Ecological Risk Assessment

Section 3
(New Uses on Grasses Grown for Seed, Green Onions and Ornamentals)

Dimethenamid
(PC Code 120051, CASN 163515-14-8)

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I. EXECUTIVE SUMMARY

A. Nature of Chemical Stressor

The Environmental Fate and Effects Division (EFED) has reviewed the proposed new uses of Outlook™ for use on grasses grown for seed and green onions and the proposed new product of Dimethenamid-P Ornamentals Herbicide on terrestrial non-cropped areas where ornamentals are grown, stored or planted. The end use products, Outlook™ and Dimethenamid-P Ornamentals Herbicide, are liquid formulations consisting of 63.9% ai (6 pounds per gallon of the active isomer s-dimethenamid). S-dimethenamid is the herbicidally active isomer of r/s-dimethenamid which is currently registered for use on the following terrestrial crops; beets, bulb vegetables, corn, dry beans, peanut, potatoes, horseradish, tuberous and corm vegetables, sorghum and soybean (SAN 852, Frontier and Outlook). Dimethenamid may be applied via ground broadcast or aerial spray as well as impregnated on granular fertilizer producing granular formulation products. For granular fertilizer application, shallow (1-2 inches) soil incorporation of the granules is required. Dimethenamid may be applied with spray adjuvants or crop oil concentrates to improve burndown of emerged weeds. Maximum application rates for the proposed new uses are 0.98 lb ai/A for grasses grown for seed and green onions and 2 applications of 1.5 lb ai/A with a reapplication interval of 42 days for ornamentals.

Environmental fate studies indicate that dimethenamid is moderately persistent in the soil, has a high aqueous solubility and does not partition to soil mineral or organic fractions. Thus, there is a moderate risk of surface water contamination through runoff. Dimethenamid is likely to leach to ground water in much of its potential use area. If the compound were to reach surface water it may persist for a significant period of time due to the fact that it is stable to hydrolysis at pH 5, 7, and 9. The major route of dissipation is through soil metabolism.

B. Potential Risks to Non-target Wildlife and Plants

This screening risk assessment did not result in risk of acute and chronic effects to freshwater and marine/estuarine fish and invertebrates. The chronic risk assessment for estuarine/marine animals was based on an acute to chronic ratio approach from testing with r/s-dimethenamid on freshwater animals. EFED currently does not quantify risk to non-target terrestrial insects; however, available honeybee toxicity data indicates that the risk to non-target terrestrial insects is likely to be low. Tables IB-1 and IB-2 provides summaries for the environmental risk conclusions for aquatic and terrestrial animals and plants.

The taxonomic groups potentially at risk from exposure to dimethenamid as follows:

Aquatic Plants

This screening risk assessment indicates that there are exceedances of the LOCs for endangered non-vascular and vascular aquatic plants exposed to a combination of runoff and drift from the maximum application rates applied via ground and aerial spray, including granular application to ornamentals and grasses grown for seed and via ground spray to green onions. Likewise, the non-endangered aquatic plant LOC is exceeded for ground and aerial spray with the exception of non-vascular plants from granular application at the maximum application rate for ornamentals (1.5 lb ai/A). Ground application to green onions at 0.98 lb ai/A also resulted in exceedances of the non-endangered aquatic plant LOC. There is no LOC exceedances for non-endangered aquatic plants from dimethenamid applications to grasses grown for seed at 0.98 lb ai/A

Avian

For the maximum application rate of 1.5 lb ai/A (2 applications) and maximum predicted residue levels, the Acute Risk LOC is exceeded for small birds (20 g) foraging on short grass; the Acute Restricted Use LOC is exceeded for small birds (20 g) foraging on short grass, tall grass and broadleaf forage/small insects and for 100 g birds foraging on short grasses; and the Acute Endangered Species LOC is exceeded for 20 g birds foraging on short grass, tall grass, and broadleaf forage/small insects and for 100 g birds foraging on short grass, tall grass and broadleaf forage/small insects and for 1000 g birds foraging on short grass. At the lower application rate of 0.98 lb ai/A and assuming maximum predicted residue levels, the Acute Restricted Use LOC is exceeded for small birds (20 g) foraging on short grass and broadleaf forage/small insects; and the Acute Endangered Species LOC is exceeded for 20 g birds foraging on short grass, tall grass, and broadleaf forage/small insects and 100 g birds foraging on short grass.

Using the LD_{50}/ft^2 exposure method for granular applications, the Acute Risk, Acute Restricted use and Acute Endangered Species are exceeded for 20 g birds foraging on granules at both application rates and the Acute Endangered Species LOC is exceeded for 100 g birds foraging on granules following application at 1.5 lb ai/A.

EFED currently uses surrogate data (birds) for non-target terrestrial amphibians and reptiles and does not quantify risks to terrestrial non-target insects. Avian risk data indicates that terrestrial-phase amphibians and reptiles may be at risk to adverse effects to survival and growth from the acute oral exposure to s-dimethenamid as a result of consuming contaminated feed items or ingesting fertilizer impregnated granules at proposed application rates. In addition, terrestrial-phase amphibians and reptiles may be at risk to adverse effects to growth and reproduction from chronic oral exposure to s-dimethenamid as a result of consuming contaminated short grass at the higher application rate (1.5 lbs ai/A x 2 applications applied 42 days apart).

Mammals

At both application rates (0.98 and 1.5 lb ai/A) and maximum predicted residue levels, the dose-based RQs exceeded the Chronic Risk and Endangered Species LOCs for all weight classes of mammals (15, 35, 1000 g) consuming short grass, tall grass, and broadleaf forage/small insects. At the maximum application rate and maximum predicted residue levels, the dietary-based RQ exceeded the Chronic Risk and Endangered Species LOCs for mammals consuming short grass.

Based on LD_{50}/ft^2 exposure method and mammal oral LD_{50} of 2400 mg/kg-bw, the Acute Endangered Species Risk LOC was exceeded for 15 g mammals exposed to fertilizer impregnated granules at both application rates.

Terrestrial Plants

At the application rate of 0.98 lb ai/A *and* the use of dimethenamid on ornamentals at the application rate of 1.5 lb ai/A, the LOC is exceeded for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas primarily as the result of a combination of runoff and drift from ground and aerial applications. Runoff from granular formulations of dimethenamid (both unincorporated and incorporated) applied at 0.98 lb ai/A *and* 1.5 lb ai/A also resulted in exceedances of the LOC for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas.

The LOC for non-endangered and endangered monocots located in dry areas is exceeded as a result of spray drift alone from aerial applications at both the 0.98 lb ai/A and 1.5 lb ai/A application rates.

TABLE I-B1. Summary of Environmental Risk Conclusions for Aquatic.

Assessment Endpoint	Use Patterns with LOC Exceedances	Summarized Risk Characterization[1]
Acute Risk to Freshwater and Marine/Estuarine Fish and Aquatic-phase Amphibians	None	At the peak EECs, there are no exceedances of the Acute Risk, Acute Restricted Use, or Acute Endangered Species LOCs for fish. EFED currently use surrogate data (fish) for aquatic-phase amphibians. Fish risk assessment indicates no acute LOC exceedances, consequently, no risk concerns for aquatic-phase amphibians.
Chronic Risk to Freshwater Fish and Aquatic-phase Amphibians	None	There are no chronic LOC exceedances for either taxonomic group. A comparison of the 21- and 60-day EECs in surface water to chronic toxicity values for freshwater (FW) invertebrates and fish indicates that the highest EECs are an order of magnitude lower than the lowest toxicity value for rainbow trout (NOAEC of 300 µg/L). EFED currently use surrogate data (fish) for aquatic-phase amphibians. Fish risk assessment indicates no chronic LOC exceedances, consequently, no risk concerns for aquatic-phase amphibians from long-term exposure to dimethenamid.
Acute Risk to Freshwater and Marine/Estuarine Invertebrates	None	At the peak surface water EECs, there are no exceedances of the Acute Risk, Acute Restricted Use, or Acute Endangered Species LOCs for invertebrates. A comparison of the peak EECs in surface water to the acute toxicity values for freshwater (FW) and estuarine/marine (E/M) fish and invertebrates indicates that the toxicity values [ranging from 3,200 to 12,000 µg/L] average two orders of magnitude higher than the highest EECs for ornamentals.
Chronic Risk to Freshwater Invertebrates	None	There are no exceedances of the Chronic Risk and Endangered Species LOCs for either taxonomic group. A comparison of the 21-day EECs in surface water to chronic toxicity values for freshwater (FW) invertebrates indicates that the highest EECs are two orders of magnitude lower than the lowest toxicity value for daphnids (NOAEC of 1,020 µg/L).
Chronic Risk to Estuarine/Marine Fish	None	Chronic values for estuarine/marine fish were estimated using an acute to chronic ratio approach from testing with r/s-dimethenamid with freshwater fish in order to determine the potential chronic risk to estuarine/marine fish. Using the ratio approach, there are no chronic LOC exceedances for estuarine/marine fish.
Chronic Risk to Estuarine/Marine Invertebrates	None	Chronic values for estuarine/marine invertebrates were estimated using an acute to chronic ratio approach from testing with r/s-dimethenamid with freshwater invertebrates in order to determine the potential chronic risk to estuarine/marine invertebrates. Using the ratio approach, there are no chronic LOC exceedances for estuarine/marine invertebrates.

TABLE I-B1. Summary of Environmental Risk Conclusions for Aquatic.		
Assessment Endpoint	**Use Patterns with LOC Exceedances**	**Summarized Risk Characterization[1]**
Risk to Aquatic Plants	Terrestrial crop use on grasses grown for seed (0.98 lb ai/A)	There are exceedances of the endangered LOCs for vascular and non-vascular aquatic plants exposed to dimethenamid at 0.98 lb ai/A. However, there are no LOC exceedances for non-endangered aquatic plants.
	Terrestrial crop use on green onions (0.98 lb ai/A	There are exceedances of the non-endangered and endangered LOCs for aquatic plants (non-vascular and vascular) exposed to dimethenamid from ground spray at 0.98 lb ai/A.
	Terrestrial non-crop use on ornamentals (1.5 lbs ai/A x 2 appls with 42 day reapplication interval)	There are exceedances of the endangered and non-endangered LOCs for vascular and non-vascular aquatic plants exposed to dimethenamid at 1.5 lb ai/A applied via aerial and ground spray. For granular application, the LOCs for aquatic plants are exceeded, except for non-endangered non-vascular plants.

[1] includes granular, ground and aerial applications unless specified.

TABLE I-B2. Summary of Environmental Risk Conclusions for Terrestrial		
Risk Conclusion	**Use Patterns with LOC Exceedances**	**Summarized Risk Characterization**
Acute Risk to Birds (including terrestrial-phase amphibians and reptiles) from Ground and Spray Application	Terrestrial non-crop use on ornamentals (1.5 lbs ai/A x 2 appls with 42 day reapplication interval)	Acute, Acute Restricted use, and Endangered Species LOCs are exceeded for 20 g birds using the dose-based LD50 value and consuming short grass, tall grass, and broadleaf plants/small insects. Acute Restricted use and Endangered Species LOCs are exceeded for 100 g birds using the dose-based LD50 value and consuming short grass, tall grass, and broadleaf plants/small insects. Acute Endangered Species LOC is exceeded for 1000 g birds using the dose-based LD50 value and consuming short grass. No Acute LOCs are exceeded using the dietary-based LC50.
	Terrestrial crop use on grasses grown for seed and green onions (0.98 lb ai/A)	Acute Restricted Use and Endangered Species LOCs are exceeded for 20 g birds using the dose-based LD50 value and consuming short grass, tall grass, and broadleaf plants/small insects. Acute Endangered Species LOC is exceeded for 100 g birds using the dose-based LD50 value and consuming short grass. No Acute LOCs are exceeded using the dietary-based LC50.
Acute Risk to Birds (including terrestrial-phase amphibians and reptiles) from Granular Application	Terrestrial non-crop and crop use	Acute Risk, Acute Restricted use and Acute Endangered Species are exceeded for 20 g birds foraging on granules at both application rates and the Acute Endangered Species LOC is exceeded for 100 g birds foraging on granules following application at 1.5 lb ai/A.

TABLE I-B2. Summary of Environmental Risk Conclusions for Terrestrial		
Risk Conclusion	**Use Patterns with LOC Exceedances**	**Summarized Risk Characterization**
Chronic Risk to Birds (including terrestrial-phase amphibians and reptiles) from Ground and Spray Application	Terrestrial non-crop use on ornamentals (1.5 lbs ai/A x 2 appls with 42 day reapplication interval)	Using the dietary-based LC50, the Chronic Risk and Endangered Species LOCs are exceeded only for birds consuming short grasses at the maximum application rate and maximum predicted residues. No risks are observed for the other feed items (tall grasses; broadleaf forage/small insects; or fruit, pods, seeds, large insects).
	Terrestrial crop use on grasses grown for seed and green onions (0.98 lb ai/A)	No LOCs are exceeded for birds.
Acute Risk to Mammals from Spray and Ground Applications	None	The acute RQs for all weight classes of mammals consuming all feed types are less than the Level of Concern (LOC) indicating adverse effects are not expected from the spray (aerial or ground) or ground application of dimethenamid.
Acute Risk to Mammals from Granular Application	Terrestrial crop and non-crop use (1.5 and 0.98 lb ai/A)	The Acute Endangered Species Risk LOC is exceeded for 15 g mammals exposed to fertilizer impregnated granules at both application rates. The label requires that the granular application of impregnated fertilizer be incorporated into the soil to a depth of 1 to 2 inches; thus, over-estimating the potential exposure of mammals to the granules.
Chronic Risk to Mammals	Terrestrial crop and non-crop use (0.98 and 1.5 lb ai/A)	At both application rates (0.98 and 1.5 lbs ai/A) and maximum predicted residue levels, the dose-based RQs exceeded the Chronic Risk and Endangered Species LOCs for all weight classes of mammals (15, 35, 1000 g) consuming short grasses, tall grasses, and broadleaf forage/small insects. At 1.5 lb ai/A x 2 applications at 42 days interval and maximum predicted residue levels, the dietary-based RQ exceeded the Chronic Risk and Endangered Species LOCs for mammals consuming short grasses.
Risk to Non-target Invertebrates	None likely	Low toxicity to bees. Qualitative assessment indicates probable low risk.

TABLE I-B2. Summary of Environmental Risk Conclusions for Terrestrial		
Risk Conclusion	**Use Patterns with LOC Exceedances**	**Summarized Risk Characterization**
Risk to Terrestrial Plants	Terrestrial crop use on grasses grown for seed and onions (0.98 lb ai/A)	At the application rate of 0.98 lbs ai/A, the LOC is exceeded for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas primarily as the result of a combination of runoff and drift from ground and aerial applications. Runoff from granular formulations of dimethenamid (both unincorporated and incorporated) applied at 0.98 lbs ai/A also resulted in exceedances of the LOC for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas. The LOC is exceeded for non-endangered and endangered monocots located in dry areas as a result of spray drift alone from aerial applications at the 0.98 lbs ai/A application rate.
	Terrestrial non-crop use on ornamentals (1.5 lbs ai/A x 2 appls with 42 day reapplication interval)	At the maximum application rate of 1.5 lbs ai/A from aerial and ground application, the LOC is exceeded for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas primarily as the result of a combination of runoff and drift. Runoff from granular formulations of dimethenamid (both unincorporated and incorporated) applied at 1.5 lbs ai/A resulted in exceedances of the LOC for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas. The LOC is exceeded for non-endangered and endangered monocots located in dry areas as a result of spray drift alone from aerial applications at the 1.5 lbs ai/A application rates.

C. Conclusions – Exposure Characterization

Based on environmental fate properties measured in laboratory studies, dimethenamid is moderately persistent in the soil, has a high aqueous solubility and has limited partitioning to soil mineral or organic fractions (K_d: from 1.4 to 13.5 mL/g). It therefore meets the criteria for potential to leach to groundwater and it also may reach surface water through runoff. If the compound were to reach surface water, it may persist for a significant period of time due to the fact that it is stable to hydrolysis at pH 5, 7, and 9 and has limited photolysis. The major route of dissipation is through soil metabolism (aerobic $t_{1/2}$: 31 days; anaerobic $t_{1/2}$: 54 days). One major degradate (oxalamide) was formed through aerobic soil metabolism and three major degradates [M3 (dechlorinated parent), M10 (methyl sulfone derivative of M3), and M13 (methyl sulfoxide derivative of M3)] were formed through anaerobic aquatic metabolism. At application rates similar to the proposed new uses, terrestrial field studies found that dimethenamid dissipated with half-lives of 4 to 43 days with no leaching detected below 20 cm depth.

Routes of aquatic exposure evaluated in this screening risk assessment included deposition, runoff and spray drift from aerial and ground applications of dimethenamid and runoff from granular application of dimethenamid impregnated fertilizer. Tier II aquatic models PRZM/EXAMS (Ver. 3.12beta/2.98.04.06) simulate the transport of the pesticide off the field and its fate in surface water. They were used to estimate EECs in a standard pond based on the dimethenamid aerial and ground applications at the proposed maximum application rates of 0.98

lb ai/acre for the proposed new uses. Degradates were not considered in estimating aquatic exposure.

Routes of exposure for the terrestrial assessment of birds and mammals were developed using the T-REX (Ver.1.2.3) model to estimate dimethenamid residues on food types as the result of dimethenamid application. Likewise, EECs for non-target terrestrial plants were estimated for broadcast and aerial application using the TerrPlant (Ver.1.2.1) model in conjunction with AgDrift (Ver. 2.0.1). AgDrift provides further refinement of spray drift dispersion and deposition to plants located in proximity to treated areas. There are several reported incidents recorded in the Ecological Incident Information System (EIIS) of damage to terrestrial plants, primarily crops, from the direct use of dimethenamid.

D. Conclusions – Effects Characterization

Available acute toxicity data for aquatic species indicates that dimethenamid is moderately toxic to freshwater fish and marine/estuarine invertebrates and slightly toxic to marine/estuarine fish and freshwater invertebrates. Results of chronic studies with r/s-dimethenamid indicates that reduced larval growth in rainbow trout was observed at 0.24 mg/L and reduced survival and growth in daphnids was observed at 2.52 mg/L. Chronic values for s-dimethenamid were estimated using an acute to chronic ratio approach in order to determine the potential chronic risk to estuarine/marine fish and invertebrates.

S-dimethenamid is highly toxic to aquatic vascular plants, with an EC_{50} of 0.0089 mg/L for duckweed (NOAEC 0.0012 mg/L), based on reduction of frond biomass. Results of Tier II toxicity studies with non-vascular aquatic plants indicate that s-dimethenamid adversely affected cell density with EC_{50}'s ranging from 0.014 to 0.37 mg/L. The freshwater green algae were the most sensitive species with an NOAEC of 0.0021 mg/L.

Available acute toxicity data indicate that s-dimethenamid is slightly toxic to upland game birds by the oral route (LD_{50} 1,068 mg/kg-bw) and practically non-toxic to both upland game birds and waterfowl by the subacute dietary route (LC_{50} >5620 mg/kg-diet). Results of chronic studies with r/s-dimethenamid indicate that upland game birds are more sensitive, with adult male body weight being significantly decreased at 900 mg/kg-diet, resulting in a NOAEC of 360 mg/kg-diet. Eggshell thickness in bobwhite quail was significantly decreased at 1800 mg/kg-diet. No treatment-related effects were observed in mallards at the highest dose tested 1800 mg/kg-diet.

