. The spray drift ratio used here is in agreement with the policy procedures at the time the worksheet was designed.

Currently, 1) this worksheet is designed to derive the plant exposure concentrations from a single, maximum application rate only. 2) For pesticide applications with incorporation of depth of less than 1 inch, the total loading EECs derived for the incorporation method will be same as the unincorporated method.

To calculate RQ values for Non-listed Terrestrial Plants:

Terrestrial Plants Inhabiting Areas Adjacent to Treatment Site:

Emergence RQ = Total Loading to Adjacent Area or EEC/Seedling Emergence EC25

Drift RQ = Drift EEC/Vegetative Vigor EC25

Terrestrial Plants Inhabiting Semi-aquatic Areas Adjacent to Treatment Site:

Emergence RQ = Total Loading to Semi-aquatic Area or EEC/Seedling Emergence EC25

Drift RQ = Drift EEC/Vegetative Vigor EC25

To calculate RQ values for Listed Terrestrial Plants:

Listed Terrestrial Plants Inhabiting Areas Adjacent to Treatment Site:

Emergence RQ = Total Loading to Adjacent Area or EEC/Seedling Emergence EC05

Drift RQ = Drift EEC/Vegetative Vigor EC05 or NOAEC

Listed Terrestrial Plants Inhabiting Semiaquatic Areas Near Treatment Site:

Emergence RQ = Total Loading to Semiaquatic Area or EEC/Seedling Emergence EC05

Drift RQ = Drift EEC/Vegetative Vigor EC05 or NOAEC

Formulas used to calculate EEC values (8/08/01; version 1.0)

To calculate EECs for terrestrial plants inhabiting in areas adjacent to treatment sites

Un-incorporated Ground Application (Non-granular):

Sheet Runoff = Application Rate (lb ai/A) x Runoff Value
Drift = Application Rate (lb ai/A) x 0.01
Total Loading = EEC = Sheet Runoff + Drift

Incorporated Ground Application with Drift (Non-granular):

Sheet Runoff = [Application Rate (lb ai/A)/Incorporation Depth (inch)] x Runoff Value
Drift = Application Rate (lb ai/A) x 0.01
Total Loading = EEC = Sheet Runoff + Drift

Un-incorporated Ground Application (Granular):

Sheet Runoff = EEC = Application Rate (lb ai/A) x Runoff Value

Incorporated Ground Application without Drift (Granular):

Sheet Runoff = EEC = [Application Rate (lb ai/A)/Incorportion Depth (inch)]

x Runoff Value

Aerial/Airblast/Spray Chemigation Applications:

Sheet Runoff = Application Rate (lb ai/A) x Runoff Value x Application Efficiency of 0.6

Drift = Application Rate (lb ai/A) x 0.05
Total Loading = EEC = Sheet Runoff + Drift

Runoff Value = 0.01, 0.02, or 0.05 when the solubility of the chemical is <10 ppm, 10-100 ppm, or>100 ppm, respectively

Incorporation Depth: Use the minimum incorporation depth reported on the label.

APPENDIX F: Results from Submitted Eco Toxicity Studies for Pyrasulfotole

ANIMALS

SPECIES	ENDPOINT	DURATION	MRID	CLASSIFICATION	COMMENTS
ACUTE					
TERRESTRIAL					
Birds					
Colinus virginianus Northern bobwhite quail	LD_{50} = >2000 mg a.i./kg-bw	14-day	468017-29	Acceptable	Acute oral test; NOAEL = >2000 mg a.i./kg-bw
Colinus virginianus Northern bobwhite quail	LC_{50} = >4911 mg a.i./kg diet	8-day	468017-30	Acceptable	Acute dietary test; NOAEC = >4911 mg a.i./kg diet
Anas platyrhynchos Mallard duck	LC_{50} = >5089 mg a.i./kg diet	8-day	46017-31	Acceptable	Acute dietary; NOAEC = 5089 mg a.i./kg diet
Mammals					
Wistar rat	LD_{50} = >2,000 mg a.i./kg-bw	14-day	46801836	Acceptable	Acute oral; LOAEL = 500 mg/kg-bw (increased incidents of corneal opacity, corneal neovascularization and retinal degeneration)
Terrestrial Invertebrates					
Apis mellifera Honey bee	LD_{50} = >120 μg a.i./bee	72-hr	468017-34	Supplemental	Oral toxicity
Apis mellifera Honey Bee	LD_{50} = >75 μg a.i./bee	72-hr	468017-35	Supplemental	Contact toxicity; only a solvent control and no negative control was tested
Eisenia foetida Earthworm	LC_{50}/EC_{50} = >1000 mg a.i./kg NOAEC = >1000 mg a.i./kg	14-day	468017-41	Supplemental	Non-guideline (EPA requires 28-day test)
AQUATIC					
Fish					
Oncorhychus mykiss Rainbow trout	LC_{50} = >96 mg a.i./L	96-hr	468017-24	Acceptable	Limit test; static conditions
Lepmis macrochirus Bluegill sunfish	LC_{50} = >96.5 mg a.i./L	96-hr	468017-25	Acceptable	Limit test; static conditions
Cyprinodon variegates	LC_{50} = >100 mg a.i./L	96-hr	468017-26	Acceptable	Limit test; static conditions

SPECIES	ENDPOINT	DURATION	MRID	CLASSIFICATION	COMMENTS
Sheepshead minnow					
Aquatic Invertebrates					
Daphnia magna	EC$_{50}$ = >95.8 mg a.i./L	48-hr	468017-21	Acceptable	Limit test; static conditions
Crassostrea virginica Eastern oyster	EC$_{50}$ = >104 mg a.i../L	96-hr	468017-22	Acceptable	Limit test; flow-through conditions
Americamysis bahia Mysid	LC$_{50}$ = 1.1 mg a.i./L	96-hr	468017-23	Acceptable	Static conditions
CHRONIC					
TERRESTRIAL					
Birds					
Colinus virginianus Northern bobwhite quail	NOAEC = 205 mg a.i./kg diet LOAEC = 594 mg ai.i./kg diet	22-week	468017-32	Acceptable	Slight reduction in hatchling weight
Anas platyrhynchos Mallard duck	NOAEC = 167 mg a.i./kg diet LOAEC = 557 mg a.i./kg diet	20-week	468017-33	Acceptable	Male body-weight gain
Mammals					
Wistar rat	NOAEL – 2.5 mg/kg-bw/day	2-generation	46801907	Acceptable	Delays of balano-preputial and increased corneal opacity (LOAEL = 26.3 mg/kg bw/day in males and 32.6 mg/kg-bw/day in females)
AQUATIC					
Fish					
Pimephales promelas Fathead minnow	NOAEC = 0.58 mg a.i./L (reduction in total length)	35-day	468017-28	Acceptable	Flow-through conditions
Aquatic Invertebrates					
Daphnia magna	NOAEC = 12.8 mg a.i./L	21-day	468017-27	Acceptable	Static renewal conditions; EC$_{50}$ = >52.9 mg a.i./L (highest conc. tested)