Acute and chronic toxicity data indicate that r/s-dimethenamid is practically non-toxic to mammals (acute LD_{50} value of 2,400 mg/kg bw; rat developmental toxicity NOAEC of 300 mg/kg/day; rat reproductive toxicity NOAEC of 500 mg/kg-diet). The only treatment-related toxicity observed in the 2-generation reproduction study with rats exposed to r/s-dimethenamid was reduced pup weight resulting in the NOAEC for offspring toxicity of 500 mg/kg-diet in males. Chronic values for s-dimethenamid were estimated using an acute to chronic ratio approach from testing with r/s-dimethenamid in order to determine the potential chronic risk to birds and mammals. Acute contact studies indicate that r/s-dimethenamid is practically non-toxic to honey bees (LD_{50} 94 µg/bee).

Terrestrial plant toxicity studies with monocots and dicots indicate that seedling emergence and vegetative vigor are severely impacted by exposure to s-dimethenamid. Seedling emergence, based on shoot length, was adversely impacted in monocots (ryegrass) at an EC_{25} of 0.0059 lb ai/A and in dicots (lettuce) with an EC_{25} of 0.0064 lb ai/A. Vegetative vigor in monocots, based on shoot weight, was adversely impacted at an EC_{25} of 0.026 lb ai/A in ryegrass. In dicots, s-dimethenamid was less toxic with an EC_{25} of 0.12 lb ai/A in cucumber, based on shoot length. Phytotoxic effects observed in the vegetative vigor study included chlorosis and necrosis.

E. Uncertainties and Data Gaps

There are a number of areas of uncertainty in the terrestrial and the aquatic organism risk assessment that could potentially cause an underestimation of risk. First, this assessment accounts only for exposure of non-target animals to dimethenamid, but not to its degradation products. The risks presented in this assessment could be underestimated if degradates also exhibit toxicity under the conditions of use as stated on the label as limited data are available concerning the toxicity of the degradates. Second, the risk assessment only considers the most sensitive species tested and only considers a subset of possible use scenarios. For the aquatic organism risk assessment, there are uncertainties associated with the PRZM/EXAMS models, input values, and the use of surrogate scenarios. The potential impacts of these uncertainties are outlined in the Aquatic Exposure, the Terrestrial Exposure and the Risk Characterization sections of this document.

Additional uncertainty results from the lack of information and/or data in several components of this ecological risk assessment, as follows.

It is noted that no toxicity information is available for the degradation products of dimethenamid.

Current data were not provided to determine the potential exposure to birds, mammals, and pollinators from residues on foliage, flowers, and seeds.

No field studies are available. Spray drift presents a potential risk to non-target plants inhabiting edge habitats adjacent to target fields and riparian vegetation along streams and/or ponds in close proximity to sprayed fields.

The LOCATES tool does has a crop analysis available for "green onions", however, does not have one available for "ornamentals" or "grasses grown for seed"; therefore, a list of nursery crops (*aquatic plants; bedding/garden plants; bulbs/corms/rhizomes/ tubers; christmas trees cut \ acres in production; floriculture crops - bedding/garden plants; cut flowers& florist greens; foliage and potted flowering plants; flowers and florist greens; foliage plants; greenhouse vegetable; nursery and greenhouse crops – other; nursery stock; nursery; floriculture; vegetable & flower seed crops; sod harvested; grown in the open; irrigated; greenhouse; floriculture; mushrooms; flower seeds; vegetable seeds; potted flowering plants; seeds – flower; vegetable seeds; and woody crops)* and grasses (*bentgrass; Kentucky bluegrass; fescue; orchardgrass; and ryegrass)* were selected for ornamentals and grasses grown for seed, respectively, located nationwide.

II. PROBLEM FORMULATION

The purpose of this ecological risk assessment (ERA) is to assist the Agency in evaluating the actions needed, if any, to address ecological risks associated with the registration of the selective pre-emergence herbicide, the active ingredient, dimethenamid which is used to control annual grasses, annual broadleaf weeds and sedges in crop-growing counties and non-crop sites.

A. Stressor Source and Distribution

1. Source and Intensity

The end use products, Outlook™ and Dimethenamid-P Ornamentals Herbicide, are liquid formulations consisting of 63.9% ai (6 pounds per gallon of the active isomer s-dimethenamid). Proposed new uses of Outlook™ are for use on grass grown for seed and green onions while the proposed new use of Dimethenamid-P Ornamentals Herbicide is on ornamentals. For green onions, dimethenamid can only be applied as ground broadcast. For grass grown for seed and ornamentals, dimethenamid can be applied via ground spray (broadcast or banded) or aerial spray or may be impregnated on granular fertilizer producing granular formulation products. For granular fertilizer applications, shallow (1-2 inches) soil incorporation of granules is required.

Ornamentals are grown throughout the United States in all kinds of environments. Therefore, the use of dimethenamid is likely to encompass a wide variety of ecosystems. The maximum seasonal application rate for use on ornamentals is three times higher than for any previously registered use. Dimethenamid may reach non target sites by spray drift, runoff, and/or erosion from adjacent agricultural sites.

2. Physical/Chemical/Fate and Transport Properties

The chemical structure of dimethenamid is shown below in Figure IIA-1. It has a chiral center and can be found as two enantiomers, r- or s-dimethenamid. S-dimethenamid is the herbicidally active isomer and is the active ingredient in the formulated products under consideration in this new use registration. The racemic mixture of r/s-dimethenamid (PC Code 129051) is currently registered in other end use products.

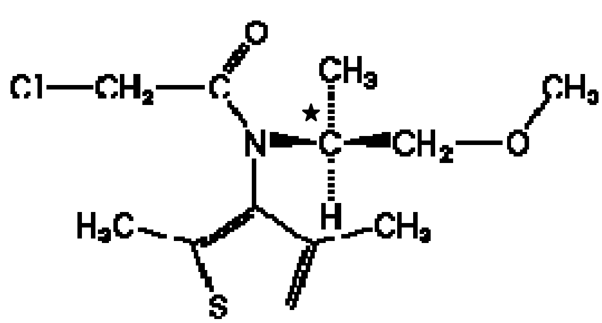

FIGURE IIA. 1. Chemical Structure of Dimethenamid. Star denotes chiral center.

A summary of selected physical and chemical properties and environmental fate properties for s-dimethenamid is presented in Table IIA-1. For some of the parameters, data were not available for the s-isomer and the reported values are based on measurements of the racemic mixture instead. Physical properties of enantiomers are expected to be similar, and laboratory studies have shown that in this case, degradation rates and pathways for the racemic mixture and the purified s-isomer are similar as well. In past assessments, EFED agreed to consider data generated for r/s-dimethenamid to fulfill certain data requirements for the purified s-isomer.

TABLE II-A1. Some Physical, Chemical and Environmental Fate Properties of s-Dimethenamid

Physical and Chemical Properties		
Chemical name	s-dimethenamid (2-chloro-N-(1-methyl-2-methoxy)ethyl)-N-(2,4-dimethy-thien-3-yl) acetamide	
Empirical Formula	$C_{12}H_{18}ClNO_2S$	
Molecular Weight	275	
Aqueous Solubility at 25°C	1,449 ± 17 µg/mL	(MRID 443322-14)
K_{ow} [1]	141 ± 6 @ 25° C	(MRID 415965-11)
Vapor Pressure at 25°C	1.88×10^{-5} mm Hg	(MRID 443322-15)
Henry's Law Constant at 25°C [1]	8.52×10^{-8} atm-m^3/mole	(DP Barcode 285445)
Dissociation Constant [1]	none between pH 1 and pH 11	(MRID 415965-10)
Environmental Fate Properties		
Hydrolysis half life (pH 5, 7, and 9)	Stable	(MRID 443322-58)
Aqueous photolysis half-life [2]	50.4 days	(MRID 443322-59)
Soil photolysis half-life [2]	89.4 days	(MRID 443322-60)
Aerobic soil metabolism half-life	31 days	(MRID 443322-61)
Anaerobic soil metabolism half-life[1]	54 days	(MRID 417068-01)
Anaerobic aquatic metabolism half-life[1]	36 days	(MRID 423672-10)
Soil-water distribution coefficients (K_d)	range: 1.4 to 13.5 mL/g	(MRID 443322-63)

[1] These data were measured on the R/S isomer mixture. No data are available for the S isomer alone.
[2] Photolysis half-lives are estimated for a 12 hour light/12 hour dark cycle.

In soil, the primary route of dissipation for s-dimethenamid is aerobic soil metabolism, which occurs at a moderate rate. Similar moderate rates of biodegradation occurred in anaerobic conditions. Limited partitioning to soil mineral or organic fractions was observed. Based on these properties, s-dimethenamid in soil is expected to be moderately persistent with high mobility. In aqueous environments, s-dimethenamid has high solubility, is stable to hydrolysis, and has limited aqueous photolysis. S-dimethenamid that reaches surface water may persist for a significant amount of time.

Major degradates of dimethenamid, seen in laboratory studies at ≥10%, include M23 (oxalamide), from aerobic soil metabolism, and M3 (dechlorinated parent), M10 (methyl sulfone derivative of M3), and M13 (methyl sulfoxide derivative of M3), from anaerobic aquatic metabolism. The structures and complete chemical names of these compounds are provided in Appendix B. Multiple minor degradates (<10% of applied) are seen in laboratory studies.

3. Pesticide Type, Class, and Mode of Action

Dimethenamid is a chloroacetamide herbicide (protein synthesis inhibitor) that is used for control of germinating seeds and very small emerged seedlings of many annual grasses and few small-seeded broadleaf species. Treated seeds usually germinate, but the seedlings either do not emerge from the soil or emerge and exhibit abnormal growth due to inhibition of cell elongation and cell division. Chloroacetamides have been reported to inhibit the synthesis of lipids, fatty acids, leaf waxes, terpenes, flavoniods and proteins as well interfere with hormone regulation. Uptake of chloroacetamides herbicides is primarily through the shoots (especially monocots) and roots (especially dicots). The primary anatomical sites of action are the developing leaves beneath the coleoptile and the apical and intercalary meristems near the coleoptilar mode. In addition, chloroacetamides are metabolized in plants.

4. Overview of Pesticide Usage

Dimethenamid herbicide is a liquid formulation consisting of 63.9% or 6 pounds per gallon of the active isomer s-dimethenamid, can be applied with liquid fertilizer, may be impregnated on granular fertilizer producing a granular formulation, and is also generally compatible with other herbicides. Outlook™ herbicide is a selective pre-plant surface, pre-plant incorporated, pre-emergence, or post-emergence herbicide for controlling annual grasses, annual broadleaf weeds, and sedges. It is currently registered for use in beets (sugar, table (garden)), bulb vegetables (dry bulb onions, garlic, dry bulb shallots), corn (field, pop, seed, and sweet), dry bean, potato, sweet potato, horseradish, tuberous and corm vegetables, peanut, grain sorghum, and soybean crops. Proposed new uses of Outlook™ herbicide are for control of weeds in grasses grown for seeds and green onions.

Dimethenamid-P Ornamentals Herbicide is a new end use product proposed for use as a pre-emergence herbicide in landscape or grounds maintenance and ornamental production. The maximum seasonal application rate for this product is three times higher than any previously registered use. A summary of registered and proposed uses of dimethenamid is provided in Table IIA-2.

TABLE II-A 2. Current and Proposed Uses for Dimethenamid						
Use Sites	**Timing**	**Maximum Application Rate[3] (lb ai/acre)**	**Maximum # of Appls. per Year**	**Minimum # of Days Between Applications**	**PHI[5] (day)**	**Maximum Seasonal Appl. Rate (lb ai/acre)**
			Proposed New Uses			
Grasses[1] (grown for seed)	postemergence (fall treatment)	0.98	1	n/a[4]	ns[6]	0.98
Green Onions[1]	Postemergence	0.98	1-2	sequential	30	0.98
Ornamentals[2]	preemergence	0.98 - 1.5	1-2	42	ns	3.0
			Registered Uses[3]			
Beets	Postemergence	0.84 - 0.98	1-2	ns	ns	0.98
Bulb Vegetables	Postemergence	0.98	1-2	sequential	30	0.98
Corn	preplant surface; preplant incorporated; preemergence or postemergence	ns	ns	ns	50	0.98
Dry Bean	preplant surface; preplant incorporated; preemergence or postemergence	0.56 - 0.98	1-2	ns	70	0.98
Peanut	preplant surface; preplant incorporated; preemergence or postemergence	0.98	1-2	sequential	80	0.98
Potato, Sweet Potato, and Horseradish	Preemergence	0.98	1	n/a	40	0.98
Tuberous and Corm Vegetables	Preemergence	0.98		n/a	40	0.98
Sorghum (grain)	preplant surface; preplant incorporated; preemergence or postemergence	0.98	1-2	sequential	80	0.98
Soybean	preplant surface; preplant incorporated; preemergence or postemergence	0.98	1-2	sequential	ns	0.98

[1] Information from proposed supplemental product labels for Outlook™ (BASF, 2004; Reg. No. 7969-156)
[2] Information from proposed product label for Dimethenamid-P Ornamentals Herbicide (BASF, 2005; 7969-xxx)
[3] For all currently registered uses except for sugar beets, application rates vary by soil texture and organic matter. Soil texture groupings used in this label are **coarse** (sand, loamy sand, sandy loam), **medium** (silt, silt loam, loam, sandy clay loam), and **fine** (sandy clay, silty clay loam, clay loam, and clay). For the proposed new uses, the crop-specific label application information does not limit the application rate by soil types.
[4] Not applicable
[5] Pre-harvest Interval
[6] Not specified

B. Receptors

Registrant-submitted toxicological studies with representative test species will be utilized for this screening level risk assessment for dimethenamid (Table II-B1). Within each broad taxonomic group, an acute and/or chronic measure of effect is selected from the available test data. A complete discussion of all toxicity data available for this risk assessment for dimethenamid and the resulting measurements of effect selected for each taxonomic group are included in Section III.C and Appendix F.

TABLE II-B 1. Taxonomic groups and test species evaluated for ecological effects in screening-level risk assessments.

Taxonomic group	***Example(s) of representative species***
Birds [a]	Mallard duck (*Anas platyrhynchos*) Bobwhite quail (*Colinus virginianus*)
Mammals	Laboratory rat (*Sprague-Dawley*)
Insects[b]	Honey bee (*Apis mellifera L.*)
Freshwater fish [c]	Bluegill sunfish (*Lepomis macrochirus*) Rainbow trout (*Oncorhynchus mykiss*)
Freshwater invertebrates	Water flea (*Daphnia magna*)
Estuarine/marine fish	Sheepshead minnow (*Cyprinodon variegatus*)
Estuarine/marine invertebrates	Eastern oyster (*Crassostrea virginica*) Mysid (*Americamysis bahia*)
Terrestrial plants [d]	Monocots – onion, oat, corn, ryegrass Dicots – cabbage, turnip, cucumber, lettuce, soybean, tomato
Aquatic plants and algae	Duckweed (*Lemna gibba*) Green algae (*Selenastrum capricornutum*) Blue-green algae (*Anabaena flos-aquae*) Freshwater Diatom (*Navicula pelliculosa*) Marine Diatom (*Skeletonema costatum*)

[a]Birds represent surrogates for amphibians (terrestrial phase) and reptiles.
[b]Honey bee data provides an additional line of evidence for terrestrial invertebrates
[c] Freshwater fish may be surrogates for amphibians (aquatic phase).
[d]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.

1. Aquatic Effects

Spray drift and runoff to adjacent bodies of water are the most likely sources of dimethenamid exposure to nontarget aquatic animals, including endangered and threatened species. Dimethenamid has a high aqueous solubility and does not partition to soil mineral or organic fractions; thus, runoff and leaching to groundwater may occur. If the compound were to reach surface water it may persist for a significant period of time due to the fact that it is stable to hydrolysis at pH 5, 7, and 9. Dimethenamid is not expected to bioaccumulate in aquatic animals or to adsorb to sediments; consequently risk to benthic-dwelling animals should be minimal.

For dimethenamid, effects on aquatic animals are estimated from acute and chronic laboratory studies submitted to the Agency. Acute data are available for freshwater fish (rainbow trout (*Oncorhynchus mykiss))* and bluegill sunfish (*Lepomis macrochirus*); marine/estuarine fish (sheepshead minnow (*Cyprinidon variegates)*), freshwater invertebrates (water flea (*Daphnia* *magna*)); and marine/estuarine invertebrates (mysid shrimp (*Americamysis bahia*) and eastern oyster (*Crassostrea virginica*)). Reproductive or growth effects from chronic exposure are estimated from studies conducted with freshwater fish (rainbow trout) and freshwater invertebrates (water flea). No data are available to evaluate chronic effects on estuarine/marine fish and invertebrates; however, EFED grants the waiver based on no LOC exceedances for acute or chronic risks to freshwater fish and invertebrates estimated via the acute to chronic ratio method.. Toxicity data are available to evaluate the effects of dimethenamid to aquatic vascular (duckweed – *Lemna gibba)* and non-vascular plants (algae and diatoms).

2. Terrestrial Effects

Ground deposition, spray drift, and wind erosion of soil particles with resulting residues on foliage and on flowers and seeds are the most likely sources of dimethenamid exposure to nontarget terrestrial animals, including endangered and threatened species. In addition, uptake in plant shoots (monocots) and roots (dicots) would be expected to occur. Current data were not provided to determine the potential exposure to birds, mammals, and pollinators from residues on foliage, flowers, and seeds. An additional source of exposure to dimethenamid could be in puddled water on treated fields through preening and grooming, involving the oral ingestion of material from the feathers or fur. Dimethenamid is moderately persistent in the soil and will be applied as a granule; thus, risks from exposure to birds, small mammals, and soil invertebrates through dermal contact or ingestion of soils may occur. Exposure to dimethenamid via inhalation would be expected to be low due to its low vapor pressure. The effect of dimethenamid on all bird species is estimated from acute, subacute and chronic studies on two species, bobwhite quail (*Colinus virginianus*) and mallard duck (*Anas platyrhynchos*). These species also act as surrogates for reptiles and terrestrial-phase amphibians. Effects on mammals are estimated from acute and chronic rat studies reviewed by the Registration Division (RD) and Health Effects Division (HED).

Spray drift presents a potential risk to non-target semi-aquatic and terrestrial plants inhabiting edge habitats adjacent to target fields and riparian vegetation along streams and/or ponds in close proximity to sprayed fields. In addition, uptake in plant shoots and roots could occur through ground spray application. Studies (seedling emergence and vegetative vigor) were submitted to evaluate the effects of dimethenamid to terrestrial monocots and dicots.

3. Ecosystems at Risk

The terrestrial ecosystems potentially at risk include the treated area and areas immediately adjacent to the treated area that might receive spray drift, runoff, or wind-erosion of soil particles, and might include other cultivated fields, fence rows and hedgerows, meadows, fallow fields or grasslands, woodlands, and other uncultivated areas. For both terrestrial and aquatic animal species, direct and indirect acute and chronic exposures are considered. Risk will be assessed to terrestrial plants assumed to exclusively occur in areas immediately adjacent to, and in wetlands receiving runoff from treated areas. In addition to terrestrial plants, indirect risks to animals will also be addressed with the endangered species analysis.

The labeled uses of dimethenamid could result in exposure to aquatic and terrestrial animals and plants inhabiting flowing, non-flowing or transient freshwater/marine waterbodies, wetlands and transitional areas, and to wildlands (forests and ecotones, such as edge and riparian habitats). For uses in coastal areas, aquatic habitat also includes marine ecosystems including estuaries.

For Tier 1 assessment purposes, risk will be assessed to aquatic animals and plants assumed to occur in small, static ponds receiving runoff and drift from treated areas. Dimethenamid is readily absorbed through the shoot and roots of plants; consequently, it could be injurious to non-target plant species by drift, runoff, or leaching to roots. Damage to non-target plants may be sufficient to prevent the plant from competing successfully with other plants for resources and water.

C. Assessment Endpoints

A summary of the assessment and measurement endpoints selected to characterize potential ecological risks associated with exposure to dimethenamid are summarized in Table II-C1. The ecological relevance of selecting these assessment endpoints is as follows: 1) complete exposure pathways exist for these receptors; 2) the receptors may be potentially sensitive to pesticides in affected media and in residues on plants, seeds, and insects; and 3) the receptors could potentially inhabit areas where pesticides are applied or areas where runoff and/or drift may impact the sites.

This ecological risk assessment considers single application at the maximum dimethenamid application rates to sites that have vulnerable soils to estimate exposure concentrations. This assessment is not intended to represent a site- or time-specific analysis. Instead, it is intended to represent high-end exposures at a national level. Likewise, the most sensitive toxicity endpoints are used from surrogate test species to estimate treatment-related direct effects on acute mortality and chronic reproductive, growth and survival assessment endpoints. Toxicity tests are intended to determine effects of pesticide exposure on birds, mammals, fish, terrestrial and aquatic invertebrates, and terrestrial and aquatic plants. These tests include short-term acute, subacute, and reproduction studies and are typically arranged in a hierarchical or tiered system that progresses from basic laboratory tests to applied field studies. The toxicity studies 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). A summary of measurements of effect selected to characterize potential ecological risks associated with exposure to dimethenamid are provided in Table II-C1.

In order to protect threatened and endangered species, all assessment endpoints are measured at the individual level. Measuring endpoints at the individual level also provides insight about risks at higher levels of biological organization (e.g. populations and communities). For example, pesticide effects on individual survivorship have important implications for both population growth increase and habitat carrying capacity.

TABLE II-C 1. Summary of Assessment Endpoints and Measures of Ecological Effects	
Assessment Endpoint	**Measures of Ecological Effect**
1. Abundance (i.e., survival, reproduction, and growth) of individuals and populations of birds	1a. Bobwhite quail acute oral LD_{50} 1b. Bobwhite quail and mallard duck subacute dietary 5-day LC_{50} 1c. Bobwhite quail and mallard duck chronic reproduction NOAEC and LOAEC
2. Abundance (i.e., survival, reproduction, and growth) of individuals and populations of mammals	2a. Laboratory rat acute oral LD_{50} 2b. Laboratory rat oral reproduction and developmental chronic NOAEC and LOAEC
3. Survival and reproduction of individuals and communities of freshwater fish and invertebrates	3a. Rainbow trout and bluegill sunfish acute LC_{50} 3b. Rainbow trout chronic (early life-stage) NOAEC and LOAEC 3c. Water flea (and other freshwater invertebrates) acute EC_{50} 3d. Water flea chronic (life cycle) NOAEC and LOAEC
4. Survival and reproduction of individuals and communities of estuarine/marine fish and invertebrates	4a. Sheepshead minnow acute LC_{50} (no study available) 4b. Fish chronic value (early life-stage) NOAEC and LOAEC estimated by acute to chronic ratio approach 4c. Eastern oyster acute EC_{50} and mysid acute LC_{50} 4d. Invertebrate chronic NOAEC and LOAEC estimated by acute to chronic ratio approach
5 Perpetuation of individuals and populations of non-target terrestrial plant species (crops and non-crop plant species)	5a. Monocot and dicot seedling emergence and vegetative vigor EC_{25}, EC_{05}, and NOAEC values
6. Survival of beneficial insect populations	6a. Honeybee acute contact LD_{50}
7. Maintenance and growth of individuals and populations of aquatic plants from standing crop or biomass	7a. Algal and vascular plant (i.e., duckweed) EC_{50} and NOAEC values for growth rate and biomass measurements

LD_{50} = Lethal dose to 50% of the test population.
NOAEC = No observed adverse effect concentration.
LOAEC = Lowest observed adverse effect concentration.
LC_{50} = Lethal concentration to 50% of the test population.
EC_{50}/EC_{25} = Effect concentration to 50%/25% of the test population.

D. Conceptual Model

1. Risk Hypotheses

Risk hypotheses are specific assumptions about potential adverse effects (i.e. changes in assessment endpoints) and may be based on theory and logic, empirical data, mathematical models, or probability models (EPA, 1998). For this assessment, the risk is stressor-linked, where the stressor is the release of dimethenamid to the environment. The following risk hypothesis is presumed for this screening level assessment.

The use of dimethenamid as an herbicide in terrestrial crop and non-crop sites will likely involve situations where terrestrial and aquatic animals and plants will be exposed to the chemicals. Based on the mobility and persistence of dimethenamid, the mode of action, and the food-web of the target aquatic and terrestrial ecosystems, dimethenamid has the potential to cause reduced survival, and reproductive and growth impairment for both terrestrial and aquatic animals and plant species.

2. Conceptual Model

All potential routes of exposure are considered and presented in the conceptual model. The conceptual model shown in Figure II-D1 for ground and aerial spray applications generally depicts the potential sources of dimethenamid, release mechanisms, abiotic receiving media, biological receptor types, and effects endpoints of potential concern. Also, a conceptual model was developed for the application of dimethenamid after it is impregnated on fertilizer to produce a granular form (Figure II-D2).

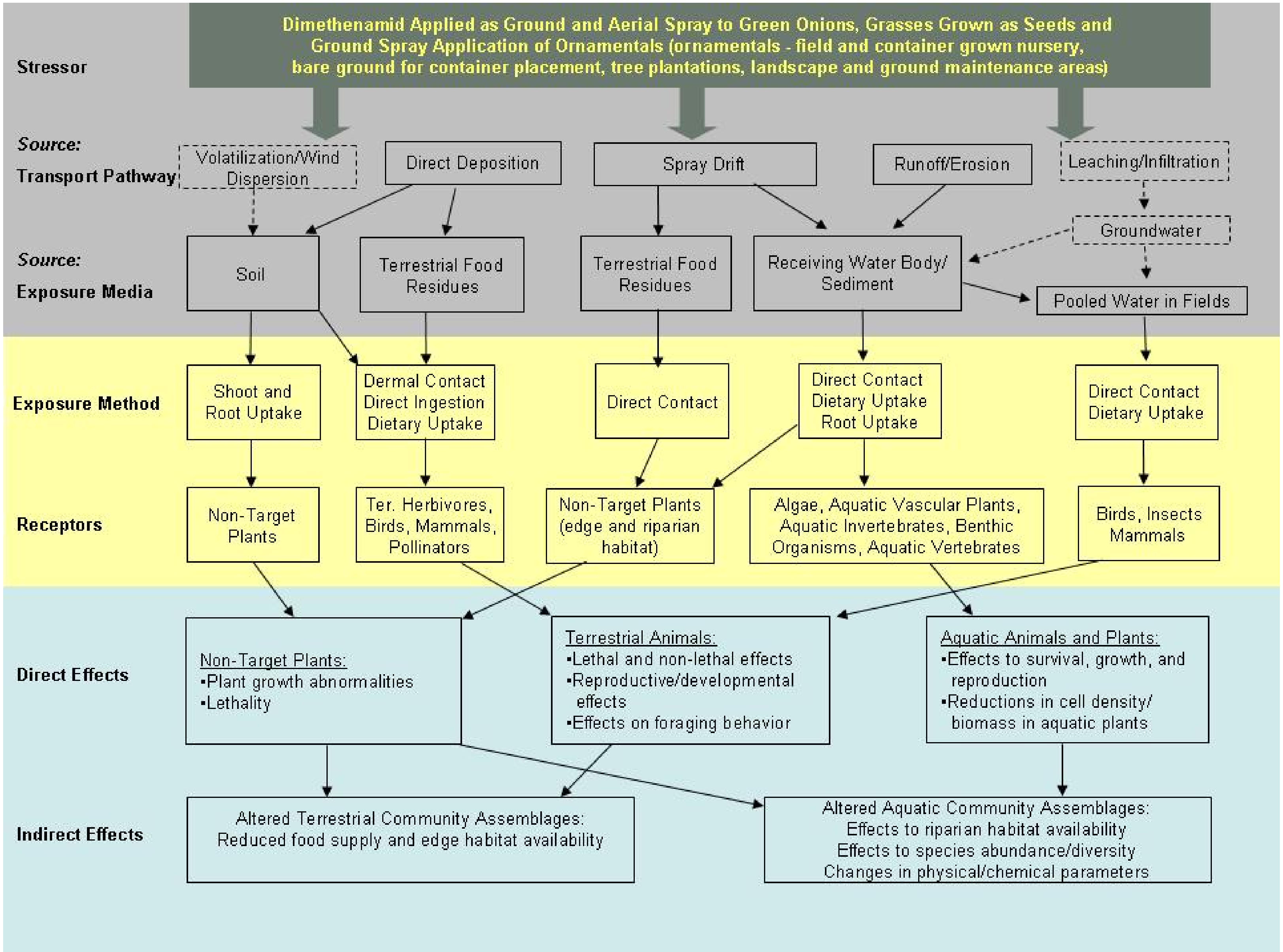

FIGURE II D 1. Ecological Risk Assessment Conceptual Model for Dimethenamid (terrestrial non-granular uses)

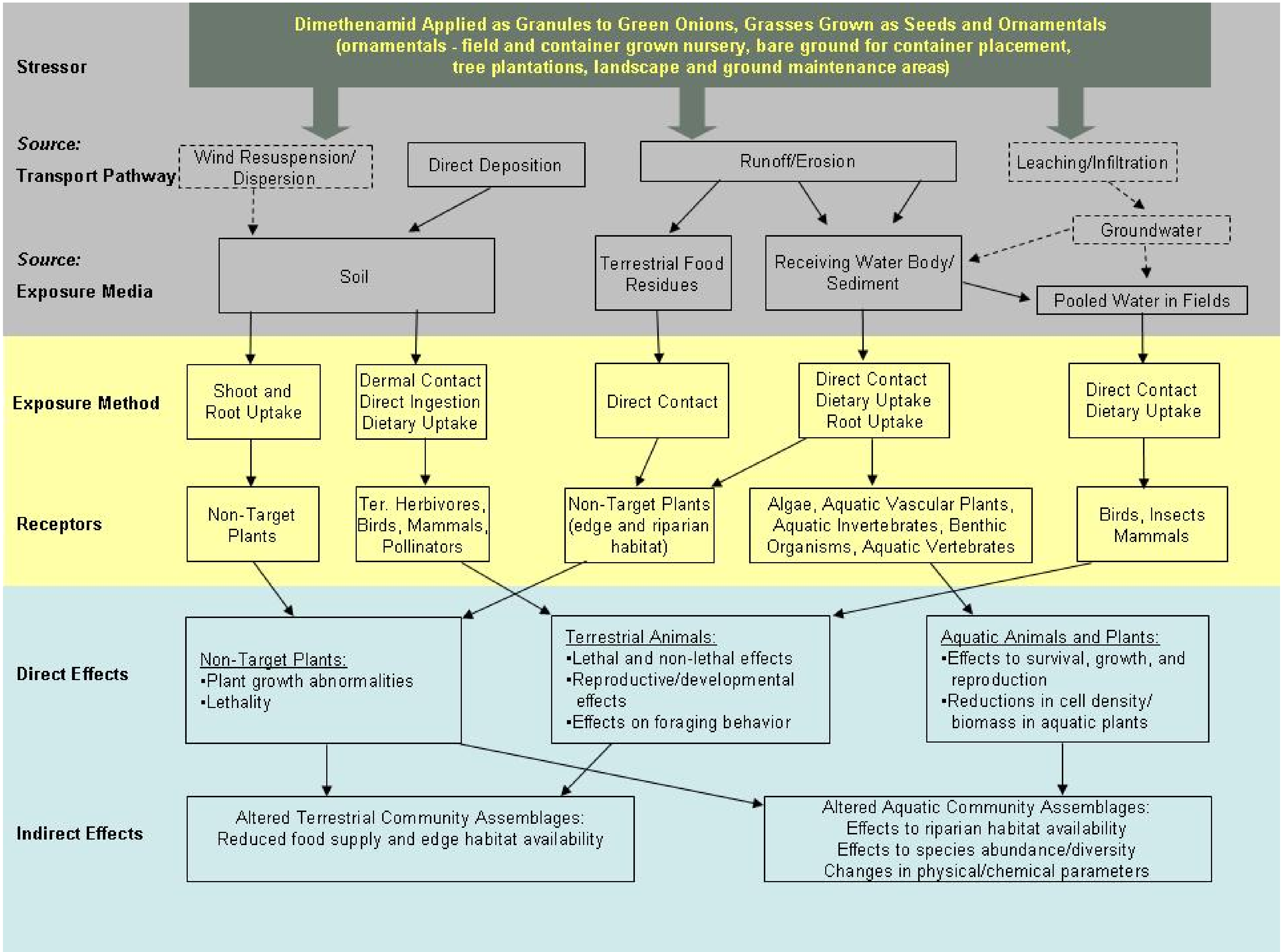

FIGURE II D 2. Ecological Risk Assessment Conceptual Model for Dimethenamid (terrestrial granular uses

E. Analysis Plan

The Agency's new use science chapter for dimethenamid consists of a deterministic screening level risk quotient analysis. The aquatic and terrestrial assessments focus on the proposed agricultural and non-agricultural use of dimethenamid for weed control in green onions, grasses grown for seed and ornamentals. Potential exposure pathways (i.e., runoff and spray drift) result from ground and aerial application of aqueous dimethenamid formulations as well as granular formulations where dimethenamid is impregnated on fertilizer before application.

The Agency reviewed the available laboratory environmental fate data submitted in support of the proposed new use of dimethenamid to determine dimethenamid persistence and mobility. Based on this data, the Agency developed its quantitative aquatic assessment of dimethenamid exposure using the PRZM/EXAMS model (version 3.12/2.98) to represent potential dimethenamid use areas. Likewise, terrestrial wildlife may be exposed to dimethenamid through the plant or animal material that they contact or consume as food. For ground and aerial spray applications of dimethenamid, exposure to terrestrial wildlife was estimated by relating food item residues to pesticide application using the Kenaga nomogram as modified by Fletcher (Hoerger and Kenaga, 1972; Fletcher *et al.*, 1994). A computer model (T-REX, Version 1.2.3) was used to predict degradation of residues on foliar surfaces and insects. For mammals, the residue concentration was converted to a daily oral dose based on fractions of body weight consumed daily. In addition, exposure to birds and mammals from granular applications of dimethenamid was assessed using the LD_{50} ft^2 calculations (100% unincorporation) in the T-REX model. Terrestrial non-target plant exposure characterization employed runoff and spray drift scenarios based on dimethenamid use and were estimated using OPP's TerrPlant model (Version 1.2.1) as well as the AgDrift 2.0.1 model to provide further refinement of spray drift dispersion and deposition to terrestrial plants located in proximity to treated fields.

The most sensitive aquatic and terrestrial eco-toxicological values from studies submitted to the Agency were used in this quantitative assessment. Risks were estimated based on a deterministic approach, where a single point estimate of toxicity is divided by an exposure estimate to calculate a risk quotient (RQ). The acute and chronic RQ values for each taxonomic group identified as an assessment endpoint were compared to the Agency's Levels of Concern (LOCs). LOCs serve as criteria for categorizing potential risk to non-target animals. RQ values were calculated in the risk estimation section for each endpoint, and characterization and interpretation of risk is described in the risk description. Risks for each taxonomic group were described based on available lines of evidence from registrant-submitted studies, open literature, and incident reports. In addition, a preliminary assessment of listed species of concern was also completed.

1. Preliminary Identification of Data Gaps and Methods

Environmental fate data for s-dimethenamid and r/s-dimethenamid is mostly complete with the exception of aerobic aquatic metabolism information. Studies indicate that dimethenamid is moderately persistent in aerobic soils and anaerobic aquatic environments and mobile in aquatic environments, thus aerobic aquatic metabolism information is needed to determine its persistence in aquatic environments.

Likewise, the toxicity data for s-dimethenamid and r/s-dimethenamid are mostly complete. Toxicity data are available for either the herbicidally active isomer or the racemic mixture of dimethenamid. Data are not available to determine potential chronic toxicity to marine/estuarine fish and invertebrates; however, EFED has waived these studies.

The following uncertainties and information gaps were identified as part of the problem formulation:

- It is noted that no toxicity information is available for the degradation products of dimethenamid.

- Current data were not provided to determine the potential exposure to birds, mammals, and pollinators from residues on foliage, flowers, and seeds.

- Terrestrial plant exposure modeling is limited to one application. Consequently, the estimated exposure concentrations may underestimate risk from multiple applications to non-target plants located adjacent to treated areas.

- No field studies are available. Spray drift presents a potential risk to non-target plants inhabiting edge habitats adjacent to target fields and riparian vegetation along streams and/or ponds in close proximity to sprayed fields.

- Dermal contact and soil ingestion pathways for terrestrial mammals and birds were not evaluated because these routes of exposure are not considered in deterministic risk assessments. Uncertainties associated with exposure pathways for terrestrial animals are discussed in detail in Section 4.4.3.

- Risks to semiaquatic wildlife via consumption of pesticide-contaminated fish were not evaluated. However, given that bioaccumulation of dimethenamid is expected to be low, ingestion of fish by piscivorus wildlife is not likely to be of concern.

- Risks to top-level carnivores were not evaluated due to a lack of data for these receptors. Ingestion of grass, plants, fruits, insects, and seeds by terrestrial wildlife was considered; however, consumption of small mammals and birds by carnivores was not evaluated. In addition, food chain exposures for aquatic receptors (i.e., fish consumption of aquatic invertebrates and/or aquatic plants) were also not considered.

- Surrogates were used to predict potential risks for species with no data (i.e., reptiles and amphibians). It was assumed that use of surrogate effects data is sufficiently conservative to apply to the broad range of species within taxonomic groups. If other species are more or less sensitive to dimethenamid than the surrogates, risks may be under or overestimated, respectively.

2. Measures to Evaluate Risk Hypotheses and Conceptual Model

a. Measures of Exposure

Aquatic Animals and Plants

Based on the conceptual models presented in Figures II.D1 and II.D2 above, the potential exposure pathways by which dimethenamid may inadvertently affect non-target plant and animal populations in aquatic areas include: drift during aerial and ground application, and runoff/leaching of contaminated water from treated areas to untreated areas. In semi-aquatic areas, the exposure routes are: drift during application, runoff events (off-site movement of contaminated water), and wind erosion of contaminated soil particles. There may be exposure to non-target terrestrial plants adjacent to treated areas via drift and runoff from transitional sites or wetlands which may be dry during certain periods, or via wind-blown treated soil particles from those pathways for aquatic species.

As part of the aquatic assessment for terrestrial uses, EFED modeled exposure concentrations of dimethenamid to non-target aquatic animals and plants from application of dimethenamid following labeled use information. EECs were determined using Tier II model PRZM-EXAMS to estimate exposure to aquatic animals and emerged/floating plants inhabiting shallow-water aquatic communities that receives runoff during rainfall events and/or drift from adjacent use sites. Peak, 96-hour, 21-day, and 60-day concentrations were used to estimate risk to aquatic animals and plants.