PLANTS

SPECIES	ENDPOINT	DURATION	MRID	CLASSIFICATION	COMMENTS
ACUTE					
AQUATIC					
Lemna gibba G3 Duckweed	EC_{50}/IC_{50} = 28 µg a.i./L	7-day	468017-36	Acceptable	Based on frond dry weight
Pseudokirchneriella subcapitata Algae	EC_{50}/IC_{50} = 11 mg a.i./L	96-hr	468017-37	Acceptable	Based on cell density and biomass
Navicula pelliculosa Algae	EC_{50}/IC_{50} = 53 mg a.i./L	96-hr	468017-38	Acceptable	Based on biomass
Anabaena flos-aquae Algae	EC_{50}/IC_{50} = 45.71 mg a.i./L	96-hr	468017-39	Supplemental	Based on growth rate
Skeletonema costatum Algae	EC_{50}/IC_{50} = 8.3 mg a.i./L	96-hr	468017-40	Acceptable	Based on biomass
TERRESTRIAL					
Various species; seedling emergence (AE 0317309 02 SE06)	Monocot: N/A Dicot: EC_{25} = 0.0011 lb a.i./acre NOAEC = 0.000399 lb a.i./acre	21 days	468019-26	Acceptable	Based on tomato dry weight
Various species; seedling emergence (AE 0317309 + Bromo)	Monocot: N/A Dicot: EC_{25} = 0.00025 lb a.i./acre NOAEC = 0.00022 lb a.i./acre	21 day	468019-36	Acceptable	Based on tomato dry weight
Various species; vegetative vigor (AE 0317309 02 SE06)	Monocot: EC_{25} = 0.017 lb a.i./acre NOAEC = 0.0125 lb a.i./acre Dicot: EC_{25} = 0.00081 lb a.i./acre NOAEC = 0.000797 lb a.i./acre	21 days	468019-27	Supplemental	Based on: Monocots – Onion dry weight Dicots – Tomato dry weight
Various species; vegetative vigor (AE 0317309 + Bromo)	Monocot: N/A Dicot: EC_{25} = 0.00017 lb	21 days	468019-37	Supplemental	Based on cucumber dry weight

SPECIES	ENDPOINT	DURATION	MRID	CLASSIFICATION	COMMENTS
	a.i./acre NOAEC = <0.00012 lb a.i./acre EC_{05} = 0.000016 lb a.i./acre				

APPENDIX G: Input Parameters from AgDRIFT

```
AgDRIFT® Input Data Summary

Tier: III Aerial Application
Title: Pyrasulfotole
Notes: Fine to Medium Droplet Size Distribution
Default values appear when they differ from the Current values.

--Aircraft--               ----------Current----------- ----------
Default-----------
Name                                 Air Tractor AT-401
Type                                              Basic
Boom Height (ft)                                     10
Flight Lines                                         20
Wing Type                                    Fixed-Wing
Semispan (ft)                                      24.5
Typical Speed (mph)                              119.99
Biplane Separation (ft)                               0
Weight (lbs)                                       6000
Planform Area (ft²)                                 294
Propeller RPM                                      2000
Propeller Radius (ft)                               4.5
Engine Vert Distance (ft)                          -1.2
Engine Fwd Distance (ft)                           11.9

-Drop Size Distribution 1- ----------Current----------- ----------
Default-----------
Name                                ASAE Fine to Medium
Type                                              Basic
Drop Categories          #       Diam (um)         Frac       Diam (um)
Frac
                         1           10.77       0.0010
                         2           16.73       0.0003
                         3           19.39       0.0007
                         4           22.49       0.0003
                         5           26.05       0.0007
                         6           30.21       0.0010
                         7           35.01       0.0010
                         8           40.57       0.0020
                         9           47.03       0.0033
                        10           54.50       0.0053
                        11           63.16       0.0067
                        12           73.23       0.0090
                        13           84.85       0.0133
                        14           98.12       0.0223
                        15          113.71       0.0330
                        16          131.73       0.0393
                        17          152.79       0.0480
                        18          177.84       0.0647
                        19          205.84       0.0830
                        20          238.45       0.1147
                        21          276.48       0.1283
                        22          320.60       0.1380
                        23          372.18       0.1127
                        24          430.74       0.0640
```

```
                         25          498.91       0.0440
                         26          578.54       0.0317
                         27          670.72       0.0203
                         28          777.39       0.0093
                         29          900.61       0.0010
                         30         1044.42       0.0007
                         31         1210.66       0.0003

--Nozzle Distribution--    ----------Current----------- ----------
Default-----------
Name                       Nozzles for Air Tractor A...
Type                                              Basic
Horiz Distance Limit (%)                              0
Boom Length (%)                                    76.3
Nozzle DSD & Locations    #     DSD  H(ft)  V(ft)  F(ft)     DSD  H(ft)
V(ft)  F(ft)
                          1       1  -18.7      0      0
                          2       1 -17.79      0      0
                          3       1 -16.87      0      0
                          4       1 -15.96      0      0
                          5       1 -15.05      0      0
                          6       1 -14.14      0      0
                          7       1 -13.22      0      0
                          8       1 -12.31      0      0
                          9       1  -11.4      0      0
                         10       1 -10.49      0      0
                         11       1  -9.58      0      0
                         12       1  -8.66      0      0
                         13       1  -7.75      0      0
                         14       1  -6.84      0      0
                         15       1  -5.93      0      0
                         16       1  -5.02      0      0
                         17       1   -4.1      0      0
                         18       1  -3.19      0      0
                         19       1  -2.28      0      0
                         20       1  -1.37      0      0
                         21       1 -0.456      0      0
                         22       1  0.456      0      0
                         23       1   1.37      0      0
                         24       1   2.28      0      0
                         25       1   3.19      0      0
                         26       1    4.1      0      0
                         27       1   5.02      0      0
                         28       1   5.93      0      0
                         29       1   6.84      0      0
                         30       1   7.75      0      0
                         31       1   8.66      0      0
                         32       1   9.58      0      0
                         33       1  10.49      0      0
                         34       1   11.4      0      0
                         35       1  12.31      0      0
                         36       1  13.22      0      0
                         37       1  14.14      0      0
                         38       1  15.05      0      0
                         39       1  15.96      0      0
                         40       1  16.87      0      0
                         41       1  17.79      0      0
```

```
                        42       1   18.7      0      0

--Swath--                  ----------Current----------- ----------
Default-----------
Swath Width                                        60 ft
Swath Displacement                0.3702 x Swath Width
Half Boom                                             No

--Spray Material--         ----------Current----------- ----------
Default-----------
Name                                               Water
Type                                               Basic
Nonvolatile Rate (lb/ac)                           0.501
Active Rate (lb/ac)                               0.2505
Spray Volume
  Rate (gal/ac)                                        2
Specific Gravity                                       1
Evaporation
  Rate (µm²/deg C/sec)                             84.76

--Meteorology--            ----------Current----------- ----------
Default-----------
Wind Speed (mph)                                      10
Wind Direction (deg)                                 -90
Temperature (deg F)                                   86
Relative Humidity (%)                                 50

--Transport--              ----------Current----------- ----------
Default-----------
Flux Plane (ft)                                        0

--Terrain--                ----------Current----------- ----------
Default-----------
Surface Roughness (ft)                            0.0246

--Advanced--               ----------Current----------- ----------
Default-----------
Wind Speed Height (ft)                              6.56
6.56
Max Compute Time (sec)                               600
Max Downwind Dist (ft)                              5280
2608.24
Vortex Decay Rate (mph)                             1.25
1.25
Aircraft Drag Coeff                                  0.1
Propeller Efficiency                                 0.8
Ambient Pressure (in hg)                           29.91
29.91

AgDRIFT® Input Data Summary

--General--
Tier: III Aerial Application
Title: Pyrasulfotole
Notes: Medium to Coarse Droplet Size Distribution
Default values appear when they differ from the Current values.
```

```
--Aircraft--               ----------Current----------- ----------
Default-----------
Name                                 Air Tractor AT-401
Type                                              Basic
Boom Height (ft)                                     10
Flight Lines                                         20
Wing Type                                    Fixed-Wing
Semispan (ft)                                      24.5
Typical Speed (mph)                              119.99
Biplane Separation (ft)                               0
Weight (lbs)                                       6000
Planform Area (ft²)                                 294
Propeller RPM                                      2000
Propeller Radius (ft)                               4.5
Engine Vert Distance (ft)                          -1.2
Engine Fwd Distance (ft)                           11.9

-Drop Size Distribution 1- ----------Current----------- ----------
Default-----------
Name                              ASAE Medium to Coarse          ASAE
Fine to Medium
Type                                              Basic
Drop Categories          #       Diam (um)         Frac       Diam (um)
Frac
                         1          35.01       0.0003           10.77
0.0010
                         2          40.57       0.0003           16.73
0.0003
                         3          47.03       0.0010           19.39
0.0007
                         4          54.50       0.0027           22.49
0.0003
                         5          63.16       0.0050           26.05
0.0007
                         6          73.23       0.0063           30.21
0.0010
                         7          84.85       0.0057           35.01
0.0010
                         8          98.12       0.0070           40.57
0.0020
                         9         113.71       0.0123           47.03
0.0033
                        10         131.73       0.0217           54.50
0.0053
                        11         152.79       0.0327           63.16
0.0067
                        12         177.84       0.0380           73.23
0.0090
                        13         205.84       0.0430           84.85
0.0133
                        14         238.45       0.0633           98.12
0.0223
                        15         276.48       0.0870          113.71
0.0330
                        16         320.60       0.1237          131.73
0.0393
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                        17          372.18        0.1397            152.79
0.0480
                        18          430.74        0.1347            177.84
0.0647
                        19          498.91        0.1150            205.84
0.0830
                        20          578.54        0.0817            238.45
0.1147
                        21          670.72        0.0353            276.48
0.1283
                        22          777.39        0.0127            320.60
0.1380
                        23          900.61        0.0100            372.18
0.1127
                        24         1044.42        0.0083            430.74
0.0640
                        25         1210.66        0.0067            498.91
0.0440
                        26         1403.04        0.0060            578.54
0.0317

--Nozzle Distribution--    ----------Current----------- ----------
Default-----------
Name                       Nozzles for Air Tractor A...
Type                                              Basic
Horiz Distance Limit (%)                              0
Boom Length (%)                                    76.3
Nozzle DSD & Locations   #     DSD  H(ft)  V(ft)  F(ft)     DSD  H(ft)
V(ft)  F(ft)
                         1       1  -18.7      0      0
                         2       1 -17.79      0      0
                         3       1 -16.87      0      0
                         4       1 -15.96      0      0
                         5       1 -15.05      0      0
                         6       1 -14.14      0      0
                         7       1 -13.22      0      0
                         8       1 -12.31      0      0
                         9       1  -11.4      0      0
                        10       1 -10.49      0      0
                        11       1  -9.58      0      0
                        12       1  -8.66      0      0
                        13       1  -7.75      0      0
                        14       1  -6.84      0      0
                        15       1  -5.93      0      0
                        16       1  -5.02      0      0
                        17       1   -4.1      0      0
                        18       1  -3.19      0      0
                        19       1  -2.28      0      0
                        20       1  -1.37      0      0
                        21       1 -0.456      0      0
                        22       1  0.456      0      0
                        23       1   1.37      0      0
                        24       1   2.28      0      0
                        25       1   3.19      0      0
                        26       1    4.1      0      0
                        27       1   5.02      0      0
                        28       1   5.93      0      0
```