The PRZM-EXAMS model simulates the transport of the pesticide off the field and estimates pesticide concentrations in surface waters. Maximum seasonal application rates of 3.0 lb ai/A (ornamentals) and 0.98 lb ai/A (grasses grown for seeds and green onions) were modeled, as listed on the labels for the three proposed new uses (see Table IIA-2).

Terrestrial Animals and Plants

The potential exposure pathways for terrestrial plants and animals include deposition from ground and aerial spray applications, ingestion of granules, runoff/leaching from treated areas, spray drift, and wind erosion of soil particles resulting in residues on non-target animals as well as residues on food items for non-target animals. As part of the terrestrial assessment, EFED modeled exposure concentrations of dimethenamid to non-target terrestrial plants and animals following the ground, aerial, and granule application rates provided by the registrant for terrestrial uses (Table IIA-2). Similar to the aquatic assessment, a maximum (3.0 lb ai/A) and minimum (0.98 lb ai/A) ground and granular application rate for dimethenamid use on terrestrial sites was modeled using T-REX (Ver 1.2.3.) to estimate dimethenamid residues on various food items which may be contacted or consumed by wildlife.

As part of the terrestrial assessment for terrestrial use patterns, EFED modeled EECs of dimethenamid to non-target terrestrial plants from application to terrestrial non-cropped and cropped areas. EECs were evaluated for ground, aerial and granular applications of dimethenamid at the maximum application rates using the TerrPlant 1.2.1 model. EEC calculations were used to estimate exposure to terrestrial plants inhabiting terrestrial communities that receives runoff from a treated acre to an adjacent acre (1:1 ratio) inhabited by plants. Runoff to semi-aquatic areas inhabited by terrestrial plants is assumed from 10 treated acres to a distant low-lying acre (10:1 ratio). Also, the AgDrift 2.0.1 model provided further refinement of spray drift dispersion and deposition to terrestrial plants located in proximity to sites treated with dimethenamid.

b. Measures of Effect

Measures of ecological effects are obtained from a suite of registrant-submitted guideline studies conducted with a limited number of surrogate species on dimethenamid. The test species are not intended to be representative of the most sensitive species but rather were selected based on their ability to thrive under laboratory conditions. Consistent with EPA test guidelines, a suite of ecological effects data on technical grade dimethenamid that complies with good laboratory testing requirements has been submitted. These data are summarized in Section III.C and in Appendix F.

As stated above, toxicity testing does not represent all species of birds, mammals, or aquatic animals. Only a few surrogate species for both freshwater fish and birds 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. Estuarine/marine testing is usually limited to a crustacean, a mollusk, and a fish. Also, neither reptiles nor amphibian data are available. The risk assessment assumes that avian and reptilian toxicities are similar. The same assumption is used for fish and amphibians.

c. Measures of Ecosystem and Receptor Characteristics

Although not required, field studies would assist in determining indirect effects to plant and animal communities in wetland and riparian habitats along freshwater/marine waterbodies near sprayed fields or to forest and edge habitats adjacent to target fields or sites. An evaluation of modeled EECs and calculated RQs will determine if direct effects to receptor species could result in effects at the higher levels of organization (i.e. population, trophic level, community, and ecosystem). In terrestrial and shallow-water aquatic communities, plants are the primary producers upon which the succeeding trophic levels depend. If the available plant material is impacted due to the effects of dimethenamid, this may have adverse effects not only on the herbivores, but throughout the food chain. Also, depending on the severity of impacts to the plant communities in the adjacent forests, wetlands, and ecotones (edge and riparian edge habitats), community assemblages and ecosystem stability may be altered (i.e. reduced production of fruits and seeds as a food source for bird and mammal populations in forest and edge habitats, reduced riparian vegetation resulting in increased light penetration and temperature in aquatic habitats, loss of cover and food sources for fish; reduced productivity/biomass in wetlands). In addition, riparian vegetation is not only a significant component of the food supply for aquatic herbivores and detritivores but also provides habitat (i.e. leaf packs, materials for case-building for invertebrates).

For the Tier II aquatic assessment using PRZM-EXAMS and the Tier I terrestrial assessment using T-REX, the ecosystems that are modeled are intended to be generally representative of any aquatic or terrestrial ecosystem associated with areas where dimethenamid is used. For aquatic assessment, generally fish and aquatic invertebrates in both freshwater and estuarine/marine environments are represented. For terrestrial assessments, three different size classes of small mammals and birds are represented, along with four potential foraging categories.

III. ANALYSIS

A. Use Characterization

BASF is seeking registration of new uses for the herbicide dimethenamid, a root and shoot growth inhibitor that controls susceptible germinating seedlings before or soon after they emerge from the soil. There are a number of currently registered uses for Outlook™, a liquid formulation containing 63.9% dimethenamid, as described in Section II A-4. This ecological risk assessment focuses exclusively on the proposed new uses in green onions, grasses grown for seeds and ornamentals.

Outlook™ is proposed for new uses in grasses grown for seed and in green onions. The use on grasses grown for seeds includes established stands of bentgrass, Kentucky bluegrass, fine fescues, tall fescue, orchardgrass, and perennial ryegrass grown for seed. The green onion use includes leeks, spring onions or scallions, Japanese bunching onions, green shallots or green eschalots.

In addition to the proposed new uses of Outlook™, BASF has requested registration of a new product, Dimethenamid-P Ornamentals Herbicide, also a liquid formulation containing 63.9% dimethenamid. Dimethenamid-P Ornamentals Herbicide is proposed for use in landscape or grounds maintenance and ornamental production. This use includes several categories:

- Field, liner, or container nurseries; tree plantations; non-production areas in commercial nurseries
- Landscaped ornamental areas (residential and commercial establishments, multifamily dwellings, military and other institutions, university or college campuses, parks, airports, roadsides, schools, picnic grounds, athletic fields, houses of worship, golf courses, cemeteries, prairie grass areas)
- General maintained areas (parking lots, driveways, rights-of-way, bikes & jogging paths, vacant lots, buildings, stone gardens & gravel yards, around statuary or monuments, utility sub-stations, fence lines, mulch beds, and other similar areas)

Proposed maximum use rates are as follows;

Green onions: 0.98 lb ai/acre/season, applied post-emergence. May be used in a split application using 1/2 to 2/3 the maximum rate and the remaining 1/2 to 1/3 in sequential application. Label permits application by broadcast ground spray.

Restrictions: Do not exceed a total of 0.98 lb ai/A/season. Do not apply within 30 days of harvest.

Grasses grown for seeds: 0.98 lb ai/acre/application. Single application recommended in the fall for weed suppression. Label permits ground (broadcast and banded) and aerial application as well as a formulation of active ingredient impregnated in granular fertilizer.

Restrictions: Do not exceed a total of 0.98 lb ai/A/season.

Ornamentals: 0.98 - 1.5 lbs ai/acre/application. May be used in one or two applications with the maximum rate of 3.0 lbs ai/acre/season with a minimum 42 day interval between applications. Label permits ground (broadcast and banded) and aerial application as well as a formulation of active ingredient impregnated in granular fertilizer.

Restrictions: Do not exceed a total of 3.0 lb ai/A/season. Do not apply in greenhouses, shade houses, or other enclosed structures. Do not treat plants grown for food or feed.

B. Exposure Characterization

The dimethenamid exposure characterization in this assessment combined the environmental fate data with Tier II exposure models to estimate environmental exposure concentrations (EECs). Exposure models estimate EECs following the conceptual diagram of dimethenamid usage and potential exposure endpoints shown in Figures II-D1 and II-D2. The EECs for aquatic endpoints are developed using the Tier II PRZM and EXAMS simulation models. These models determine EECs based on geographic areas nationwide and product use sites in close proximity to water bodies. The input parameters used in this assessment were selected from the environmental fate data submitted by the registrant and in accordance with US EPA-OPP EFED water model parameter selection guidelines, *Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides*, Version II, February 28, 2002. A detailed aquatic resource exposure assessment is attached in Appendix C. The goal of Tier II aquatic modeling is to better define the range of EECs that can be reasonably expected under variable weather conditions. Likewise, EECs for birds and terrestrial mammals were estimated using the T-REX model (version 1.2.3, August 8, 2005). The terrestrial exposure assessment evaluated potential exposure resulting from dimethenamid residues on wildlife food items.

1. Environmental Fate and Transport Characterization

a. Summary of Environmental Fate of Dimethenamid

This discussion of the environmental fate of dimethenamid is based on laboratory studies of the s-isomer when available. Bridging studies show, however, that fate properties of the racemic mixture are similar to those of the s-isomer alone, and so data from studies of r,s-dimethenamid are included in this discussion as well. All studies considered in this discussion are described in more detail in Appendix A.

Based on environmental fate properties measured in laboratory studies, dimethenamid is moderately persistent in the soil, has a high aqueous solubility and has limited partitioning to soil mineral or organic fractions. It therefore meets the criteria for potential to leach to groundwater and it also may reach surface water through runoff. If the compound were to reach surface water, it may persist for a significant period of time due to the fact that it is stable to hydrolysis at pH 5, 7, and 9 and has limited photolysis. The major route of dissipation is through soil metabolism. Terrestrial field studies found that dimethenamid dissipated with half-lives of 4 to 43 days with no leaching detected below 20 cm depth.

In laboratory studies, one major degradate, oxalamide (M23), was formed through aerobic soil metabolism at up to 14.8% of the applied parent compound. The major degradates M3 (dechlorinated parent), M10 (methyl sulfone derivative of M3), and M13 (methyl sulfoxide derivative of M3) were formed through anaerobic aquatic metabolism at levels up to 20.6%, 9.8%, and 12.4% of the applied, respectively. The structures and complete chemical names of these compounds are provided in Appendix B. Multiple minor degradates (<10% of applied) are seen in laboratory studies. These include PL3688 (methylthio derivative of the decholorinated parent); M9 [N-(2,4-dimethyl-3-thienyl)-5-methyl-3-morpholine]; M11 [N-(2,4-dimethyl-3-thienyl)-2-hydroxy-N-(2-methoxy-1-methylethyl)-acetamide]; M30 (STLA); M31 [STGA; thioglycolic acid sulfoxide]; M32 [TGA; thioglycolic acid conjugate; N-(2,4-dimethyl-3-thienyl)-N-(2-methoxy-1-methylethyl)-carboxymethylene thionyl-acetamide]; and, Fr4 (sulfoxide of the thioglycolic acid of dimethenamid). Structures and names of some of these minor degradation products are shown in Appendix B.

b. Persistence and Transformation

Radiolabeled s-dimethenamid was hydrolytically stable in pH 5, 7, and 9 aqueous buffer solutions incubated for 31 days. Direct aqueous photolysis is not a major transformation pathway as s-dimethenamid degraded slowly in irradiated samples. The half-life in 12 hour light/12 hour dark cycles was determined to be 51.4 days. Likewise, photodegradation on soil studies indicate that radiolabeled s-dimethenamid degraded slowly with a 12 hour light/12 hour dark half-life of 89.4 days. A comparison study found similar rates of photodegradation in soil of s-dimethenamid and r,s-dimethenamid. No major degradates were formed through aqueous or soil photolysis. In both soil and aquatic environments, the parent was stable in dark, sterile controls.

Aerobic soil metabolism studies conducted with radiolabeled dimethenamid showed that biotransformation under aerobic conditions is the major degradation route for dimethenamid. When radiolabeled s-dimethenamid was incubated in the dark for 182 days, s-dimethenamid degraded with a first order, linear half-life of 31 days. A comparison study found a half-life of 30 days for r,s-dimethenamid in the same conditions. In these studies, no major degradates were observed. The degradate oxalamide (M23) was formed at up to 8% of the applied. An earlier study of r,s-dimethenamid found oxalamide at 14.8% of the applied, however, so it is considered a major degradate. Multiple minor degradates were found. By the end of the study, bound residues in various fractions reached up to 40% of the applied and carbon dioxide had been formed at 29% of the applied.

No studies of s-dimethenamid in anaerobic conditions are available. R,S-dimethenamid metabolized in anaerobic conditions with a half-life of 53.8 days in soil and 36 days in an aquatic/sediment system. The primary metabolite in soil was oxalamide which reached a maximum level of 8.7% of applied radioactivity by day 93. Several major degradates were formed in anaerobic aquatic conditions, including M3 (dechlorinated parent), M10 (methyl sulfone derivative of M3), and M13 (methyl sulfoxide derivative of M3) at levels up to 20.6%, 9.8%, and 12.4% of the applied, respectively. Structures and chemical names for these compounds can be found in Appendix B.

c. Transport and Mobility

Dimethenamid is highly mobile as observed in laboratory studies with several soil types. Radiolabeled s-dimethenamid (SAN 1289H) was determined to be very mobile in batch equilibrium studies in Arizona clay, Illinois clay loam, California sandy loam and Illinois silt loam, and a California loam sediment. Freundlich K_{ads} values were 2.1 for the clay soil, 2.5 for the clay loam soil, 1.4 for the sandy loam soil, 2.0 for the silt loam soil, and 3.0 for the loam sediment; corresponding K_{oc} values were 212, 105, 247, 396 and 129 mL/g (MRID 443322-63).

Mobility of s-dimethenamid was also tested in European soils and found to be highly mobile in sandy clay loam (Italy), clay loam (Greece), sandy loam (Great Britain) and silt loam (France) and mobile in sand (Germany). Freundlich K_{ads} values were 6.6 for the sandy clay loam soil, 2.5 for the clay loam soil, 2.1 for the sandy loam soil, 1.2 for the silt loam soil and 13.5 for the sand soil; corresponding K_{oc} values were 474, 123, 90, 101 and 393 mL/g (MRID 443322-63).

Volatilization from soil or water are not expected to be major dissipation routes for dimethenamid. Dimethenamid has low potential to bioaccumulate.

d. Field Studies

There are no terrestrial field studies available for s-dimethenamid, but several have been conducted on the racemic mixture. Given the demonstrated similarity in physical, chemical, and fate properties between the s-isomer and the r/s-mixture, these studies provide information relevant to the fate of s-dimethenamid in the environment. In terrestrial field dissipation studies, r/s-dimethenamid dissipated with half-lives of 8 days in a silt loam soil near Leonard, Missouri; 8 days in a sandy loam soil near Lucama, North Carolina; 14 days in a silt loam soil near Noblesville, Indiana; and 43 days in a loam soil near Hollandale, Minnesota (MRIDs 422662-02, -03, -04, -05, and -06). All four sites were treated with liquid formulation at 1.5 lb ai/A pre-emergence to either corn or soybeans; soil pH's ranged from 6.4 to 7.7. Most detections of dimethenamid were in the 0-10 cm layer of soil although detections were down to the 20- to 30-cm depth at the Minnesota site. The colder climate in Minnesota resulting in a longer half-life may have contributed to increased leaching. Oxalamide was detected down to the 20-cm depth. Analysis was not performed for other degradates.

2. Measures of Aquatic Exposure

a. Aquatic Exposure Modeling

The Tier II screening simulation models Pesticide Root Zone Model (PRZM v3.12beta, May 24, 2001) and Exposure Analysis Modeling System (EXAMS v2.98.04, Aug. 18, 2002) were coupled with the input shell pe4v01.pl (Aug.8, 2003) to generate estimated environmental concentrations (EECs) of dimethenamid that may occur in surface water from use on adjacent crops at maximum use rates. The PRZM model simulates pesticide movement and transformation from crop application through soil residue processes. The EXAMS model simulates the fate of pesticides that reach an adjacent pond through runoff, erosion, and spray drift. The coupled PRZM/EXAMS model assumes a standard pond scenario in which a 10-hectare field cropped at 100% drains into an adjacent 1-hectare pond of 2-meter depth. Linked crop-specific scenarios and meteorological data are used to estimate expected environmental concentrations from the proposed applications of dimethenamid. Weather and agricultural practices are simulated over 30 years so that the 1-in-10-year EECs can be estimated. Additional information on these models and use scenarios can be found at: http://www.epa.gov/oppefed1/models/water/index.htm.

The crop-specific scenarios modeled are those currently approved to represent the three proposed new uses for dimethenamid: ornamentals, grass for seed, and green onions. Scenarios are generally developed to represent sites at roughly the upper 90^{th} percentile of runoff-vulnerability for pesticide transport to surface waters from a particular crop. The ornamental use of dimethenamid includes a broad range of plant types and geographic areas. The Oregon Christmas tree, Florida turf, and Pennsylvania turf scenarios were modeled to capture this range. Dimethenamid use on grass grown for seed was modeled using the Oregon grass seed scenario. This scenario was developed for the OP cumulative to represent the northwest region and may not be representative of the most vulnerable sites nationally. The green onion use was modeled using the California onion and Georgia onion scenarios. Although onions grown in California are typically irrigated, due to limitations in the current model, irrigation was not accounted for in this simulation. This may lead to underestimation of EECs for this scenario. More information about these scenarios is provided in Table III-B1 and additional detail can be found in the scenario metadata available on the modeling website.

TABLE III-B 1. Summary of Crop Scenarios Used in Estimating Aquatic EECs

Use	Crop Scenario (Location)	Primary Soil Type	Met File	Dimethenamid Application Date[1]
Ornamentals	OR xmas tree (Marion County)	Silt loam	MLRA A2; W24232.dvf	February 15
	FL turf (Osceola County)	Adamsville sand	MLRA 155A; W12834.dvf	March 15
	PA turf (York County)	Silt loam	MLRA 148; W14737.dvf	May 15
Grass for Seed	OR grass seed (Benton County)	Clay	MLRA A2; W24232.dvf	September 15
Green Onions	CA onion (San Joaquin County)	Loam, clay, mixed	MLRA17; W23155.dvf	February 1
	GA onion (Toombs County)	Tifton loamy, sand	MLRA153A /133A; W03822.dvf	June 15

[1] Application date is not scenario specific. It is selected based on label and crop information.

Application rates, frequency, number of applications and the maximum application rate (Table II-A2) were taken from the proposed supplemental labels for the end-use product Outlook™ and the proposed label for Dimethenamid-P Ornamentals Herbicide. For green onions, dimethenamid use is only labeled for application by ground spray. Ground, aerial and/or granular (impregnated on fertilizer) applications are acceptable for grasses grown for seeds and ornamentals. For selection of application dates, an application window was determined based on label recommendations and crop emergence dates. From within this window, the application date when the scenario had the highest precipitation was chosen to provide a conservative estimate of potential runoff.

Input parameters for the PRZM/EXAMS models are presented for dimethenamid in Table III-B2. Aquatic exposure concentrations were estimated for the parent dimethenamid following aerial application (Table III-B3), ground application (Table III-B4), and granular application (Table III-B5) at the maximum application rates for the proposed new uses on green onions, grasses grown for seed and ornamentals.