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                        29        1   6.84      0      0
                        30        1   7.75      0      0
                        31        1   8.66      0      0
                        32        1   9.58      0      0
                        33        1  10.49      0      0
                        34        1   11.4      0      0
                        35        1  12.31      0      0
                        36        1  13.22      0      0
                        37        1  14.14      0      0
                        38        1  15.05      0      0
                        39        1  15.96      0      0
                        40        1  16.87      0      0
                        41        1  17.79      0      0
                        42        1   18.7      0      0

--Swath--                  ----------Current----------- ----------
Default-----------
Swath Width                                      60 ft
Swath Displacement                0.2781 x Swath Width        0.3702
x Swath Width
Half Boom                                           No

--Spray Material--         ----------Current----------- ----------
Default-----------
Name                                             Water
Type                                             Basic
Nonvolatile Rate (lb/ac)                         0.501
Active Rate (lb/ac)                             0.2505
Spray Volume
  Rate (gal/ac)                                      2
Specific Gravity                                     1
Evaporation
  Rate (µm²/deg C/sec)                           84.76

--Meteorology--            ----------Current----------- ----------
Default-----------
Wind Speed (mph)                                    10
Wind Direction (deg)                               -90
Temperature (deg F)                                 86
Relative Humidity (%)                               50

--Transport--              ----------Current----------- ----------
Default-----------
Flux Plane (ft)                                      0

--Terrain--                ----------Current----------- ----------
Default-----------
Surface Roughness (ft)                          0.0246

--Advanced--               ----------Current----------- ----------
Default-----------
Wind Speed Height (ft)                            6.56
6.56
Max Compute Time (sec)                             600
Max Downwind Dist (ft)                            5280
2608.24
```

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Vortex Decay Rate (mph)                          1.25
1.25
Aircraft Drag Coeff                               0.1
Propeller Efficiency                              0.8
Ambient Pressure (in hg)                        29.91
29.91

AgDRIFT® Input Data Summary

--General--
Tier: I Ground Application
Title: Pyrasulfotole
Notes: Fine to Medium/Coarse Droplet Size Distribution

                           ----------Current----------- ----------
Default-----------
Application Method                             Ground
Aerial
Application Selection      High Boom, ASAE Fine to M...
ASAE Fine
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APPENDIX H: Federally Listed Species that Co-Occur with Potential Pyrasulfotol Use Sites at the County-Level (Based on LOCATES).

Species that Could Be Potentially DIRECTLY Affected by Pyrasulfotole Use:

Species Common Name:	Taxa:	No. of Co. Occurrences
Allocarya, Calistoga	Dicot	1
Ambrosia, San Diego	Dicot	6
Ambrosia, South Texas	Dicot	7
Aster, Ruth's Golden	Dicot	2
Avens, Spreading	Dicot	13
Ayenia, Texas	Dicot	5
Barberry, Island	Dicot	2
Barberry, Nevin's	Dicot	6
Bear-poppy, Dwarf	Dicot	2
Bedstraw, Island	Dicot	2
Bird's-beak, Palmate-bracted	Dicot	19
Bird's-beak, Pennell's	Dicot	3
Bird's-beak, salt marsh	Dicot	11
Bird's-beak, Soft	Dicot	7
Bittercress, Small-anthered	Dicot	9
Bladderpod, San Bernardino Mountains	Dicot	3
Bladderpod, Spring Creek	Dicot	2
Blazing Star, Scrub	Dicot	1
Blue-star, Kearney's	Dicot	4
Bluet, Roan Mountain	Dicot	4
Broom, San Clemente Island	Dicot	2
Buckwheat, Cushenbury	Dicot	3
Buckwheat, Ione (incl. Irish Hill)	Dicot	1
Buckwheat, Steamboat	Dicot	1
Bush-mallow, San Clemente Island	Dicot	2
Bush-mallow, Santa Cruz Island	Dicot	2
Buttercup, Autumn	Dicot	1
Button-celery, San Diego	Dicot	6
Cactus, Arizona Hedgehog	Dicot	9
Cactus, Bakersfield	Dicot	5
Cactus, Black Lace	Dicot	6
Cactus, Brady Pincushion	Dicot	1
Cactus, Knowlton	Dicot	4
Cactus, Kuenzler Hedgehog	Dicot	8
Cactus, Nichol's Turk's Head	Dicot	8
Cactus, Peebles Navajo	Dicot	1
Cactus, Pima Pineapple	Dicot	4
Cactus, San Rafael	Dicot	3
Cactus, Sneed Pincushion	Dicot	10
Cactus, Star	Dicot	3
Cactus, Tobusch Fishhook	Dicot	10
Cactus, Wright Fishhook	Dicot	7
Campion, Fringed	Dicot	13
Ceanothus, Coyote	Dicot	2
Chaffseed, American	Dicot	48
Checker-mallow, Keck's	Dicot	8
Checker-mallow, Kenwood Marsh	Dicot	3
Checker-mallow, Pedate	Dicot	3
Checker-mallow, Wenatchee Mountains	Dicot	1

Clarkia, Pismo	Dicot	4
Clarkia, Presidio	Dicot	1
Clarkia, Vine Hill	Dicot	3
Cliffrose, Arizona	Dicot	12
Clover, Leafy Prairie	Dicot	24
Clover, Monterey	Dicot	3
Clover, Running Buffalo	Dicot	100
Clover, Showy Indian	Dicot	5
Coneflower, Smooth	Dicot	103
Coneflower, Tennessee Purple	Dicot	4
Coyote-thistle, Loch Lomond	Dicot	1
Crownscale, San Jacinto Valley	Dicot	4
Daisy, Willamette	Dicot	18
Dawn-flower, Texas Prairie (=Texas Bitterweed)	Dicot	3
Dogweed, Ashy	Dicot	2
Dropwort, Canby's	Dicot	57
Dudleya, Santa Clara Valley	Dicot	16
Evening-primrose, Antioch Dunes	Dicot	6
Fiddleneck, Large-flowered	Dicot	8
Flannelbush, Mexican	Dicot	2
Frankenia, Johnston's	Dicot	2
Fringe Tree, Pygmy	Dicot	1
Fringepod, Santa Cruz Island	Dicot	2
Gerardia, Sandplain	Dicot	8
Gilia, Hoffmann's Slender-flowered	Dicot	2
Gilia, Monterey	Dicot	3
Golden Sunburst, Hartweg's	Dicot	11
Goldenrod, Short's	Dicot	11
Goldfields, Burke's	Dicot	7
Goldfields, Contra Costa	Dicot	18
Grass, Hairy Orcutt	Dicot	26
Grass, Sacramento Orcutt	Dicot	4
Ground-plum, Guthrie's	Dicot	2
Harebells, Avon Park	Dicot	1
Harperella	Dicot	52
Hypericum, Highlands Scrub	Dicot	1
Ipomopsis, Holy Ghost	Dicot	2
Jewelflower, California	Dicot	24
Jewelflower, Tiburon	Dicot	2
Larkspur, Baker's	Dicot	5
Larkspur, San Clemente Island	Dicot	2
Larkspur, Yellow	Dicot	5
Layia, Beach	Dicot	8
Leather-flower, Alabama	Dicot	3
Leather-flower, Morefield's	Dicot	1
Lessingia, San Francisco	Dicot	1
Liveforever, Santa Barbara Island	Dicot	2
Lomatium, Bradshaw's	Dicot	18
Lomatium, Cook's	Dicot	6
Loosestrife, Rough-leaved	Dicot	49
Lousewort, Furbish	Dicot	3
Lupine, Clover	Dicot	12
Lupine, Nipomo Mesa	Dicot	4
Lupine, Scrub	Dicot	1
Malacothrix, Island	Dicot	2
Malacothrix, Santa Cruz Island	Dicot	3

Mallow, Kern	Dicot	5
Manioc, Walker's	Dicot	2
Manzanita, Del Mar	Dicot	2
Manzanita, Santa Rosa Island	Dicot	2
Meadowfoam, Butte County	Dicot	5
Meadowfoam, Large-flowered Woolly	Dicot	3
Meadowfoam, Sebastopol	Dicot	3
Meadowrue, Cooley's	Dicot	11
Milk-vetch, Applegate's	Dicot	3
Milk-vetch, Braunton's	Dicot	3
Milk-vetch, Clara Hunt's	Dicot	4
Milk-vetch, Coachella Valley	Dicot	4
Milk-vetch, Coastal Dunes	Dicot	3
Milk-vetch, Cushenbury	Dicot	3
Milk-vetch, Holmgren	Dicot	2
Milk-vetch, Jesup's	Dicot	1
Milk-vetch, Lane Mountain	Dicot	3
Milk-vetch, Mancos	Dicot	5
Milk-vetch, Sentry	Dicot	1
Milk-vetch, Shivwits	Dicot	2
Milk-vetch, Triple-ribbed	Dicot	7
Milk-vetch, Ventura Marsh	Dicot	3
Mint, Longspurred	Dicot	1
Mint, Otay Mesa	Dicot	6
Mint, San Diego Mesa	Dicot	2
Monardella, Willowy	Dicot	2
Monkey-flower, Michigan	Dicot	17
Mountainbalm, Indian Knob	Dicot	4
Mountain-mahogany, Catalina Island	Dicot	2
Mustard, Carter's	Dicot	1
Mustard, Slender-petaled	Dicot	3
Navarretia, Few-flowered	Dicot	15
Navarretia, Many-flowered	Dicot	15
Niterwort, Amargosa	Dicot	4
Oxytheca, Cushenbury	Dicot	3
Paintbrush, San Clemente Island Indian	Dicot	2