TABLE III-B 2. PRZM/EXAMS Input Parameters for Dimethenamid.			
Parameter	**Value**	**Comment**	**Source**
Application Rate per Event *lb a.i./A (kg a.i./ha)*	Grass for seed: 0.98 (1.1) Green onions: 0.98 (1.1) Ornamentals: 1.50 (1.68)		Reg. No. 7969-156 Reg. No. 7969-156 Reg. No. 7969-xxx
No. of Applications (Interval)	Grass for seed: 1 Green onions: 1 Ornamentals: 2 (42 days)		Reg. No. 7969-156 Reg. No. 7969-156 Reg. No. 7969-xxx
CAM (Chemical App. Method)	Ground & aerial spray: 2 Granular use: 1	For spray applications, foliar based on crop canopy. For granular, soil applied.	
Depth of Incorporation	0 cm	For CAM=1, model assumes incorporation depth of 4 cm.	
Aerobic Soil Metabolism $t_{1/2}$	37 days	Estimated upper 90th percentile based on 3 studies[1] (2 with R/S mixture as the test substance)	MRID 443322-16 MRID 415965-32
Spray Drift Fraction / Application Efficiency	Ground spray: 0.01 / 0.99 Aerial spray: 0.05 / 0.95 Granular: 0.00 / 1.00		EFED Input Guidance[1]
Aerobic Aquatic Degradation $t_{1/2}$	74 days	No data available; used one-half aerobic soil metabolism rate	EFED Input Guidance[1]
Anaerobic Aquatic Degradation $t_{1/2}$	108 days	3 x single reported value[1]; R/S mixture as the test substance	MRID 423672-01
Aqueous Photolysis $t_{1/2}$	50 days	Dark corrected; 12 hour light/12 hour dark cycle	MRID 443322-59
Hydrolysis $t_{1/2}$	Stable	pH 5, 7, 9	MRID 443322-58
Soil Partition Coefficient (K_d)	1.4 mL/g	Lowest non-sand K_d	MRID 443322-63
Molecular Weight	275 g/mole		Product Chemistry
Water Solubility @ 25°C	1,449 mg/L		MRID 443322-14
Vapor Pressure	1.88 x 10^{-5} torr		MRID 443322-15

[1] http://www.epa.gov/oppefed1/models/water/input_guidance2_28_02.htm

TABLE III-B 3. Aquatic EECs (surface water) Following AERIAL Application of Dimethenamid.							
Use **Scenario**	*1-in-10 year Concentration (µg/L)*						
	Peak	**96 hour**	**21-day**	**60-day**	**90-day**	**Annual Mean**	**30-Year Average**
Grass for seed (0.98 lb ai/A * 1 app)							
OR Grass seed	5.59	5.53	5.30	5.09	4.88	2.89	2.39
Ornamentals (1.5 lb ai/A * 2 app)							
OR Xmas tree	19.68	19.55	19.01	17.74	17.42	10.67	6.89
FL Turf	23.32	22.93	21.29	18.26	16.75	8.58	4.72
PA Turf	17.80	17.56	16.39	15.41	14.51	8.62	6.53

TABLE III-B 4. Aquatic EECs (surface water) Following GROUND Application of Dimethenamid.							
Use **Scenario**	*1-in-10 year Concentration (µg/L)*						
	Peak	**96 hour**	**21-day**	**60-day**	**90-day**	**Annual Mean**	**30-Year Average**
Grass for seed (0.98 lb ai/A * 1 app)							
OR Grass seed	2.94	2.93	2.83	2.75	2.64	1.29	0.84
Ornamentals (1.5 lb ai/A * 2 app)							
OR Xmas tree	12.71	12.62	12.26	11.75	11.35	6.53	2.63
FL Turf	18.83	18.51	17.21	14.54	13.11	6.58	2.68
PA Turf	11.94	11.77	11.10	10.24	9.69	5.10	3.14
Onions (0.98 lb ai/A * 1 app)							
CA Onion	3.28	3.26	3.18	2.98	2.77	1.26	0.60
GA Onion	33.24	32.56	31.17	26.44	23.11	10.51	5.04

TABLE III-B 5. Aquatic EECs (surface water) Following GRANULAR Application of Dimethenamid.							
Use **Scenario**	*1-in-10 year Concentration (µg/L)*						
	Peak	**96 hour**	**21-day**	**60-day**	**90-day**	**Annual Mean**	**30-Year Average**
Grass for seed (0.98 lb ai/A * 1 app)							
OR Grass seed	2.34	2.33	2.26	2.16	2.07	0.90	0.45
Ornamentals (1.5 lb ai/A * 2 app)							
OR Xmas tree	11.44	11.37	11.03	10.33	9.84	5.49	1.57
FL Turf	7.50	7.39	6.94	6.46	5.91	2.49	0.90
PA Turf	5.56	5.50	5.25	4.60	4.17	2.23	0.99

b. Aquatic Exposure Monitoring and Field Data

Monitoring data have not been considered for dimethenamid. No monitoring studies were required from or submitted by the registrant and no search was conducted for monitoring data from external sources.

3. Measures of Terrestrial Exposure

a. Terrestrial Exposure Modeling for Spray Applications

Terrestrial wildlife exposure estimates are typically calculated for bird and mammals, emphasizing a dietary exposure route for uptake of pesticide active ingredients. These exposures are considered as surrogates for terrestrial-phase amphibians as well as reptiles. For exposure to terrestrial wildlife, such as birds and small mammals, pesticide residues on food items are estimated, based on the assumption that animals are exposed to a single pesticide residue in a given exposure scenario. For this terrestrial exposure assessment, aerial and ground spray application methods for dimethenamid are considered.

For dimethenamid spray applications, estimation of pesticide concentrations in wildlife food items focuses on quantifying possible dietary ingestion of residues on vegetative matter and insects. No field residue data or field study information is available for dimethenamid; therefore, the residue estimates were based on a nomogram that relates food item residues to pesticide application rate. The residue EECs were generated from a spreadsheet-based model (T-REX Version 1.2.3) that calculates the decay of a chemical applied to foliar surfaces for single or multiple applications and is based on the methods of Hoerger and Kenaga (1972) as modified by Fletcher *et al.* (1994). Uncertainties in the terrestrial EECs are primarily associated with a lack of data on interception and subsequent dissipation from foliar surfaces. Residue EECs were calculated for two application rates; 0.98 lbs ai/A for grasses grown as seed and green onions, and 3.0 lbs ai/A for ornamentals (2 applications at 1.5 lbs ai/A). EECs were calculated using a foliar dissipation default half-life of 35 days (Willis and McDowell, 1987) because dimethenamid is stable to hydrolysis and has the following half-lives: aerobic soil metabolism (37 d), aquatic aerobic metabolism (36 d) and anaerobic aquatic metabolism (54 d). The frequency of dimethenamid application for ornamentals was assumed to be 42 days based on the Dimethenamid-P Ornamentals Herbicide label.

The EECs on terrestrial food items may be compared directly with dietary toxicity data or converted to an oral dose, as is the case for small mammals. For mammals, the residue concentration is converted to daily oral dose based on the fraction of body weight consumed daily as estimated through mammalian allometric relationships. The risk assessment for dimethenamid uses upper bound (i.e., 90th percentile) predicted residues as the measure of exposure. The predicted upper bound and mean residues of dimethenamid that may be expected to occur on selected avian or mammalian food items immediately following dimethenamid application (at the maximum label rates) are presented in Table III-B6.

TABLE III-B 6. Terrestrial EEC's (Bird and Mammal) Following Dimethenamid Spray Application to Grass Grown for Seed, Onions and Ornamentals.

Uses	# of App. x App. Rate	Food Items	Maximum EEC

	(application method)		(ppm)
Grass Green Onions	1 x 0.98 lbs ai/A (broadcast)	Short Grass Tall Grass Sm. Insects, Broadleaf Plants Lg. Insects, Fruits, Pods	235.20 107.80 132.30 14.70
Ornamentals	2 x 1.5 lbs ai/A (broadcast)	Short Grass Tall Grass Sm. Insects, Broadleaf Plants Lg. Insects, Fruits, Pods	516.70 236.82 290.64 32.29

EECs for granular fertilizer applications containing dimethenamid at maximum application rates of 0.98 lbs ai/A for grasses grown as seed and 3.0 lbs ai/A for ornamentals (2 applications at 1.5 lbs ai/A) were also calculated using the T-REX model. EECs for birds and mammals were calculated based on ft^2 for granular broadcast application of dimethenamid impregnated fertilizer and are presented in Table III-B7.

TABLE III-B 7. Terrestrial EEC's (Bird and Mammal) Following Dimethenamid Granular Application to Grass Grown for Seed and Ornamentals.		
Uses	**# of App. x App. Rate (application method)**	**EEC (mg ai/ ft^2)**
Grass	1 x 0.98 lbs ai/A (granular)	10.20
Ornamentals	2 x 1.5 lbs ai/A (granular)	15.62

Effects on non-target terrestrial plants are most likely to occur as a result of spray drift and/or runoff from aerial and ground applications of dimethenamid. Spray drift and runoff is an important factor in characterizing the risk of dimethenamid to non-target plants, which is assumed to reach off-site areas. The TerrPlant model (Ver.1.2.1) predicts EECs for terrestrial plants located in dry and semi-aquatic areas adjacent to the treated areas. The EECs are based on the application rate and solubility of the pesticide in water and drift characteristics, which depend on ground or aerial applications. The amount of dimethenamid that runs off is a proportion of the application rate and is assumed to be 5% based on dimethenamid's solubility of >100 ppm in water. Drift from ground and aerial applications are assumed to be 1% and 5%, respectively, of the application rate. For dry areas, the loading of pesticide active ingredient from runoff to an adjacent non-target area is assumed to occur from one acre of treatment to one acre of non-target area and is characterized as "sheet runoff". For terrestrial plants inhabiting semi-aquatic (wetland) areas, runoff is considered to occur from a larger source area with active ingredient loading originating from 10 acres of treated area to a single acre of non-target wetland and is characterized as "channelized runoff". Predicted terrestrial plant EECs following spray and granular applications at the maximum application rates of dimethenamid are summarized in Tables III-B8 and III-B9, respectively.

TABLE III-B 8. EECs for Terrestrial Plants Located Adjacent to Dimethenamid (non-granular application) Treated Sites.				
Terrestrial Use	**Application Method (Non-granular)**	**Concentration (lbs ai/A)**		
		Total Loading to Areas Adjacent to	**Total Loading to Semi-Aquatic Areas Adjacent**	**Drift to Adjacent Areas[3]**

		Treated Areas[1]	to Treated Areas[2]	
Grass Onions (0.98 lb ai/A)	Ground Unincorp.[4] Ground Incorp.[5] Aerial	0.058 0.034 0.098	0.499 0.254 0.539	0.009 0.009 0.049
Ornamentals (1.5 lb ai/A)	Ground Unincorp. Ground Incorp. Aerial	0.090 0.052 0.150	0.765 0.390 0.825	0.015 0.015 0.075

[1] EEC = Sheet Runoff + Drift (1% for ground; 5% for aerial)
[2] EEC = Channelized Runoff + Drift (1% for ground; 5% for aerial)
[3] EEC for ground (appl. rate x 1% drift); for aerial (appl. rate x 5% drift)
[4] EEC for Unincorporated Ground Spray Application
[5] EEC for Incorporated Ground Spray Application

TABLE III-B 9. EECs for Terrestrial Plants Located Adjacent to Dimethenamid (granular application) Treated Sites.			
Terrestrial Use	Application Method (Granular)	Concentration (lbs ai/A)	
		Total Loading to Areas Adjacent to Treated Areas[1]	Total Loading to Semi-Aquatic Areas Adjacent to Treated Areas[2]
Grass (0.98 lb ai/A)	Unincorporated[3] Incorporated[4]	0.049 0.024	0.490 0.245
Ornamentals (1.5 lb ai/A)	Unincorporated Incorporated	0.075 0.037	0.75 0.375

[1] EEC = Sheet Runoff + Drift (1% for ground; 5% for aerial)
[2] EEC = Channelized Runoff + Drift (1% for ground; 5% for aerial)
[3] EEC for Unincorporated Granular Application
[4] EEC for Incorporated Granular Application

C. Ecological Effects Characterization

In screening-level ecological risk assessments, effects characterization describes the types of effects a pesticide has on aquatic or terrestrial animals. This characterization is based on registrant-submitted studies that describe information regarding acute and chronic effects toxicity for various aquatic and terrestrial animals and plants. Surrogate test species of birds, mammals, fish, aquatic and terrestrial invertebrates and plants are used to estimate treatment-related direct effects on acute mortality and chronic reproduction, growth, and survival of non-target species. Toxicity tests include short-term acute, subacute, and reproduction/chronic studies that progress from basic laboratory tests to applied field studies. In addition, avian species are used as surrogates for terrestrial-phase amphibians and reptiles and fish species are used as surrogates for aquatic-phase amphibians.

The following studies with s-dimethenamid are not available: avian reproduction, mammalian acute oral and reproduction, honeybee acute contact, freshwater fish early life-stage, and freshwater invertebrate life cycle. However, acceptable studies with r/s-dimethenamid are available. This screening risk assessment is performed by bridging information obtained from the s-dimethenamid studies with previously submitted studies for the registration of r/s-dimethenamid. For chronic studies with birds, fish and invertebrates, EFED has derived toxicity values by extrapolation on the basis of an acute to chronic ratio. The fate parameters and ecotoxicity profiles of r/s-dimethenamid and s-dimethenamid are very similar, with the exception of toxicity to terrestrial plants for which s-dimethenamid is much more toxic than r/s-dimethenamid.

1. Aquatic Effects Characterization

Table III-C1 presents the toxicity endpoint values used to calculate RQs and estimate risk to aquatic receptors from exposure to dimethenamid through surface runoff/leaching. Acute and chronic freshwater fish and invertebrate studies using the TGAI are required for dimethenamid because the end-use product is expected to be transported to surface waters from the intended use site. Details of the registrant-submitted studies for aquatic animals and plants are provided in Appendix F.

Available acute toxicity data for aquatic species indicates that dimethenamid is moderately toxic to freshwater fish and marine/estuarine invertebrates and slightly toxic to marine/estuarine fish and freshwater invertebrates. Results of chronic studies with r/s-dimethenamid indicates that reduced larval growth in rainbow trout was observed at 0.24 mg/L and reduced survival and growth in daphnids was observed at 2.52 mg/L. Chronic values for s-dimethenamid were estimated using an acute to chronic ratio approach from testing with r/s-dimethenamid in order to determine the potential chronic risk to estuarine/marine fish and invertebrates. s-Dimethenamid is highly toxic to aquatic vascular plants, with an EC_{50} of 0.0089 mg/L for duckweed (NOAEC 0.0012 mg/L), based on reduction of frond biomass. Results of Tier II toxicity studies with non-vascular aquatic plants indicate that s-dimethenamid adversely affected cell density with EC_{50}'s ranging from 0.014 to 0.37 mg/L. The freshwater green algae were the most sensitive species with an NOAEC of 0.0021 mg/L. Consequently, s-dimethenamid presents a potential risk to non-target aquatic plants inhabiting aquatic systems, as well as to wetland and riparian habitats along streams and/or ponds in close proximity to sprayed fields.

TABLE III-C 1. s-Dimethenamid Toxicity Endpoint Values for Assessing Risk to Aquatic Animals

Exposure Scenario	Species	Exposure Duration	Toxicity Endpoint Value	Endpoint	Reference (Classification)
Freshwater Fish					
Acute	Rainbow trout *Oncorhynchus mykiss*	96 hour	LC_{50} = 6.3 mg/L NOEC = 3.7 mg/L	Lethality	MRID 443322-27 (Acceptable)
Chronic	Rainbow trout *Oncorhynchus mykiss*	Full life cycle	NOAEC = 0.3 mg/L* LOAEC = 0.24 mg/L	Reproductive effects	MRID 423366-05 (Acceptable)
Freshwater Invertebrates					
Acute	Water flea *Daphnia magna*	48 hour	EC_{50} = 12 mg/L NOEC = 3.4 mg/L	Immobilization	MRID 443322-29 (Acceptable)
Chronic	Water flea *Daphnia magna*	21-day	NOAEC = 1.02 mg/L* LOAEC = 2.51 mg/L	Growth; Reproduction	MRID 439143-01 (Acceptable)
Estuarine/Marine Fish					
Acute	Sheepshead minnow *Cyprinodon variegatus*	96 hour	LC_{50} = 12 mg/L NOEC = 5.3 mg/L	Lethality	MRID 443322-30 (Acceptable)
Chronic			Waived		

Estuarine/Marine Invertebrates					
Acute	Saltwater mysid *Mysidiopsis bahia*	96 hour	LC_{50} = 3.2 mg/L NOEL = 1.2 mg/L	Lethality	MRID 443322-31 (Supplemental)
Chronic			Waived		
Aquatic Plants					
Nonvascular	Green algae *Selenastrum capricornutum*	5-day	EC_{50} = 0.014 mg/L NOEC = 0.0021 mg/L	Cell density	MRID 443322-53 (Acceptable)
Macrophysics	Duckweed Lemna gibba	14-day	EC_{50} = 0.0089 mg/L NOEC = 0.0012 mg/L	Frond biomass	MRID 443322-57 (Acceptable)

*As previously agreed, (see review under D225398), toxicity value is estimated for s-dimethenamid via acute to chronic ratio.

2. Terrestrial Effects

Table III-C2 presents the toxicity endpoint values used to calculate RQs and estimate risk to terrestrial receptors from oral exposure to dimethenamid residues as the result of direct deposition and spray applications. Ground deposition, spray drift, and wind erosion of soil particles with resulting residues on foliage and on flowers and seeds are the most likely sources of dimethenamid-P exposure to nontarget terrestrial animals, including endangered and threatened species. In addition, uptake in plant shoots (monocots) and roots (dicots) would be expected to occur. An additional source of exposure to dimethenamid could be in puddled water on treated fields through preening and grooming, involving the oral ingestion of material from the feathers or fur. Details of the registrant-submitted studies for terrestrial animals and plants are provided below and in Appendix F.

Available acute toxicity data indicate that s-dimethenamid is slightly toxic to upland game birds by the oral route (LD_{50} 1,068 mg/kg bw) and practically non-toxic to both upland game birds and waterfowl by the subacute dietary route (LC_{50} >5620 mg/kg-diet). Results of chronic studies with r/s-dimethenamid indicate that upland game birds are more sensitive, with adult male body weight being significantly decreased at 900 mg/kg-diet, resulting in a NOAEC of 360 mg/kg-diet. Eggshell thickness in bobwhite quail was significantly decreased at 1800 mg/kg-diet. No treatment-related effects were observed in mallards at the highest dose tested 1800 mg/kg-diet. Acute and chronic toxicity data indicate that r/s-dimethenamid is practically non-toxic to mammals (acute LD_{50} value of 2,400 mg/kg bw; rat developmental toxicity NOAEC of 300 mg/kg/day; rat reproductive toxicity NOAEC of 500 mg/kg-diet). The only treatment-related toxicity observed in the 2-generation reproduction study with rats exposed to r/s-dimethenamid was reduced pup weight resulting in the NOAEC for offspring toxicity of 500 mg/kg-diet in males. Chronic values for s-dimethenamid were estimated using an acute to chronic ratio approach from testing with r/s-dimethenamid in order to determine the potential chronic risk to birds. Acute contact studies indicate that r/s-dimethenamid is practically non-toxic to honey bees (LD_{50} 94 μg/bee).

Terrestrial plant toxicity studies with monocots and dicots indicate that seedling emergence and vegetative vigor are severely impacted by exposure to s-dimethenamid. Seedling emergence, based on shoot length, was adversely impacted in monocots (ryegrass) at an EC_{25} of 0.0059 lb ai/A and in dicots (lettuce) with an EC_{25} of 0.0064 lb ai/A. Vegetative vigor in monocots, based on shoot weight, was adversely impacted at an EC_{25} of 0.026 lb ai/A in ryegrass. In dicots, s-dimethenamid was less toxic with an EC_{25} of 0.12 lb ai/A in cucumber, based on shoot length. Phytotoxic effects observed in the vegetative vigor study included chlorosis and necrosis.