Paintbrush, Soft-leaved	Dicot	2
Paintbrush, Tiburon	Dicot	5
Penny-cress, Kneeland Prairie	Dicot	1
Pennyroyal, Todsen's	Dicot	2
Penstemon, Blowout	Dicot	15
Pentachaeta, Lyon's	Dicot	3
Pentachaeta, White-rayed	Dicot	3
Phacelia, Clay	Dicot	3
Phacelia, Island	Dicot	2
Phlox, Texas Trailing	Dicot	1
Phlox, Yreka	Dicot	4
Pinkroot, Gentian	Dicot	3
Pitcher-plant, Alabama Canebrake	Dicot	8
Pitcher-plant, Green	Dicot	14
Pitcher-plant, Mountain Sweet	Dicot	5
Plum, Scrub	Dicot	1
Polygala, Lewton's	Dicot	2
Pondberry	Dicot	46
Popcornflower, Rough	Dicot	3
Poppy, Sacramento Prickly	Dicot	1

Poppy-mallow, Texas	Dicot	5
Potentilla, Hickman's	Dicot	4
Rattleweed, Hairy	Dicot	3
Reed-mustard, Barneby	Dicot	5
Reed-mustard, Shrubby	Dicot	6
Rhododendron, Chapman	Dicot	1
Ridge-cress (=Pepper-cress), Barneby	Dicot	3
Rock-cress, Hoffmann's	Dicot	2
Rock-cress, Large (=Braun's)	Dicot	9
Rock-cress, McDonald's	Dicot	3
Rock-cress, Santa Cruz Island	Dicot	2
Rock-cress, Shale Barren	Dicot	21
Rock-cress, Small	Dicot	5
Rosemary, Short-leaved	Dicot	1
Rush-pea, Slender	Dicot	2
Sandlace	Dicot	2
Sand-verbena, Large-fruited	Dicot	3
Sandwort, Cumberland	Dicot	3
Sandwort, Marsh	Dicot	4
Sea-blite, California	Dicot	4
Snowbells, Texas	Dicot	8
Spineflower, Howell's	Dicot	3
Spineflower, Orcutt's	Dicot	2
Spineflower, Robust	Dicot	3
Spineflower, Slender-horned	Dicot	11
Spineflower, Sonoma	Dicot	5
Stickseed, Showy	Dicot	1
Stickyseed, Baker's	Dicot	3
Stonecrop, Lake County	Dicot	15
Sumac, Michaux's	Dicot	76
Sunflower, San Mateo Woolly	Dicot	1
Sunflower, Schweinitz's	Dicot	44
Taraxacum, California	Dicot	3
Tarplant, Gaviota	Dicot	2
Thistle, Chorro creek Bog	Dicot	4
Thistle, Fountain	Dicot	5
Thistle, La Graciosa	Dicot	6
Thistle, Suisun	Dicot	3
Thornmint, San Mateo	Dicot	1
Tuctoria, Green's	Dicot	26
Umbel, Huachuca Water	Dicot	8
Wallflower, Contra Costa	Dicot	3
Wallflower, Menzie's	Dicot	7
Warea, Wide-leaf	Dicot	1
Watercress, Gambel's	Dicot	12
Wild-buckwheat, Clay-loving	Dicot	6
Wire-lettuce, Malheur	Dicot	2
Wireweed	Dicot	1
Woodland-star, San Clemente Island	Dicot	2
Woolly-star, Santa Ana River	Dicot	7
Woolly-threads, San Joaquin	Dicot	27
Yerba Santa, Lompoc	Dicot	2
Ziziphus, Florida	Dicot	1
Adobe Sunburst, San Joaquin	Dicot	11
Amaranth, Seabeach	Dicot	26
Amphianthus, Little	Dicot	35

Aster, Decurrent False	Dicot	66
Baccharis, Encinitas	Dicot	2
Barbara Buttons, Mohr's	Dicot	8
Birch, Virginia Round-leaf	Dicot	3
Birds-in-a-nest, White	Dicot	1
Bladderpod, Dudley Bluffs	Dicot	1
Bladderpod, Lyrate	Dicot	5
Bladderpod, Missouri	Dicot	15
Blazing Star, Ash Meadows	Dicot	4
Blazing Star, Heller's	Dicot	7
Bluecurls, Hidden Lake	Dicot	3
Bonamia, Florida	Dicot	2
Buckwheat, Scrub	Dicot	2
Buckwheat, Southern Mountain Wild	Dicot	3
Butterfly Plant, Colorado	Dicot	9
Butterwort, Godfrey's	Dicot	1
Cactus, Bunched Cory	Dicot	1
Cactus, Cochise Pincushion	Dicot	4
Cactus, Lee Pincushion	Dicot	3
Cactus, Mesa Verde	Dicot	5
Cactus, Siler Pincushion	Dicot	3
Cactus, Uinta Basin Hookless	Dicot	19
Cactus, Winkler	Dicot	5
Catchfly, Spalding's	Dicot	44
Ceanothus, Vail Lake	Dicot	4
Centaury, Spring-loving	Dicot	4
Checker-mallow, Nelson's	Dicot	26
Clarkia, Springville	Dicot	4
Clover, Fleshy Owl's	Dicot	19
Clover, Prairie Bush	Dicot	284
Crownbeard, Big-leaved	Dicot	2
Cycladenia, Jones	Dicot	4
Daisy, Lakeside	Dicot	12
Daisy, Maguire	Dicot	5
Daisy, Parish's	Dicot	7
Dudleya, Conejo	Dicot	1
Dudleya, Marcescent	Dicot	4
Dudleya, Santa Cruz Island	Dicot	2
Dudleya, Santa Monica Mountains	Dicot	3
Dudleya, Verity's	Dicot	1
Dwarf-flax, Marin	Dicot	2
Evening-primrose, San Benito	Dicot	3
Fleabane, Zuni	Dicot	2
Four-o'clock, Macfarlane's	Dicot	6
Fruit, Earth (=geocarpon)	Dicot	24
Goldenrod, Blue Ridge	Dicot	3
Goldenrod, Houghton's	Dicot	28
Goldenrod, White-haired	Dicot	2
Gooseberry, Miccosukee	Dicot	4
Grass, Slender Orcutt	Dicot	25
Groundsel, San Francisco Peaks	Dicot	1
Gumplant, Ash Meadows	Dicot	4
Heartleaf, Dwarf-flowered	Dicot	31
Heather, Mountain Golden	Dicot	4
Howellia, Water	Dicot	23
Ivesia, Ash Meadows	Dicot	4

Joint-vetch, Sensitive	Dicot	62
Locoweed, Fassett's	Dicot	9
Lupine, Kincaid's	Dicot	24
Manzanita, Ione	Dicot	1
Manzanita, Morro	Dicot	4
Manzanita, Pallid	Dicot	4
Milk-vetch, Ash Meadows	Dicot	4
Milk-vetch, Deseret	Dicot	3
Milk-vetch, Fish Slough	Dicot	1
Milk-vetch, Heliotrope	Dicot	6
Milk-vetch, Pierson's	Dicot	4
Milkweed, Mead's	Dicot	89
Milkweed, Welsh's	Dicot	1
Monkshood, Northern Wild	Dicot	44
Navarretia, Spreading	Dicot	8
Paintbrush, Ash-grey Indian	Dicot	3
Paintbrush, Golden	Dicot	13
Potato-bean, Price's	Dicot	37
Primrose, Maguire	Dicot	3
Pussypaws, Mariposa	Dicot	8
Reed-mustard, Clay	Dicot	3
Rosemary, Cumberland	Dicot	6
Roseroot, Leedy's	Dicot	19
Rush-rose, Island	Dicot	2
Sandwort, Bear Valley	Dicot	3
Skullcap, Large-flowered	Dicot	16
Sneezeweed, Virginia	Dicot	9
Spineflower, Monterey	Dicot	3
Spiraea, Virginia	Dicot	50
Spurge, Hoover's	Dicot	22
Spurge, Telephus	Dicot	1
Sunflower, Pecos	Dicot	11
Sunray, Ash Meadows	Dicot	4
Tarplant, Otay	Dicot	2
Tarplant, Santa Cruz	Dicot	6
Thelypody, Howell's Spectacular	Dicot	7
Thistle, Pitcher's	Dicot	93
Thistle, Sacramento Mountains	Dicot	1
Thornmint, San Diego	Dicot	2
Townsendia, Last Chance	Dicot	7
Twinpod, Dudley Bluffs	Dicot	1
Whitlow-wort, Papery	Dicot	1
Wild-buckwheat, Gypsum	Dicot	4
Wings, Pigeon	Dicot	1
Yellowhead, Desert	Dicot	3
Arrowhead, Bunched	Monocot[1]	5
Bluegrass, Napa	Monocot	1
Bulrush, Northeastern (=Barbed Bristle)	Monocot	48
Grass, California Orcutt	Monocot	7
Grass, Solano	Monocot	6
Lily, Pitkin Marsh	Monocot	3
Pondweed, Little Aguja Creek	Monocot	2
Sedge, White	Monocot	3
Wild-rice, Texas	Monocot	10
Grass, Colusa	Monocot	13
Grass, San Joaquin Valley Orcutt	Monocot	24

Pink, Swamp	Monocot	76
Water-plantain, Kral's	Monocot	5
Bat, Gray	Mammal[2]	354
Bat, Indiana	Mammal	1947
Bat, Lesser (=Sanborn's) Long-nosed	Mammal	32
Bat, Mexican Long-nosed	Mammal	1
Bat, Ozark Big-eared	Mammal	8
Bat, Virginia Big-eared	Mammal	38
Caribou, Woodland	Mammal	8
Deer, Columbian White-tailed	Mammal	11
Ferret, Black-footed	Mammal	347
Fox, San Joaquin Kit	Mammal	52
Fox, San Miguel Island	Mammal	2
Fox, Santa Catalina Island	Mammal	2
Fox, Santa Cruz Island	Mammal	2
Fox, Santa Rosa Island	Mammal	2
Jaguar	Mammal	20
Jaguarundi, Gulf Coast	Mammal	31
Jaguarundi, Sinaloan	Mammal	20
Kangaroo Rat, Fresno	Mammal	17
Kangaroo Rat, Giant	Mammal	34
Kangaroo Rat, Morro Bay	Mammal	4
Kangaroo Rat, San Bernardino Merriam's	Mammal	7
Kangaroo Rat, Stephens'	Mammal	9
Kangaroo Rat, Tipton	Mammal	14
Manatee, West Indian	Marine mml	44
Mountain Beaver, Point Arena	Mammal	3
Mouse, Alabama Beach	Mammal	2
Mouse, Choctawhatchee Beach	Mammal	3
Mouse, Pacific Pocket	Mammal	4
Mouse, Perdido Key Beach	Mammal	4
Mouse, Salt Marsh Harvest	Mammal	16
Ocelot	Mammal	43
Panther, Florida	Mammal	1
Pronghorn, Sonoran	Mammal	11
Rabbit, Pygmy	Mammal	20
Rabbit, Riparian Brush	Mammal	4
Sheep, Sierra Nevada Bighorn	Mammal	3
Shrew, Buena Vista Lake Ornate	Mammal	5
Squirrel, Carolina Northern Flying	Mammal	9
Squirrel, Delmarva Peninsula Fox	Mammal	34
Squirrel, Mount Graham Red	Mammal	4
Squirrel, Virginia Northern Flying	Mammal	14
Vole, Amargosa	Mammal	3
Vole, Florida Salt Marsh	Mammal	2
Vole, Hualapai Mexican	Mammal	1
Whale, Finback	Marine mml	10
Whale, Humpback	Marine mml	10
Whale, northern right	Marine mml	8
Whale, Sei	Marine mml	10
Whale, Sperm	Marine mml	10
Wolf, Gray	Mammal	288
Woodrat, Riparian	Mammal	4
Bear, Grizzly	Mammal	124
Bear, Louisiana Black	Mammal	110
Lynx, Canada	Mammal	113

Mouse, Preble's Meadow Jumping	Mammal	24
Otter, Northern Sea	Marine mml	2
Otter, Southern Sea	Marine mml	7
Prairie Dog, Utah	Mammal	15
Seal, Guadalupe Fur	Marine mml	2
Squirrel, Northern Idaho Ground	Mammal	4

[1] The monocots included here are associated with aquatic habitat classifications in LOCATES (*i.e.*, Freshwater, Terrestrial/Freshwater, Vernal Pool, or Vernal Pool/Terrestrial).

[2] No attempt was made to eliminate species based on body size.

Species that Could Be Potentially INDIRECTLY Affected by Pyrasulfotole Use:

Species Common Name:	Taxa:	No. of Co. Occurrences
Abalone, White	Gastropod	7
Ambersnail, Kanab	Gastropod	1
Amphipod, Illinois Cave	Crustacean	5
Amphipod, Noel's	Crustacean	4
Amphipod, Peck's Cave	Crustacean	10
Beetle, American Burying	Insect	109
Beetle, Coffin Cave Mold	Insect	2
Beetle, Comal Springs Dryopid	Insect	10
Beetle, Comal Springs Riffle	Insect	10
Beetle, Helotes Mold	Insect	2
Beetle, Hungerford's Crawling Water	Insect	6
Beetle, Kretschmarr Cave Mold	Insect	2
Beetle, Salt Creek Tiger	Insect	5
Beetle, Tooth Cave Ground	Insect	4
Bobwhite, Masked	Bird	4
Butterfly, Behren's Silverspot	Insect	6
Butterfly, Callippe Silverspot	Insect	2
Butterfly, El Segundo Blue	Insect	2
Butterfly, Fender's Blue	Insect	14
Butterfly, Karner Blue	Insect	121
Butterfly, Lange's Metalmark	Insect	3
Butterfly, Lotis Blue	Insect	3
Butterfly, Mission Blue	Insect	3
Butterfly, Mitchell's Satyr	Insect	46
Butterfly, Myrtle's Silverspot	Insect	5
Butterfly, Palos Verdes Blue	Insect	2
Butterfly, Quino Checkerspot	Insect	6
Butterfly, Saint Francis' Satyr	Insect	8
Butterfly, San Bruno Elfin	Insect	1
Butterfly, Smith's Blue	Insect	3
Butterfly, Uncompahgre Fritillary	Insect	6
Campeloma, Slender	Gastropod	3
Cavefish, Alabama	Fish	2
Cavesnail, Tumbling Creek	Gastropod	1
Chub, Bonytail	Fish	35
Chub, Borax Lake	Fish	2
Chub, Gila	Fish	24
Chub, Humpback	Fish	22
Chub, Mohave Tui	Fish	12
Chub, Oregon	Fish	22
Chub, Owens Tui	Fish	1

Chub, Pahranagat Roundtail	Fish	1
Chub, Virgin River	Fish	4
Chub, Yaqui	Fish	4
Cladonia, Florida Perforate	Lichen	2
Combshell, Southern (=Penitent mussel)	Bivalve	5
Combshell, Upland	Bivalve	18
Condor, California	Bird	25
Crane, Mississippi Sandhill	Bird	1
Crane, Whooping	Bird	977
Crayfish, Cave (Cambarus aculabrum)	Crustacean	4
Crayfish, Nashville	Crustacean	1
Crayfish, Shasta	Crustacean	4
Cui-ui	Fish	1
Curlew, Eskimo	Bird	9
Cypress, Santa Cruz	Conf/cycds	1
Dace, Ash Meadows Speckled	Fish	4
Dace, Clover Valley Speckled	Fish	1
Dace, Independence Valley Speckled	Fish	1
Dace, Moapa	Fish	4
Darter, Amber	Fish	11
Darter, Bluemask (=jewel)	Fish	6
Darter, Boulder	Fish	7
Darter, Duskytail	Fish	7
Darter, Etowah	Fish	1
Darter, Fountain	Fish	12
Darter, Maryland	Fish	4
Darter, Okaloosa	Fish	3
Darter, Relict	Fish	3
Darter, Vermilion	Fish	2
Darter, Watercress	Fish	2
Dragonfly, Hine's Emerald	Insect	39
Elktoe, Appalachian	Bivalve	3
Fairy Shrimp, Conservancy Fairy	Crustacean	16
Fairy Shrimp, Longhorn	Crustacean	16
Fairy Shrimp, Riverside	Crustacean	9
Fairy Shrimp, San Diego	Crustacean	2
Falcon, Northern Aplomado	Bird	56
Fanshell	Bivalve	111
Fern, Aleutian Shield	Ferns	2
Fly, Delhi Sands Flower-loving	Insect	10
Flycatcher, Southwestern Willow	Bird	94
Frog, Dusky Gopher (Mississippi DPS)	Amphibian	1
Frog, Mountain Yellow-legged	Amphibian	9
Gambusia, Clear Creek	Fish	2
Gambusia, Pecos	Fish	13
Gambusia, San Marcos	Fish	10
Goby, Tidewater	Fish	30
Harvestman, Bee Creek Cave	Arachnid	6
Harvestman, Bone Cave	Arachnid	4
Harvestman, Robber Baron Cave	Arachnid	2
Isopod, Lee County Cave	Crustacean	3
Isopod, Socorro	Crustacean	1
Kidneyshell, Triangular	Bivalve	25
Kite, Everglade Snail	Bird	2
Lichen, Rock Gnome	Lichen	13
Limpet, Banbury Springs	Gastropod	7

Lizard, Blunt-nosed Leopard	Reptile	38
Logperch, Conasauga	Fish	9