TABLE III-C 2. s-Dimethenamid Toxicity Endpoint Values for Assessing Risk to Terrestrial Animals.

Exposure Scenario	Species	Exposure Duration	Toxicity Endpoint Value	Endpoint	Reference (Classification)
Mammal					
Acute Oral	Laboratory rat	Single Oral Dose	LD_{50} = 2400 mg/kg	Lethality	MRID 415965-36 (Acceptable)
Chronic Reproduction	Laboratory rat	2-generation	NOAEC = 500 ppm (M)* LOEL = not available	Reduced pup weight	MRID 41615905 (Acceptable)
Birds					
Acute Oral	Bobwhite Quail *Colinus virginianus*	14 days	LD_{50} = 1068 mg/kg bw NOEL= not determined	Lethality	MRID 443322-24 (Acceptable)
Subacute Dietary	Bobwhite Quail *Colinus virginianus*	8 days	LC_{50} = >5620 mg/kg-diet NOEL = 1780 mg/kg-diet	Lethality	MRID 443322-26 (Acceptable)
Chronic	Bobwhite Quail *Colinus virginianus*	one generation	NOAEC = 360 mg/kg-diet LOAEC = 900 mg/kg-diet	Growth and Reproduction	MRID 439258-01 (Acceptable)
Insects					
Acute Contact	Honey Bee *Apis mellifera*	96 hour	LD_{50} = 94 µg/bee NOEC = not available	Lethality	MRID 416624-18 (Acceptable)
Terrestrial Plants					
Seedling Emergence	Monocot -ryegrass	Tier II	EC_{25} = 0.0059 lb/A NOAEC = 0.0025 lb/A	Shoot length	MRID 443322-52 (Acceptable)
Seedling Emergence	Dicot - lettuce	Tier II	EC_{25} = 0.0064 lb/A NOAEC = 0.0048 lb/A	Shoot length	MRID 443322-52 (Acceptable)
Vegetative Vigor	Monocot - ryegrass	Tier II	EC_{25} = 0.026 lb/A NOAEC = 0.021 lb/A	Shoot weight	MRID 443322-52 (Acceptable)
Vegetative Vigor	Dicot - cucumber	Tier II	EC_{25} = 0.12 lb/A NOAEC = 0.084 lb/A	Shoot length	MRID 443322-52 (Acceptable)

*As previously agreed, (see review under D225398), toxicity value is estimated for s-dimethenamid via acute to chronic ratio.

IV. RISK CHARACTERIZATION

Risk characterization provides the final step in the risk assessment process. In this step, exposure and effects characterization are integrated to provide an estimate of risk relative to established levels of concern (LOCs). The results are then interpreted for the risk manager through a risk description and synthesized into an overall conclusion.

A. Risk Estimation - Integration of Exposure and Effects Data

A deterministic approach is used to evaluate the likelihood of adverse ecological effects to non-target species. In this approach, risk quotients (RQs) are calculated by dividing exposure estimates (EECs) by ecotoxicity values for non-target species, both acute and chronic.

$$RQ = \text{EXPOSURE/TOXICITY}$$

RQs are then compared to OPP's Levels of Concern (LOCs). These LOCs are criteria used by OPP to indicate potential risk to non-target animals and the need to consider regulatory action. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on non-target animals. LOCs currently address the following risk presumption categories: (1) acute - potential for acute risk to non-target species, regulatory action may be warranted in addition to restricted use classification; (2) acute restricted use - the potential for acute risk to non-target species, but this may be mitigated through restricted use classification; (3) acute endangered species – endangered species may be potentially affected by use, regulatory action may be warranted; and (4) chronic risk - the potential for chronic risk to non-target species, regulatory action may be warranted, endangered species may be potentially affected by chronic exposure. Currently, EFED does not perform assessments for chronic risk to plants, acute or chronic risks to non-target insects, or chronic risk from granular/bait formulations to mammalian or avian species.

For acute studies on taxa where a LC/LD_{50} was not established due to insufficient mortality but some mortality reported in the study or no effects were observed at any concentration level, a RQ was not calculated and the study is discussed further in the Risk Description section.

The ecotoxicity test values (i.e., measurement endpoints) used in the acute and chronic risk quotients were derived from the results of required studies. Examples of ecotoxicity values derived from the results of short-term laboratory studies that assess acute effects are: (1) LC_{50} (fish) (2) LD_{50} (birds and mammals) (3) EC_{50} (aquatic plants and aquatic invertebrates) and (4) EC_{25} (terrestrial plants). An example of a toxicity test effect level derived from the results of long-term laboratory study that assesses chronic effects is: NOAEC (birds, fish and aquatic invertebrates).

Risk presumptions, along with the corresponding RQs and LOCs are tabulated below:

TABLE IV-A 1. Risk Presumptions for Terrestrial Animals

Risk Presumption	RQ	LOC
Birds:		
Acute Risk	EEC[1]/LC_{50} or LD_{50}/sqft[2] or LD_{50}/day[3]	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or $LD_{50} < 50$ mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1
Wild Mammals:		
Acute Risk	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.5
Acute Restricted Use	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day (or $LD_{50} < 50$ mg/kg)	0.2
Acute Endangered Species	EEC/LC_{50} or LD_{50}/sqft or LD_{50}/day	0.1
Chronic Risk	EEC/NOAEC	1

[1]EEC=abbreviation for Estimated Environmental Concentration (mg/kg) on avian/mammalian food items

[2] $\frac{mg/ft^2}{LD_{50} * \text{wt. of bird}}$ [3] $\frac{\text{mg of toxicant consumed/day}}{LD_{50} * \text{wt. of bird}}$

TABLE IV-A 2. Risk Presumptions for Aquatic Animals

Risk Presumption	RQ	LOC
Acute Risk	EEC[1]/LC_{50} or EC_{50}	0.5
Acute Restricted Use	EEC/LC_{50} or EC_{50}	0.1
Acute Endangered Species	EEC/LC_{50} or EC_{50}	0.05
Chronic Risk	EEC/NOAEC	1

[1]EEC = (mg/L or µg/L) in water

Table IV-A 3. Risk Presumptions for Plants

Risk Presumption	RQ	LOC
Terrestrial Plants in Terrestrial and Semi-Aquatic Areas:		
Non-Endangered Species	EEC[1]/EC_{25}	1
Endangered Species	EEC/ NOAEC or EC_{05}[3]	1
Aquatic Plants:		
Non-Endangered Species	EEC[2]/EC_{50}	1
Endangered Species	EEC/NOAEC or EC_{05}[3]	1

[1]EEC = lbs ai/A

[2]EEC = (mg/L or µg/L) in water

[3] An EC_{05} is only used when a valid NOAEC is not available.

1. Non-target Aquatic Animals and Plants

a. Fish and Invertebrates

Acute Risks

Comparison of estimated peak concentrations in surface water following dimethenamid application to ornamentals, grass for seed and green onions to acute toxicity thresholds (LC_{50}/EC_{50}s) for freshwater and marine/estuarine fish and invertebrates are provided in Appendix C. Acute risk quotients (RQs) for all taxonomic groups are less than the Level of Concern (LOC) indicating adverse effects to survival of freshwater and marine/estuarine fish and invertebrates are not expected from the spray (aerial or ground), ground, or granular application of dimethenamid.

Chronic Risks

Chronic RQs for fish and invertebrates are below the Chronic LOC of 1 (see Appendix C) indicating that adverse effects to growth and reproduction of these taxonomic groups are not expected from the spray (aerial or ground), ground, or granular application of dimethenamid. Chronic studies with marine/estuarine fish and invertebrates were waived based on no LOC exceedances for acute or chronic risks to freshwater fish and invertebrates estimated via the acute to chronic ratio method.

b. Aquatic Plants

There are exceedances of the endangered LOCs for aquatic non-vascular and vascular plants exposed to dimethenamid from all proposed uses and all application methods, including exposure from runoff/drift from ground or aerial spray and from runoff from granular applications (Table IV-A4). Non-endangered LOCs are exceeded for vascular and non-vascular plants from use on green onions and ornamentals through all application methods, except for granular application on ornamentals that does not exceed the non-endangered LOC for non-vascular plants. Use of dimethenamid on grass grown for seed does not have any exceedances for non-endangered plants, vascular or non-vascular. For uses with EECs from multiple scenarios, RQs were calculated with the most conservative EEC; although the scenarios include localized conditions, they are intended to represent vulnerable sites nationally. Risk to aquatic plants will be discussed further in the Risk Description section and in the spray drift analysis.

TABLE IV-A 4. Summarized Aquatic Plant Risk Quotients [a.b.c.]					
Scenario	EECs (µg/L)	Endangered		Non-Endangered	
		Vascular	Non-vascular	Vascular	Non-vascular
ORNAMENTALS *(3.0 lbs ai/A/season)*					
Granular App.	11.44	9.53*	5.45*	1.29*	0.82
Ground App.	18.83	15.69*	8.97*	2.12*	1.35*
Aerial App.	23.3	19.43*	9.25*	2.62*	1.67*
GRASS FOR SEED *(0.98 lb ai/A/season)*					
Granular App.	2.34	1.95*	1.1*	0.26	0.17
Ground App.	2.94	2.45*	1.4*	0.33	0.21
Aerial App.	5.59	4.66*	2.66*	0.63	0.40
ONIONS *(0.98 lb ai/A/season)*					
Ground App	33.24	27.7*	15.8*	3.73*	2.47*

[a] Detailed description of PRZM/EXAMS modeling of EECs is provided in Section III-2a.
[b] * RQ exceeds the Endangered Species and Aquatic Plant Risk LOCs; RQ > 1.0.
[c] The endangered toxicity thresholds (NOAEC) was 0.0012 mg/L for vascular plants and 0.0021 for nonvascular plants; acute toxicity thresholds (EC_{50}) were 0.0089 mg/L (MRID 443322-57) and 0.014 mg/L (MRID 443322-53) for vascular and freshwater non-vascular plants, respectively.

2. Non-target Terrestrial Animals

a. Birds

Acute Risks for Spray and Ground Applications

Assuming the maximum application rate of 1.5 lbs ai/A (2 applications) and maximum predicted residue levels on a dose- and dietary-based approach, the Acute Risk LOC was exceeded for 20 g birds foraging on short grasses. The Acute Restricted Use LOC was exceeded for 20 g birds foraging on short grasses, tall grasses, and broadleaf forage/small insects and for 100 g birds foraging on short grasses. The Acute Endangered Species LOC was exceeded for 20 g birds foraging on short grasses, tall grasses, and broadleaf forage/small insects, for 100 g birds foraging on short grasses, tall grasses and broadleaf forage/small insects and for 1000 g birds foraging on short grasses (Table IV-A5). The endangered species LOC was not exceeded for birds foraging on fruits, pods, seeds, and large insects and for 1000 g birds foraging on tall grasses and broadleaf forage/small insects.

At the lower application rate of 0.98 lbs ai/A and assuming maximum predicted residue levels on a dose- and dietary-based approach, the Acute Restricted Use LOC was exceeded for 20 g birds foraging on short grasses and broadleaf forage/small insects. The Acute Endangered Species LOC was exceeded for 20 g birds foraging on short grasses, tall grasses, and broadleaf forage/small insects and for 100 g birds foraging on short grasses. The endangered species LOC was not exceeded for birds foraging on fruits, pods, seeds, and large insects and for 1000 g birds foraging on food items with dimethenamid residues (Table IV-A5).

Risk calculations for the acute dietary risk of dimethenamid to avian species calculated using a greater than LD_{50} value, >5620 mg/kg-diet, indicated no LOC exceedances and are provided in Appendix D. A discussion of acute risks to birds, reptiles, and terrestrial-phase amphibians from spray applications will be provided in the risk description section.

TABLE IV-A 5. Avian Dose-Based Acute Risk Quotient Summary [a,b,c,d,e]			
Food Type	Weight class (g)	Predicted maximum residues	
		0.98 lbs ai/A	1.5 lbs ai/A (2 applications)
short grass	20	0.35**	0.76*
	100	0.16***	0.34**
	1000	0.05	0.11***
tall grass	20	0.16***	0.35**
	100	0.07	0.16***
	1000	0.02	0.05
broadleaf forage, small insects	20	0.20**	0.43**
	100	0.09	0.19***
	1000	0.03	0.06
fruit, pods, seeds, large insects	20	0.02	0.05
	100	0.01	0.02
	1000	<0.01	0.01

[a] Acute toxicity threshold was quail LD_{50} = 1068 mg/kg-bw.
[b] Detailed calculations of the T-REX model (Ver.1.2.3) and Acute RQs are provided in Appendix D.
[c]* RQ exceeds the Acute Risk, Restricted Use, and Endangered Species LOCs; RQ > 0.5.
[d]** RQ exceeds the Acute Restricted Use and Endangered Species LOCs; RQ > 0.2.
[e] *** RQ exceeds the Acute Endangered Species LOC; RQ > 0.1.

Acute Risks for Granular Applications

Acute and endangered species risks to avian species will be discussed further in the Risk Description section. Based on LD_{50}/ft^2 exposure method and the toxicity value, avian oral LD_{50} of 1068 mg/kg bw, adjusted for weight classes (20, 100 and 1000 g), the Acute Risk, Restricted Use, and Endangered Species LOCs were exceeded for 20 g birds exposed to fertilizer impregnated granules at both application rates. At the maximum application rate of 1.5 lbs ai/A – 2 applications, the Acute Endangered Species LOC was exceeded for 20 and 100 g birds (Table IV-A6). There were no LOC exceedances for 1000 g birds exposed to impregnated granules at both application rates and for 100 g birds exposed to 0.98 lb ai/A impregnated granules of dimethenamid. A discussion of the acute risks to birds, reptiles, and terrestrial-phase amphibians from granular applications will be provided in the risk description section.

TABLE IV-A 6. Avian Acute Risk Quotient Summary for Granular Application [a]		
Weight Class (g)	0.98 lbs ai/A	1.50 lbs ai/A (2 applications)
20	0.66*	1.02*
100	0.10	0.16***
1,000	0.01	0.01

[a] Detailed calculations of the T-REX model (Ver.1.2.3) are provided in Appendix D.

* RQ exceeds the Acute Risk, Restricted Use and Endangered Species LOCs; RQ >0.5.
** RQ exceeds the Acute Restricted Use and Endangered Species LOCs; RQ >0.2.
*** RQ exceeds the Acute Endangered Species LOC; RQ >0.1.

Chronic Risks
Assuming the maximum application rate for ornamentals (1.5 lbs ai/A x 2 applications) and maximum predicted residue levels, the Chronic Risk and Endangered Species LOCs for birds consuming short grasses were exceeded, however, the LOCs were not exceeded for birds consuming tall grasses, broadleaf forage/small insects, and seeds/large insects (Table IV-A7). At the application rate of 0.98 lb ai/A, there were no chronic LOC exceedances for birds consuming food items with dimethenamid residues. A discussion of the chronic risk to birds, reptiles, and terrestrial-phase amphibians from spray applications will be provided in the risk description section.

TABLE IV-A 7. Avian Chronic Risk Quotient Summary [a,b]				
Food Type	0.98 lbs ai/A		1.50 lbs ai/A (2 applications)	
	Predicted max. residues	Predicted mean residues	Predicted max. residues	Predicted mean residues
short grass	0.65	0.23	1.44*	0.51
tall grass	0.30	0.10	0.66	0.22
broadleaf forage, small insects	0.37	0.12	0.81	0.27
fruit, pods, seeds, large insects	0.04	0.02	0.09	0.04

[a] Acute toxicity threshold was quail NOAEC = 360 mg/kg-diet.
[b] Detailed calculations of the T-REX model (Ver.1.2.3) and Chronic RQs are provided in Appendix D.
* RQ exceeds the Chronic Risk and Endangered Species LOCs; RQ >1.0.

b. Mammals

Acute Risks for Spray Applications
The dose-based and dietary-based acute RQs for all weight classes of mammals consuming all feed types are less than the Level of Concern (LOC) indicating adverse effects are not expected from the spray (aerial or ground) application of dimethenamid. The RQs are detailed in Appendix D.

Acute Risks for Granular Applications
Based on LD_{50}/ft^2 exposure method and the toxicity value, mammal oral LD_{50} of 2400 mg/kg-bw, adjusted for weight classes (15, 35 and 1000 g), the Acute Endangered Species LOC was exceeded for 15 g mammals exposed to fertilizer impregnated granules at both application rates (Table IV-A8). The endangered species risks to mammal species will be discussed further in the Risk Description section.

TABLE IV-A 8. Mammalian Acute Risk Quotient Summary for Granular Application [a]		
Weight Class (g)	0.98 lbs ai/A	1.50 lbs ai/A (2 applications)
15	0.13*	0.20*
35	0.07	0.10

1,000	0.01	0.01

[a] Detailed calculations of the T-REX model (Ver.1.2.3) are provided in Appendix D.
* RQ exceeds the Acute Endangered Species LOC; RQ>0.1

Chronic Risks

Dose-based and dietary-based chronic RQs were calculated using the rat reproductive NOAEC of 500 ppm. At both application rates (0.98 and 1.5 lbs ai/A x 2 applications) and maximum predicted residue levels, the dose-based RQs exceeded the Chronic Risk and Endangered Species LOCs for all weight classes of mammals (15, 35, 1000 g) consuming short grasses, tall grasses, and broadleaf forage/small insects, with the exception of mammals consuming seeds/large insects (Table IV-A 9). At the maximum application rate (1.5 lb ai/A) and maximum predicted residue levels, the dietary-based RQ exceeded the Chronic Risk and Endangered Species LOCs for mammals consuming short grasses, with the exception of mammals consuming tall grasses, broadleaf forage/small insects, and seeds/large insects (Table IV-A10). At 0.98 lb ai/A, there were no LOC exceedances for mammals consuming any feed types with dimethenamid residues. A discussion of the chronic risk to mammals will be provided in the Risk Description section.

TABLE IV-A 9. Mammalian Dose-Based Chronic Risk Quotient Summary[a,b,c]

Food type	Weight class (g)	0.98 lbs ai/A		1.5 lbs ai/A (2 applications)	
		Predicted max. residues	Predicted mean residues	Predicted max. residues	Predicted mean residues
Short grass	15	4.08*	1.44*	8.97*	3.16*
	35	3.49*	1.24*	7.66*	2.72*
	1000	1.87*	0.65	4.11*	1.43*
Tall grass	15	1.87*	0.61	4.11*	1.34*
	35	1.60*	0.52	3.51*	1.15*
	1000	0.86	0.28	1.88*	0.60
Broadleaf forage, small insects	15	2.30*	0.76	5.04*	1.68*
	35	1.96*	0.65	4.31*	1.44*
	1000	1.05*	0.34	2.31*	0.76
Fruit, large insects	15	0.26	0.12	0.56	0.26
	35	0.22	0.10	0.48	0.22
	1000	0.12	0.05	0.26	0.12
Seeds, pods	15	0.06	0.03	0.12	0.06
	35	0.05	0.02	0.11	0.05
	1000	0.03	0.01	0.06	0.02

[a] Chronic reproductive toxicity NOAEC = 500 mg/kg-diet
[b] Detailed calculations of the T-REX model (Ver.1.2.3) and Chronic RQs are provided in Appendix D.
* RQ exceeds the Chronic Risk and Endangered Species LOCs; RQ>1.0

TABLE IV-A 10. Mammalian Dietary-Based Chronic Risk Quotient Summary for Spray Application [a,b,c]				
Food Type	0.98 lbs ai/A		1.50 lbs ai/A (2 applications)	
	Predicted max. residues	Predicted mean residues	Predicted max. residues	Predicted mean residues
short grass	0.47	0.17	1.03*	0.37
tall grass	0.22	0.07	0.47	0.16
broadleaf forage, small insects	0.26	0.09	0.58	0.19
fruit, pods, seeds, large insects	0.03	0.01	0.06	0.03

[a] Chronic reproductive toxicity NOAEC = 500 mg/kg-diet

[b] Detailed calculations of the T-REX model (Ver.1.2.3) and Chronic RQs are provided in Appendix D.