Logperch, Roanoke	Fish	33
Madtom, Pygmy	Fish	4
Madtom, Scioto	Fish	12
Madtom, Smoky	Fish	4
Marstonia, Royal (=Royal Snail)	Gastropod	2
Meshweaver, Braken Bat Cave	Arachnid	2
Minnow, Rio Grande Silvery	Fish	14
Mucket, Pink (Pearlymussel)	Bivalve	203
Mussel, Acornshell Southern	Bivalve	9
Mussel, Black (=Curtus' Mussel) Clubshell	Bivalve	2
Mussel, Clubshell	Bivalve	135
Mussel, Coosa Moccasinshell	Bivalve	18
Mussel, Cumberland Combshell	Bivalve	23
Mussel, Cumberland Elktoe	Bivalve	7
Mussel, Cumberland Pigtoe	Bivalve	5
Mussel, Dark Pigtoe	Bivalve	6
Mussel, Dwarf Wedge	Bivalve	117
Mussel, Fine-rayed Pigtoe	Bivalve	42
Mussel, Flat Pigtoe (=Marshall's Mussel)	Bivalve	2
Mussel, Gulf Moccasinshell	Bivalve	39
Mussel, Heavy Pigtoe (=Judge Tait's Mussel)	Bivalve	14
Mussel, Heelsplitter Carolina	Bivalve	26
Mussel, Ochlockonee Moccasinshell	Bivalve	2
Mussel, Oval Pigtoe	Bivalve	38
Mussel, Ovate Clubshell	Bivalve	31
Mussel, Oyster	Bivalve	26
Mussel, Ring Pink (=Golf Stick Pearly)	Bivalve	67
Mussel, Rough Pigtoe	Bivalve	79
Mussel, Scaleshell	Bivalve	42
Mussel, Shiny Pigtoe	Bivalve	33
Mussel, Shiny-rayed Pocketbook	Bivalve	41
Mussel, Southern Clubshell	Bivalve	31
Mussel, Southern Pigtoe	Bivalve	19
Mussel, Speckled Pocketbook	Bivalve	1
Mussel, Winged Mapleleaf	Bivalve	17
Pearlymussel, Alabama Lamp	Bivalve	7
Pearlymussel, Appalachian Monkeyface	Bivalve	15
Pearlymussel, Birdwing	Bivalve	37
Pearlymussel, Cracking	Bivalve	33
Pearlymussel, Cumberland Bean	Bivalve	35
Pearlymussel, Cumberland Monkeyface	Bivalve	37
Pearlymussel, Curtis'	Bivalve	10
Pearlymussel, Dromedary	Bivalve	41
Pearlymussel, Fat Pocketbook	Bivalve	91
Pearlymussel, Green-blossom	Bivalve	18
Pearlymussel, Higgins' Eye	Bivalve	112
1 Pearlymussel, Little-wing	Bivalve	38
Pearlymussel, Orange-footed	Bivalve	81
Pearlymussel, Pale Lilliput	Bivalve	20
Pearlymussel, Purple Cat's Paw	Bivalve	18
Pearlymussel, Tubercled-blossom	Bivalve	59
Pearlymussel, Turgid-blossom	Bivalve	18
Pearlymussel, White Cat's Paw	Bivalve	9
Pearlymussel, White Wartyback	Bivalve	45

Pearlymussel, Yellow-blossom	Bivalve	36
Pebblesnail, Flat	Gastropod	1
Pelican, Brown	Bird	73
Plover, Piping	Bird	688
Poolfish, Pahrump (= Pahrump Killifish)	Fish	6
Prairie-chicken, Attwater's Greater	Bird	8
Pseudoscorpion, Tooth Cave	Arachnid	2
Pupfish, Ash Meadows Amargosa	Fish	4
Pupfish, Comanche Springs	Fish	6
Pupfish, Desert	Fish	41
Pupfish, Devils Hole	Fish	6
Pupfish, Leon Springs	Fish	2
Pupfish, Owens	Fish	1
Pupfish, Warm Springs	Fish	4
Purple Bean	Bivalve	19
Pygmy-owl, Cactus Ferruginous	Bird	27
Quillwort, Black-spored	Ferns	13
Quillwort, Louisiana	Ferns	11
Quillwort, Mat-forming	Ferns	8
Rabbitsfoot, Rough	Bivalve	14
Rail, California Clapper	Bird	23
Rail, Light-footed Clapper	Bird	7
Rail, Yuma Clapper	Bird	29
Rhadine exilis (ncn)	Insect	2
Rhadine infernalis (ncn)	Insect	2
Riffleshell, Northern	Bivalve	62
Riffleshell, Tan	Bivalve	52
Riversnail, Anthony's	Gastropod	12
Rock-pocketbook, Ouachita (=Wheeler's pm)	Bivalve	5
Rocksnail, Plicate	Gastropod	2
Salamander, Barton Springs	Amphibian	4
Salamander, California Tiger	Amphibian	64
Salamander, Desert Slender	Amphibian	4
Salamander, Santa Cruz Long-toed	Amphibian	3
Salamander, Shenandoah	Amphibian	8
Salamander, Sonora Tiger	Amphibian	4
Salamander, Texas Blind	Amphibian	10
Salmon, Atlantic	Fish	9
Salmon, Chinook (Sacramento River Winter Run)	Fish	40
Salmon, Chinook (Upper Columbia River Spring)	Fish	62
Salmon, Coho (Central California Coast population)	Fish	10
Salmon, Sockeye (Snake River population)	Fish	78
Sea turtle, green	Reptile	44
Sea turtle, hawksbill	Reptile	19
Sea turtle, Kemp's ridley	Reptile	40
Sea turtle, leatherback	Reptile	49
Shiner, Cahaba	Fish	4
Shiner, Cape Fear	Fish	14
Shiner, Palezone	Fish	4
Shiner, Topeka	Fish	129
Shrike, San Clemente Loggerhead	Bird	2
Shrimp, Alabama Cave	Crustacean	1
Shrimp, California Freshwater	Crustacean	6
Shrimp, Kentucky Cave	Crustacean	5
Skipper, Carson Wandering	Insect	4
Skipper, Laguna Mountain	Insect	2

Snail, Armored	Gastropod	3
Snail, Iowa Pleistocene	Gastropod	20
Snail, Lioplax Cylindrical	Gastropod	1
Snail, Morro Shoulderband	Gastropod	4
Snail, Pecos Assiminea	Gastropod	8
Snail, Snake River Physa	Gastropod	13
Snail, Tulotoma	Gastropod	9
Snail, Utah Valvata	Gastropod	11
Snail, Virginia Fringed Mountain	Gastropod	2
Snake, San Francisco Garter	Reptile	1
Sparrow, Florida Grasshopper	Bird	1
Spider, Government Canyon Cave	Arachnid	2
Spider, Madla's Cave	Arachnid	2
Spider, Robber Baron Cave	Arachnid	2
Spider, Spruce-fir Moss	Arachnid	5
Spider, Tooth Cave	Arachnid	2
Spider, Vesper Cave	Arachnid	2
Spinedace, White River	Fish	4
Spineflower, Howell's	Dicot	3
Spinymussel, James River	Bivalve	38
Spinymussel, Tar River	Bivalve	18
Springfish, Hiko White River	Fish	1
Springfish, White River	Fish	1
Springsnail, Alamosa	Gastropod	1
Springsnail, Bruneau Hot	Gastropod	3
Springsnail, Idaho	Gastropod	6
Springsnail, Koster's	Gastropod	4
Springsnail, Roswell	Gastropod	4
Springsnail, Socorro	Gastropod	1
Squawfish, Colorado	Fish	45
Starling, Ponape Mountain	Bird	1
Steelhead, (Southern California population)	Fish	11
Stickleback, Unarmored Threespine	Fish	9
Stirrupshell	Bivalve	5
Stork, Wood	Bird	245
Sturgeon, Alabama	Fish	7
Sturgeon, Pallid	Fish	366
Sturgeon, Shortnose	Fish	194
Sturgeon, White	Fish	5
Sucker, June	Fish	3
Sucker, Lost River	Fish	10
Sucker, Modoc	Fish	6
Sucker, Razorback	Fish	66
Sucker, Shortnose	Fish	6
Tadpole Shrimp, Vernal Pool	Crustacean	63
Tern, California Least	Bird	22
Tern, Interior (population) Least	Bird	575
Tern, Roseate	Bird	12
Threeridge, Fat (Mussel)	Bivalve	8
Toad, Arroyo Southwestern	Amphibian	21
Toad, Houston	Amphibian	19
Toad, Wyoming	Amphibian	1
Topminnow, Gila (Yaqui)	Fish	29
Torreya, Florida	Conf/cycds	5
Trout, Gila	Fish	9
Turtle, Alabama Red-bellied	Reptile	3

Vireo, Black-capped	Bird	145
Vireo, Least Bell's	Bird	26
Warbler (=Wood), Golden-cheeked	Bird	74
Warbler (=Wood), Kirtland's	Bird	68
Warbler, Bachman's	Bird	8
Woodpecker, Ivory-billed	Bird	9
Woodpecker, Red-cockaded	Bird	571
Bankclimber, Purple	Bivalve	28
Beetle, Delta Green Ground	Insect	3
Beetle, Northeastern Beach Tiger	Insect	21
Beetle, Puritan Tiger	Insect	13
Beetle, Valley Elderberry Longhorn	Insect	48
Butterfly, Bay Checkerspot	Insect	7
Butterfly, Oregon Silverspot	Insect	9
Caracara, Audubon's Crested	Bird	3
Catfish, Yaqui	Fish	4
Cavefish, Ozark	Fish	31
Chub, Hutton Tui	Fish	7
Chub, Slender	Fish	16
Chub, Spotfin	Fish	32
Cypress, Gowen	Conf/cycds	3
Dace, Blackside	Fish	9
Dace, Desert	Fish	4
Dace, Foskett Speckled	Fish	4
Darter, Bayou	Fish	5
Darter, Cherokee	Fish	1
Darter, Goldline	Fish	8
Darter, Leopard	Fish	3
Darter, Niangua	Fish	41
Darter, Slackwater	Fish	12
Darter, Snail	Fish	39
Eagle, Bald	Bird	4177
Elimia, Lacy	Gastropod	2
Fairy Shrimp, Vernal Pool	Crustacean	79
Fatmucket, Arkansas	Bivalve	1
Fern, Alabama Streak-sorus	Ferns	1
Fern, American hart's-tongue	Ferns	22
Frog, California Red-legged	Amphibian	45
Frog, Chiricahua Leopard	Amphibian	31
Gnatcatcher, Coastal California	Bird	12
Isopod, Madison Cave	Crustacean	8
Lizard, Coachella Valley Fringe-toed	Reptile	4
Lizard, Island Night	Reptile	5
Madtom, Neosho	Fish	33
Madtom, Yellowfin	Fish	20
Minnow, Devils River	Fish	1
Minnow, Loach	Fish	28
Moth, Kern Primrose Sphinx	Insect	5
Mucket, Orangenacre	Bivalve	15
Murrelet, Marbled	Bird	73
Mussel, Alabama Moccasinshell	Bivalve	26
Mussel, Fine-lined Pocketbook	Bivalve	47
Mussel, Heelsplitter Inflated	Bivalve	16
Naucorid, Ash Meadows	Insect	4
Owl, Mexican Spotted	Bird	113
Owl, Northern Spotted	Bird	130

Pearlshell, Louisiana	Bivalve	2
Plover, Western Snowy	Bird	37
Rattlesnake, New Mexican Ridge-nosed	Reptile	5
Rocksnail, Painted	Gastropod	7
Rocksnail, Round	Gastropod	1
Salamander, Cheat Mountain	Amphibian	4
Salamander, Flatwoods	Amphibian	38
Salamander, Red Hills	Amphibian	8
Salamander, San Marcos	Amphibian	10
Salmon, Chinook (California Coastal Run)	Fish	7
Salmon, Chinook (Central Valley Fall Run)	Fish	7
Salmon, Chinook (Central Valley Spring Run)	Fish	46
Salmon, Chinook (Lower Columbia River)	Fish	20
Salmon, Chinook (Puget Sound)	Fish	26
Salmon, Chinook (Snake River Fall Run)	Fish	83
Salmon, Chinook (Snake River spring/summer)	Fish	89
Salmon, Chinook (Upper Willamette River)	Fish	40
Salmon, Chum (Columbia River population)	Fish	14
Salmon, Chum (Hood Canal Summer population)	Fish	6
Salmon, Coho (Southern OR/Northern CA Coast)	Fish	24
Salmon, Sockeye (Ozette Lake population)	Fish	2
Scrub-Jay, Florida	Bird	
Sculpin, Pygmy	Fish	2
Sea turtle, loggerhead	Reptile	104
Sea turtle, olive ridley	Reptile	9
Shagreen, Magazine Mountain	Gastropod	1
Shiner, Arkansas River	Fish	121
Shiner, Beautiful	Fish	8
Shiner, Blue	Fish	20
Shiner, Pecos Bluntnose	Fish	8
Silverside, Waccamaw	Fish	2
Skink, Blue-tailed Mole	Reptile	1
Skink, Sand	Reptile	2
Skipper, Pawnee Montane	Insect	1
Slabshell, Chipola	Bivalve	3
Smelt, Delta	Fish	13
Snail, Bliss Rapids	Gastropod	10
Snail, Chittenango Ovate Amber	Gastropod	3
Snail, Flat-spired Three-toothed	Gastropod	4
Snail, Painted Snake Coiled Forest	Gastropod	2
Snake, Concho Water	Reptile	28
Snake, Eastern Indigo	Reptile	191
Snake, Giant Garter	Reptile	31
Snake, Lake Erie Water	Reptile	5
Snake, Northern Copperbelly Water	Reptile	30
Sparrow, San Clemente Sage	Bird	2
Spikedace	Fish	28
Spinedace, Big Spring	Fish	1
Spinedace, Little Colorado	Fish	4
Springfish, Railroad Valley	Fish	4
Alopecurus, Sonoma	Monocot	5
Arizona Agave	Monocot	9
Beargrass, Britton's	Monocot	1
Bluegrass, San Bernardino	Monocot	5
Fritillary, Gentner's	Monocot	6
Grass, Tennessee Yellow-eyed	Monocot	11

Irisette, White	Monocot	9
Ladies'-tresses, Canelo Hills	Monocot	4
Ladies'-tresses, Navasota	Monocot	14
Lily, Minnesota Trout	Monocot	11
Lily, Western	Monocot	1
Onion, Munz's	Monocot	4
Sedge, Golden	Monocot	4
Trillium, Persistent	Monocot	7
Trillium, Relict	Monocot	25
`Amole, Cammatta Canyon	Monocot	4
Amole, Purple	Monocot	7
Beaked-rush, Knieskern's	Monocot	12
Brodiaea, Thread-leaved	Monocot	11
Iris, Dwarf Lake	Monocot	37
Ladies'-tresses, Ute	Monocot	32
Orchid, Eastern Prairie Fringed	Monocot	169
Orchid, Western Prairie Fringed	Monocot	379
Pogonia, Small Whorled	Monocot	144
Sedge, Navajo	Monocot	5
Steelhead, (California Central Valley population)	Fish	55
Steelhead, (Central California Coast population)	Fish	17
Steelhead, (Lower Columbia River population)	Fish	24
Steelhead, (Middle Columbia River population)	Fish	77
Steelhead, (Northern California population)	Fish	11
Steelhead, (Snake River Basin population)	Fish	96
Steelhead, (South-Central California population)	Fish	12
Steelhead, (Upper Columbia River population)	Fish	67
Steelhead, (Upper Willamette River population)	Fish	42
Sturgeon, Gulf	Fish	84
Sucker, Santa Ana	Fish	9
Sucker, Warner	Fish	5
Tortoise, Desert	Reptile	32
Tortoise, Gopher	Reptile	19
Trout, Apache	Fish	12
Trout, Bull	Fish	282
Trout, Bull (Columbia River population)	Fish	226
Trout, Bull (Klamath River population)	Fish	227
Trout, Greenback Cutthroat	Fish	7
Trout, Lahontan Cutthroat	Fish	27
Trout, Little Kern Golden	Fish	8
Trout, Paiute Cutthroat	Fish	9
Turtle, Bog (Northern population)	Reptile	102
Turtle, Flattened Musk	Reptile	11
Turtle, Ringed Sawback	Reptile	15
Turtle, Yellow-blotched Map	Reptile	6
Whipsnake (=Striped Racer), Alameda	Reptile	4