* RQ exceeds the Chronic Risk and Endangered Species LOCs; RQ>1.0

c. Non-Target Terrestrial-phase Amphibians, Reptiles and Beneficial Insects

EFED currently uses surrogate data (birds) for terrestrial non-target amphibians and reptiles and does not quantify risks to terrestrial non-target insects. Risks are qualitatively discussed in the Risk Description section of this document.

3. Non-target Terrestrial Plants in Terrestrial and Semi-aquatic Environments

Table IV-A11 presents terrestrial plant RQs based on dimethenamid use on green onions, grass grown for seed, and ornamentals for ground, spray, and granular applications. For the use of dimethenamid on green onions and grasses grown for seed at the application rate of 0.98 lbs ai/A, the LOC was exceeded for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas primarily as the result of runoff and spray drift from ground and aerial applications. Runoff from granular formulations of dimethenamid (both unincorporated and incorporated) applied at 0.98 lbs ai/A also resulted in LOC exceedances for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas.

For the use of dimethenamid on ornamentals and the maximum single application rate of 1.5 lbs ai/A, the LOC was exceeded for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas primarily as the result of runoff and spray drift from ground and aerial applications. Runoff from granular formulations of dimethenamid (both unincorporated and incorporated) applied at 1.5 lbs ai/A resulted in LOC exceedances for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas.

The LOC for non-endangered and endangered monocots was exceeded as a result of spray drift from aerial applications at the 0.98 lbs ai/A application rate, with the exception of dicots receiving spray drift. In addition, the LOCs were not exceeded for terrestrial plants receiving spray drift alone from ground applications. At the maximum single application rate of 1.5 lbs ai/A for ornamentals, the LOC for non-endangered and endangered monocots was exceeded as a result of spray drift from aerial applications, with the exception of dicots receiving spray drift. In addition, the LOCs were not exceeded for terrestrial plants receiving spray drift alone from ground application. These risks will be discussed in detail in the AgDrift spray drift analysis in the Risk Description section.

TABLE IV-A 11. Terrestrial Plant Risk Quotient Summary for Dimethenamid Use on Green Onions, Grasses Grown for Seeds and Ornamentals [a,b,c,d]

Scenario	**Non-endangered RQs**			**Endangered RQs**		
	Terrestrial Adjacent area	Semi-aquatic Adjacent area	Drift	Terrestrial Adjacent area	Semi-aquatic Adjacent area	Drift
Onions and Grasses Grown for Seed (0.98 lbs ai/A)						
Ground spray application						
Monocot	9.97*	84.71*	0.38	23.52**	199.92**	0.47
Dicot	9.19*	78.09*	0.08	12.25**	104.13**	0.12
Incorporated Ground spray application						
Monocot	5.81*	43.19*	0.38	13.72**	101.92**	0.47
Dicot	5.36*	39.81*	0.08	7.15**	53.08**	0.12
Aerial spray application						
Monocot	16.61*	91.36*	1.88*	39.20**	215.60**	2.33**
Dicot	15.31*	84.22*	0.41	20.42**	112.29**	0.61
Granular formulation - unincorporated						
Monocot	8.31*	83.05*	na	19.60**	196.00**	na
Dicot	7.66*	76.56*	na	10.21**	102.08**	na
Granular formulation - incorporated						
Monocot	4.15*	41.53*	na	9.80**	98.00**	na
Dicot	3.83*	38.28*	na	5.10**	51.04**	na
Ornamentals (1.5 lbs ai/A)						
Ground spray application						
Monocot	15.25*	129.66*	0.58	36.00**	306.00**	0.71
Dicot	14.06*	119.53*	0.13	18.75**	159.38**	0.19
Incorporated Ground spray application						
Monocot	8.90*	66.10*	0.58	21.00**	156.00**	0.71
Dicot	8.20*	60.94*	0.13	10.94**	81.25**	0.19
Aerial spray application						
Monocot	25.42*	139.83*	2.88*	60.00**	330.00**	3.57**
Dicot	23.44*	128.91*	0.63	31.25**	171.88**	0.94
Granular Formulation- unincorporated						
Monocot	12.71*	127.12*	na	30.00**	300.00**	na
Dicot	11.72*	117.19*	na	15.63**	156.25**	na
Granular formulation - incorporated						
Monocot	6.36*	63.56*	na	15.00**	150.00**	na
Dicot	5.86*	58.59*	na	7.81**	78.13**	na

[a] Detailed calculations for RQs and TerrPlant (ver 1.2.1) input and output are provided in Appendix E.
[b] Non-endangered toxicity thresholds (EC_{25}) were 0.0059, 0.0064, 0.026, and 0.12 lb ai/A for seedling emergence monocot, seedling emergence dicot, vegetative vigor monocot, and vegetative vigor dicot, respectively.
[c] Endangered toxicity thresholds (NOAEC) were 0.0025, 0.0048, 0.021, and 0.08 lb ai/A for seedling emergence monocot, seedling emergence dicot, vegetative vigor monocot, and vegetative vigor dicot, respectively.
[d]* RQ exceeds the Non-Endangered Species LOC; RQ >1.0.
** RQ exceeds the Endangered Species LOC; RQ >1.0.

B. Risk Description

The risk hypothesis states that the use of dimethenamid on ornamentals, grasses grown for seed, and green onions has the potential to compromise survivorship, reproduction, and/or growth of non-target aquatic and terrestrial animals and plants, including Federally-listed endangered and threatened species. Based on the available ecotoxicity data and predicted environmental exposures, this ecological risk assessment supports the presumption of acute risk to birds, chronic risk to birds and mammals, risk to vascular and non-vascular non-endangered aquatic plants, and to non-target terrestrial monocots and dicots. This ecological risk assessment also supports the presumption of acute endangered species risk to birds, mammals (granular application only), vascular aquatic plants and terrestrial monocots and dicots. The presumption of acute and chronic risks to freshwater and marine/estuarine fish and invertebrates are not supported by the results of this screening risk assessment. The presumption of acute and chronic risks to estuarine/marine fish and invertebrates were determined to be minimal based on no LOC exceedances for saltwater invertebrates estimated via the acute to chronic ratio method.

1. Risks to Aquatic Animals and Plants

In the conceptual model, spray drift and surface runoff/leaching to adjacent bodies of water were predicted as the most likely sources of exposure of dimethenamid to nontarget aquatic animals and plants. Risks to aquatic animals and plants (i.e. fish, invertebrates, and plants) were assessed based on modeled estimated environmental concentrations (EECs) and available toxicity data. Aquatic EECs for the ecological exposure to dimethenamid were estimated using PRZM/EXAMS employing the standard field pond scenario (Tables III-B3, III-B4, and III-B5).

a. Animals

Fish and Invertebrates
Toxicity studies demonstrate that s-dimethenamid is moderately toxic to freshwater fish and marine/estuarine invertebrates and slightly toxic to freshwater invertebrates and marine/estuarine fish following acute exposure; however, at the peak EECs, there were no exceedances of the Acute Risk, Acute Restricted Use, or Acute Endangered Species LOCs for any of the taxonomic groups (Appendix C). Sublethal effects in fish observed in the toxicity studies included erratic swimming, discoloration, and lethargy in both rainbow trout (concentrations >7.5 mg/L mean measured) and sheepshead minnow (concentrations >9.2 mg/L mean measured). Lethargy and erratic behavior were also observed in daphnids and mysids at mean measured concentrations >5.2 and 1.8 mg/L, respectively. A comparison of the peak EECs in surface water from the simulation scenarios in Tables III-B3 and III-B4 to the acute toxicity values for freshwater (FW) and estuarine/marine (E/M) fish and invertebrates indicates that the toxicity values [ranging from 3,200 to 12,000 µg/L] average two orders of magnitude higher than the highest EECs for maximum use, ornamentals (18.8 µg/L for ground application, 23.2 µg/L for aerial application, and 11.4 for granular application). Consequently, freshwater and estuarine/marine fish and invertebrates inhabiting surface waters adjacent to a treated field would not be at risk for adverse acute effects on survival and growth, as well as sub-lethal effects when exposed to s-dimethenamid in surface runoff and/or leachate as a result of spray, ground, or granular application to ornamentals, grasses for seed or green onions.

Chronic exposure of r/s-dimethenamid reduced larval growth in rainbow trout and reduced survival and growth in daphnids; however, at the 21- and 60-day EECs, there were no exceedances of the Chronic Risk LOCs for either taxonomic group (Appendix C). A comparison of the 21- and 60-day EECs in surface water to chronic toxicity values for freshwater (FW) invertebrates and fish indicates that the highest EECs for ornamentals (ranging from 11.0 to 21.3

µg/L) are an order of magnitude lower than the lowest toxicity value for rainbow trout (NOAEC of 300 µg/L). Consequently, freshwater fish and invertebrates inhabiting surface waters adjacent to a treated field would not be at risk for adverse chronic effects on survival, growth, and reproduction when exposed to s-dimethenamid in surface runoff and/or leachate as a result of spray, ground, or granular application to ornamentals, grasses for seed or onions.

b. Aquatic Plants

Laboratory toxicity testing with s-Dimethenamid reduced growth and cell density of aquatic vascular and nonvascular plants. Sublethal effects to duckweed included curled fronds, chlorotic fronds, reduced root formation, and smaller frond size. Sublethal effects in freshwater green algae included bloated cells. There are exceedances of the endangered LOCs for vascular and non-vascular aquatic plants exposed to runoff/drift from ground and aerial spray applications and runoff from granular applications for the proposed new uses (Table IV-A4). Non-endangered LOCs for both vascular and nonvascular aquatic plants are exceeded by exposure from uses on ornamentals and green onions (Table IV-A4). Consequently, endangered aquatic plants (vascular and non-vascular) inhabiting surface waters adjacent to a treated field would be at risk for adverse effects to growth and development when exposed to s-dimethenamid in surface runoff and/or leachate as a result of spray, ground, or granular application to ornamentals and grasses grown for seed and via ground spray to green onions. Non-endangered plants (vascular and nonvascular) would be at risk from those uses except for grasses grown for seed, although there is some uncertainty in the potential for risk from grasses grown for seed because the modeled EEC may not represent the most vulnerable sites.

2. Risks to Terrestrial Animals and Plants

In the conceptual model, ground deposition of liquid and granular formulations, spray drift, and wind erosion of soil particles with resulting residues on foliage and on flowers and seeds are the most likely sources of dimethenamid exposure to nontarget terrestrial animals, including listed species. Risks to terrestrial animals and plants (i.e. birds, mammals, and plants) were assessed based on modeled EECs and available toxicity data. As part of the terrestrial assessment, exposure concentrations of dimethenamid to nontarget terrestrial plants and animals were modeled according to the labeled application rates for ornamentals, grasses for seed, and green onions. For terrestrial birds and mammals, estimates of initial levels of dimethenamid residues on various food items, which may be contacted or consumed by wildlife, were determined using the Fletcher nomogram followed by a first order decline model TREX 1.2.3. Likewise, the TerrPlant 1.2.1 model was used to estimate exposure to nontarget plants and the AgDrift 2.0.1 model provided further refinement of spray drift dispersion and deposition to terrestrial plants located in proximity to treated fields.

a. Animals

This section describes how the model, T-REX version 1.2.3, estimates the following: (1) residue concentrations on selected food items (mg/kg-dietary item); (2) dose-based EECs (mg/kg-bw) from dietary concentrations on selected food items; (3) adjusted toxicity values; and risk quotients for birds and mammals.

(1) ***Calculation of dietary concentrations on selected food items***

T-REX calculates the pesticide residue concentrations on each selected food item on a daily interval for one year. When multiple applications are modeled, residue concentrations resulting from the final application and remaining residue from previous applications are summed. The maximum concentration calculated out of the 365 days is returned as the EEC used to estimate potential risk to birds and mammals as described below. Dissipation of a chemical applied to foliar surfaces for single or multiple applications is calculated assuming a first order decay rate from the following first order rate equation:

$$C_t = C_0 e^{-kt}$$

or in log form:

$$\ln(C_t) = \ln(C_0)(-kT)$$

Where:

C_t = concentration, parts per million (ppm), at time T.

C_0 = concentration (ppm), present initially (on day zero) on the surface of selected food items. C_0 is calculated by multiplying the application rate, in pounds active ingredient per acre, by 240 for short grass, 110 for tall grass, and 135 for broad-leafed plants/small insects and 15 for fruits/pods/large insects for upper bound residue levels. Mean residue levels are derived by multiplying the application rate by 85 for short grass, 36 for tall grass, and 45 for broad-leafed plants/small insects and 7 for fruits/pods/seeds/large insects. Residue levels are based on work by Hoerger and Kenaga (1972) as modified by Fletcher *et al*. (1994). Additional applications are converted from pounds active ingredient per acre to ppm on the plant surface and the additional mass added to the mass of the chemical still present on the surfaces on the day of application.

k = Exponential rate constant = ln 2 ÷ foliar dissipation half-life. When scientifically valid, statistically robust data are not available, EFED recommends the using a default foliar dissipation half-life value of 35 days. The use of the 35-day half-life is based on the highest reported value (36.9 days), as reported by Willis and McDowell (1987).

t = time, in days, since the start of the simulation. The initial application is on day 0. The simulation is designed to run for 365 days.

The dietary concentrations estimated using the above methodology may be used directly to calculate risk quotients, but may also be used to calculate dose-based EECs (mg/kg-bw) for various size classes of mammals and birds as described below.

(2) ***Calculating EEC Equivalent Doses based on Estimated Dietary Concentrations on Selected Bird and Mammal Food Items***

EECs (mg/kg-bw) for various size classes of mammals and birds may be calculated based on the dietary residue concentrations derived using the equations presented above. To allow for this type of analysis, the EECs and toxicity values are adjusted based on food intake and body weight differences so that they are comparable for a given weight class of animal. The size classes assessed are small (20-gram), medium (100-gram), and large (1000-gram) birds, and small (15-

gram), medium (35-gram), and large (1000-gram) mammals. Equations used to calculate food intake (grams/day) and to adjust toxicity values for dose-based risk quotients are presented below.

Calculating Food Intake for Different Size Classes of Birds and Mammals:

Daily food intake (g/day) is assumed to correlate with body weight using the following empirically derived equation (U.S. EPA, 1993):

Avian consumption

$$F = \frac{0.648 * BW^{0.651}}{(1 - W)}$$

where:

F = food intake in grams of fresh weight per day (g/day)
BW = body mass of animal (g)
W = mass fraction of water in the food (EFED value = 0.8 for birds and herbivorous mammals, 0.1 for granivorous mammals)

Based on this equation, a 20-gram bird would consume 22.8 grams of food daily (114% of its body weight), a 100-gram bird would consume 65 grams of food daily (65% of its body weight daily), and 1000-gram bird would consume 290 grams of food daily (29% of its body weight). These data, together with the residue concentrations (mg/kg-food item) on selected food items calculated from the Kenaga nomogram, are used to estimate the dose (mg/kg-bw) of residue consumed by the three size classes of birds as discussed below. Using a 20-gram bird as an example, a dietary concentration of 100 mg/kg-diet (ppm) x 1.14 kg diet/kg bw (114%) would result in an equivalent dose-based EEC of 114 mg/kg-bw. T-REX calculates food intake based on dry weight and wet weight of food items. The dose-based assessment uses the wet weight food consumption values by assuming that dietary items are 80% water by weight. However, if dietary items of a species being assessed are known, then a refined dose-based EEC can be calculated using appropriate water fractions of the food items.

A similar relationship between body weight and food intake has been derived for mammals (U.S. EPA 1993):

Mammalian food consumption (g/day)

$$F = \frac{0.621 * BW^{0.564}}{(1 - W)}$$

where:

F = food intake in grams of fresh weight per day (g/day)
BW = body mass of animal (g)
W = mass fraction of water in the food (EFED value = 0.8 for birds and herbivorous mammals, 0.1 for granivorous mammals)

The scaling factors result in a percent body weight consumed presented in the following table for each weight class of mammal. These values are used in the same manner described for birds to calculate dose-based EECs (mg/kg-bw). Note the difference in food intake of grainivores compared with herbivores and insectivores. This is caused by the difference in the assumed mass fraction of water in their diets.

Organism and body weight	**Food intake (g day^{-1})**[a]	**Percent body weight consumed (day^{-1})**[a]
15 g	14.3 / 3.2	95 / 21
35 g	23 / 5.1	66 / 15
1000 g	150 / 34	15 / 3

[a] The first number in this column is specific to herbivores/insectivores. The second number is for granivores. These groups have markedly different consumption requirements.

T-REX calculates food intake based on dry weight and wet weight of food items (wet weight is used for RQ calculations). The dose-based assessment uses the wet weight food consumption values by assuming that dietary items are 80% water by weight (10% for granivores). However, if dietary items of a species being assessed are known, then a refined dose-based EEC can be calculated using appropriate water fractions of the food items.

(3) ***Calculating Adjusted Toxicity Values***

The dose-based EECs (mg/kg-bw) derived above are compared with LD_{50} or NOAEL (mg/kg-bw) values from acceptable or supplemental toxicity studies that are adjusted for the size of the animal tested compared with the size of the animal being assessed (e.g., 20-gram bird). These exposure values are presented as mass of pesticide consumed per kg body weight of the animal being assessed (mg/kg-bw). EECs and toxicity values are relative to the animal's body weight (mg residue/kg bw) because consumption of the same mass of pesticide residue results in a higher body burden in smaller animals compared with larger animals. For birds, only acute values (LD_{50}s) are adjusted because dose-based risk quotients are not calculated for the chronic risk estimation. Adjusted mammalian LD_{50}s and reproduction NOAELs (mg/kg-bw) are used to calculate dose-based acute and chronic risk quotients for 15-, 35-, and 1000-gram mammals. The following equations are used for the adjustment (U.S. EPA 1993):

Adjusted avian LD_{50}:

$$Adj.\,LD_{50} = LD_{50}\left(\frac{AW}{TW}\right)^{(x-1)}$$

where:

Adj. LD_{50} = adjusted LD_{50} (mg/kg-bw) calculated by the equation
LD_{50} = endpoint reported from bird study (mg/kg-bw)
TW = body weight of tested animal (178g bobwhite; 1580g mallard; 350g rat)
AW = body weight of assessed animal (*avian*: 20g, 100g, and 1000g)
x = Mineau scaling factor for birds; EFED default 1.15

Adjusted mammalian NOAELs and LD_{50}s (note that the same equation is used to adjust the NOAEL):

$$Adj.\,NOAEL\ or\ LD_{50} = NOAEL\ or\ LD_{50}\left(\frac{TW}{AW}\right)^{(0.25)}$$

where:

Adj. NOAEL or LD_{50} = adjusted NOAEL or LD_{50} (mg/kg-bw)
NOAEL or LD_{50} = endpoint reported from bird study (mg/kg-bw)
TW = body weight of tested animal (350g rat)
AW = body weight of assessed animal (15g, 35g, 1000g)

(4) ***Calculating Risk Quotients***

Two types of risk quotients are calculated by T-REX based on the estimated dietary residue concentrations determined from the Kenaga nomogram: (1) dietary based RQs; and (2) dose based RQs. These RQs are not equivalent. Dietary risk quotients are calculated by directly comparing the concentration of a pesticide administered (or estimated to be administered) to experimental animals in the diet in a toxicity study to the concentration estimated to be on selected food items. These risk quotients do not account for the fact that smaller-sized animals need to consume more food relative to their body weight than larger animals or those differential amounts of food are consumed depending on the water content and nutritive value of the food. The dose-based risk quotients do account for these factors. The dose-based RQs incorporate the ingestion rate-adjusted exposure from the various food items to the different weight classes of birds and the weight class-scaled toxicity endpoints. Formulas presented in Table IV-B1 are used to calculate dose-based and dietary based risk quotients:

Table IV-B1. Formulas used to calculate dose- and dietary-based risk quotients.

Duration	Dose or Dietary RQ	Surrogate Organism	Equation
Acute	Dose-based	Birds and mammals	Acute Daily Exposure (mg/kg-bw) / adjusted LD_{50} (mg/kg-bw)
	Dietary-based	Birds	*Kenaga* EEC (mg/kg-food item) / LC_{50} (mg/kg-diet)
Chronic	Dietary-based	Birds and mammals	EEC (mg/kg-food item) / NOAEC (mg/kg-diet)
	Dose-based	Mammals only	EEC (mg/kg-bw) / Adjusted NOAEL (mg/kg-bw)

These risk quotients are compared to the Agency's LOCs to determine if risk is greater than EFED's concern level.

Birds - Acute risks from spray and ground application
s-Dimethenamid is categorized as slightly toxic to upland game birds (bobwhite quail) on an acute oral basis (LD_{50} 1,068 mg/kg-bw) and practically non-toxic to both upland game birds and waterfowl by the subacute dietary route (LD_{50} >5,620 mg/kg-diet). In the oral study, sublethal effects were observed at all test dosages, resulting in a NOAEL of <292 mg/kg-bw. Sublethal

effects included reductions in feed consumption, lethargy, ruffled appearance, loss of coordination, lower limb weakness, and coma. Acute LOC exceedances occurred at both application rates (see Table IV-A5), indicating that avian species may be at risk to adverse effects to survival and growth from acute oral exposure to s-dimethenamid as a result of the labeled uses of the pesticide. The potential risk to endangered birds (20, 100 and 1000 g) will be discussed in detail in Section IV.B.6.

In order to evaluate potential lethal and sublethal effects associated with acute exposure to s-dimethenamid on a dose-related basis, the adjusted LD_{50} values are compared to predicted avian doses on food residues (EEC equivalent dose) following the application of s-dimethenamid at 1.5 lbs ai/A (2 applications). Table IV-B2 summarizes this comparison. For the use of dimethenamid on ornamentals, the highest EEC equivalent dose is 588 mg ai/kg-bw for short grass consumed by a 20g bird. The adjusted LD_{50} for a 20 g bird would be 769 mg ai/kg-bw. See Appendix D for T-REX modeling calculations and results following the application of 0.98 lb ai/A for birds.

TABLE IV-B 2. Comparison of Avian Acute Toxicity Values with Predicted Doses on Food Residues

Food Type	Weight class (g)	1.5 lbs ai/A (2 applications)	
		Predicted EEC Equivalent Dose (mg ai/kg-bw)	Adjusted LD_{50} [a] (mg ai/kg-bw)
short grass	20	588	769
	100	336	980
	1000	150	1384
tall grass	20	270	769
	100	154	980
broadleaf forage, small insects	20	331	769
	100	189	980

[a] See Appendix D for T-REX modeling results.

Risk calculations for the acute dietary risk of dimethenamid to avian species calculated using a greater than LD_{50} value (>5620 mg/kg-diet) indicated no LOC exceedances (Table IV-B3); consequently, avian species should not be at risk to adverse effects to survival and growth from acute dietary exposure to s-dimethenamid as a result of the labeled uses of the pesticide.

TABLE IV-B 3. Avian Acute Dietary Risk Quotient Summary for Spray Application [a,b]

Food Type	0.98 lbs ai/A		1.50 lbs ai/A (2 applications)	
	Predicted max. residues	Predicted mean residues	Predicted max. residues	Predicted mean residues
short grass	0.04	0.01	0.09	0.03
tall grass	0.02	0.01	0.04	0.01
broadleaf forage, small insects	0.02	0.01	0.05	0.02
fruit, pods, seeds, large insects	<0.01	<0.01	0.01	<0.01

[a] Acute toxicity threshold was LC_{50} >5620mg/kg-diet.
[b] Detailed calculations of the T-REX model (Ver.1.2.3) and Acute RQs are provided in Appendix D.

Birds – Acute risks from granular application
Based on LD_{50}/ft^2 exposure method and avian oral LD_{50} of 1068 mg/kg bw, the Acute Risk, Acute Restricted Use, and Endangered Species LOCs were exceeded for 20 g birds exposed to fertilizer impregnated granules at both application rates (see Table IV-A6). At the maximum application rate of 1.5 lbs ai/A (2 applications), the Acute Endangered Species LOC was exceeded for 100 g birds.

Birds – Chronic risks
Reproduction studies with r/s-dimethenamid indicate that upland game birds were more sensitive than waterfowl, with significant reductions in adult male body weight and eggshell thickness occurring at 900 and 1,800 mg/kg-diet, respectively. Chronic RQs for s-dimethenamid were calculated using a chronic value that was estimated from an acute to chronic ratio of testing with r/s-dimethenamid, resulting in a NOAEC of 360 mg/kg-diet. At the maximum application rate (1.5 lbs ai/A applied 2 times with 42 day interval) and maximum predicted residues, the Chronic Risk and Endangered Species LOCs were exceeded only for birds consuming short grasses (Table IV-A7), indicating that avian species consuming short grasses may be at risk to adverse effects to growth and reproduction from chronic exposure to s-dimethenamid as a result of the spray or granular application of s-dimethenamid to ornamentals. No risks were observed for the other feed items (tall grasses; broadleaf forage/small insects; or fruit, pods, seeds, large insects). No LOC exceedances were observed at the 0.98 lbs ai/A application rate, indicating that avian species would not be at risk to adverse effects to growth or reproduction from chronic exposure to s-dimethenamid as a result of the spray or granular application of s-dimethenamid to grasses grown for seed or as a result of the ground application of s-dimethenamid to green onions.

Mammals – Acute risks from spray and ground applications
r/s-Dimethenamid is classified as practically non-toxic to mammals on an acute oral basis (LD_{50} value of 2,400 mg/kg-bw). The acute RQs for all weight classes of mammals consuming all feed types are less than the Level of Concern (LOC) indicating adverse effects are not expected from aerial or ground application of dimethenamid. The RQs are detailed in Appendix D.

Mammals - Acute Risks for Granular Applications
Based on LD_{50}/ft^2 exposure method and mammal oral LD_{50} of 2400 mg/kg-bw, the Acute Endangered Species Risk LOC was exceeded for 15 g mammals exposed to fertilizer impregnated granules at both application rates (Table IV-A8). Mammalian species would be at risk to adverse effects from granular application of dimethenamid.

Mammals – Chronic Risks
In a 2-generation reproduction study with rats, r/s-dimethenamid produced decreased weight in pup males, resulting in an offspring NOAEC of 500 mg/kg-diet. No treatment-related effects on reproduction were observed (Appendix F). At both application rates (0.98 and 1.5 lbs ai/A) and maximum predicted residue levels, the dose-based RQs exceeded the Chronic Risk and Endangered Species LOCs for all weight classes of mammals (15, 35, 1000 g) consuming short grasses, tall grasses, and broadleaf forage/small insects. At the maximum application rate and maximum predicted residue levels, the dietary-based RQ exceeded the Chronic Risk and

Endangered Species LOCs for mammals consuming short grasses (Table IV-A9 and IV-A10). Consequently, mammalian species would be at risk to adverse growth or reproductive/developmental effects on foraging behavior when chronically exposed to s-dimethenamid as a result of aerial or ground application of s-dimethenamid to ornamentals, grasses for seed or as a result of the ground application of s-dimethenamid to green onions.

In order to evaluate potential chronic effects associated with exposure to s-dimethenamid on a dose-related basis, the adjusted NOAEL is compared to predicted mammalian doses on food residues (EEC equivalent dose) for all weight classes and food types for which chronic RQs were exceeded at the application rate 1.5 lbs ai/A (2 applications). Table IV-B4 summarizes this comparison. The dose-based EECs range from 9 times (15 g mammals consuming short grasses) to approximately 2 times (1000 g mammals consuming tall grasses) greater than the adjusted NOAELs. See Appendix D for T-REX modeling calculations and results following the application of 0.98 lb ai/A for mammals.

TABLE IV-B 4. Comparison of Mammalian Chronic Toxicity Values with Predicted Doses on Food Residues [a]

Food type	Weight class (g)	1.5 lbs ai/A (2 applications)	
		Dose-based EECs (mg/kg-bw)	Adjusted NOAEL (mg/kg-bw/day)
short grass	15	492.63	54.95
	35	340.48	44.46
	1000	78.94	19.23
tall grass	15	225.79	54.95
	35	156.05	44.46
	1000	36.18	19.23
broadleaf forage, small insects	15	277.11	54.95
	35	191.52	44.46
	1000	44.40	19.23

[a]NOAEC: 500 mg/kg-diet

Non-target Terrestrial-phase Amphibians, Reptiles, and Beneficial Insects
EFED currently uses surrogate data (birds) for non-target terrestrial amphibians and reptiles and does not quantify risks to terrestrial non-target insects. Avian risk data indicates that terrestrial-phase amphibians and reptiles may be at risk to adverse effects to survival and growth from the acute oral exposure to s-dimethenamid as a result of consuming contaminated feed items or ingesting fertilizer impregnated granules at proposed application rates. In addition, terrestrial-phase amphibians and reptiles may be at risk to adverse effects to growth and reproduction from chronic oral exposure to s-dimethenamid as a result of consuming contaminated short grasses at the higher application rate (1.5 lbs ai/A x 2 applications applied 42 days apart).

EFED does not quantify risk to terrestrial non-target insects. Submitted insect toxicity data (acute contact and oral) indicate that r/s-dimethenamid is practically non-toxic to honey bees; consequently, the potential risk to terrestrial insects would be minimal.

b. Terrestrial Plants

Results of Tier II toxicity studies with monocots and dicots indicate that seedling emergence and vegetative vigor are severely impacted by exposure to s-dimethenamid. Seedling emergence, based on shoot length, was adversely impacted in monocots (ryegrass) at an EC_{25} of 0.0059 lb ai/A and in dicots (lettuce) with an EC_{25} of 0.0064 lb ai/A. Vegetative vigor in monocots, based on shoot weight, was adversely impacted in monocots (ryegrass) at an EC_{25} of 0.026 lb ai/A and in dicots (cucumber) at an EC_{25} of 0.12 lb ai/A. The observed phytotoxic effects to monocots and dicots included chlorosis and necrosis.

For the use of dimethenamid on green onions and grasses grown for seed at the application rate of 0.98 lbs ai/A and for ornamentals at the single maximum application rate of 1.5 lbs ai/A, the LOC was exceeded for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas primarily as the result of runoff and drift combined from ground and aerial applications. Runoff from granular formulations of dimethenamid (both unincorporated and incorporated) applied at 0.98 lbs ai/A and 1.5 lbs ai/A also resulted in exceedances of the LOC for non-endangered and endangered monocots and dicots located in adjacent areas and in semi-aquatic areas (Table IV-A11). The LOC was exceeded for non-endangered and endangered monocots located in dry areas as a result of spray drift from aerial applications at 0.98 lbs and 1.5 lbs ai/A application rates. Consequently, nonendangered and endangered monocots and dicots inhabiting semi-aquatic areas and monocots inhabiting dry areas adjacent to a treated field would be at risk for adverse effects to growth and development when exposed to s-dimethenamid as a result of the aerial, ground or granular application of s-dimethenamid to ornamentals, grasses for seed or as a result of the ground application of s-dimethenamid to green onions. A complete spray drift analysis for exposures to non-target terrestrial plants in terrestrial and semi-aquatic areas is provided in Section IV.B.3. The potential risk to endangered monocots and dicots will be discussed in greater detail in Section IV.B.6.

3. Spray Drift Analysis

a. Spray drift buffer for non-target plants

The AgDrift model (Version 2.0.1) was used to calculate the spray drift buffers that would be needed to avoid adverse effects to non-target and listed terrestrial and aquatic plant species. The Tier I model predicts relatively high end drift deposition values at varying distances (a maximum of 1000 feet downwind is observed). Several inputs such as wind speed (10 mph) and release height (10 ft) are preset in the model to represent 90^{th} percentile values for agricultural application. The drift values (drift EECs) at a specific distance obtained from the Tier I model are then compared to the most sensitive plant selected in the vegetative vigor test and aquatic plant studies with dimethenamid to calculate risk quotients. For the AgDrift terrestrial assessment, the ryegrass EC_{25} of 0.0059 lb ai/A and NOAEC of 0.0025 lb ai/A were used as toxicity endpoints. The duckweed EC_{50} of 8.9 µg/L and NOAEC of 1.2µg/L were the toxicity endpoints used in the AgDrift aquatic assessment.

Point exposures were estimated for AgDrift Tier 1 assessment (ground-spray and aerial spray scenarios) for non-target terrestrial and aquatic plants based on single application rates of 0.98 lb ai/A (for onions and grasses grown as seeds) and 1.5 lb ai/A (for ornamentals). In the terrestrial assessment, the ground-spray scenario assumed two sets of application conditions. For ground-spray application to onions and grasses grown for seed, the application rate modeled was 0.98 lb ai/A with low boom application, ASAE[C] very fine to fine spray, and 90th percentile exposure. For ground spray to ornamentals, the application rate modeled was 1.5 lbs ai/A with low boom application and ASAE fine to medium/coarse spray according to statements on the label for Dimethenamid-P Ornamentals Herbicide.

In the terrestrial assessment, two aerial spray scenarios were modeled for the application rates of 0.98 and 1.5 lb ai/A and AgDrift Tier 1 with ASAE very fine to fine spray. Results are presented in Tables IV-B5 and IV-B6. The model runs and additional spray drift analyses are located in Appendix G. Bold values in the tables are LOC exceedances (RQ>1.0).

TABLE IV-B 5. Spray Drift Terrestrial Assessment at 0.98 lb ai/A for Listed and Non-listed Plant Species [a]

No. of application (0.98 lb a.i/.A)	distance from edge of field	% of application rate	EEC (lb ai/A)	Non-listed RQ	Listed RQ	Spray Method
1	0 feet	50	0.60	**102**	**240**	Aerial
1	100 feet	22	0.27	**46**	**108**	Aerial
1	500 feet	6.7	0.08	**14**	**32**	Aerial
1	750 feet	5	0.05	**8.5**	**20**	Aerial
1	1000 feet	4	0.04	**6.8**	**16**	Aerial
1	0 feet	100	0.98	**166**	**392**	Ground
1	100 feet	0.44	0.007	**1.2**	**2.8**	Ground
1	500 feet	0.12	0.002	0.3	0.8	Ground
1	750 feet	<0.1	0.001	0.2	0.4	Ground
1	1000 feet	<0.1	<0.001	<0.1	<0.1	Ground

[a]Based on ryegrass EC_{25} of 0.0059 lb ai/A and NOAEC of 0.0025 lb ai/A.

Under high-end EEC assumptions (ASAE very fine to fine spray) and label recommended assumptions (ASAE medium to coarse spray for ground applications) for the maximum application rate of 0.98 lb ai/A dimethenamid (Table IV-B5), the AgDrift model predicts LOC exceedances for *listed* plant species at distances from the edge of the field to more than 1000 feet for aerial application and up to 210 feet for ground applications. The estimated spray buffers for non-target terrestrial plants (*non-listed*) were more than 1000 feet for aerial application and up to 167 feet for ground application. The estimated aerial spray drift for non-target plants is 4% of applied at 1000 feet; the estimated ground spray drift is 0.6% of applied at 167 feet. The

[C] The American Society of Agricultural Engineers (ASAE) has established standard drop size distributions by which to classify nozzle performance.

estimated ground spray drift for *listed* plants is 0.3% of applied at 210 feet and 4% of applied at 1000 feet for aerial spray drift.

TABLE IV-B 6. Spray Drift Terrestrial Assessment at 1.5 lb ai/A for Listed and Non-listed Plant Species [a]						
No. of application (1.5 lb a.i/.A)	distance from edge of field	% of application rate	EEC (lb ai/A)	Non-listed RQ	Listed RQ	Spray Method
1	0 feet	50	0.75	**127**	**300**	Aerial
1	100 feet	22	0.34	**58**	**136**	Aerial
1	500 feet	6.7	0.10	**17**	**40**	Aerial
1	750 feet	5	0.07	**12**	**28**	Aerial
1	1000 feet	4	0.06	**10**	**24**	Aerial
1	0 feet	100	1.5	**254**	**600**	Ground
1	100 feet	0.95	0.009	**1.5**	**3.6**	Ground
1	500 feet	0.21	0.002	0.3	0.8	Ground
1	750 feet	0.13	0.001	0.2	0.4	Ground
1	1000 feet	<0.1	<0.001	<0.1	<0.1	Ground

[a]Based on ryegrass EC_{25} of 0.0059 lb ai/A and NOAEC of 0.0025 lb ai/A.

Under high-end EEC assumptions (ASAE very fine to fine spray for aerial applications) and label recommended assumptions (ASAE medium to coarse spray for ground applications) for the maximum application rate of 1.5 lb ai/A dimethenamid (Table IV-B6), the AgDrift model predicts LOC exceedances for *listed* plant species at distances from the edge of the field to more than 1000 feet for aerial application and up to 351 feet for ground applications from the edge of the field. The estimated spray buffers for non-target terrestrial plants (*non-listed*) were more than 1000 feet for aerial application and up to 118 feet for ground application. The estimated aerial spray drift for non-target plants is 4% of applied at 1000 feet; the estimated ground spray drift is 0.4% of applied at 118 feet. The estimated ground spray drift for *listed* plants is 0.2% of applied at 351 feet and 4% of applied at 1000 feet for aerial spray drift.

The AgDrift exposure may be over-estimated if the ASAE spray nozzles are more coarse than the ones used in the model and the ground application boom was below the high setting in the terrestrial assessment. These factors lend an uncertainty to the estimate.

b. Surface water measure of exposure from spray drift alone and spray drift buffers

The AgDrift model was used to calculate aquatic exposures where terrestrial and aquatic plants inhabit the EPA standard pond and standard wetland, from spray drift due to agricultural use (single application only). A *ground* spray Tier 1 aquatic assessment was performed, assuming low boom application with ASAE medium to coarse spray, and 90^{th} percentile drift, at the single application rates of 0.98 and 1.5 lb ai/A; the *aerial* spray scenario assumed ASAE coarse to very coarse spray.

Assuming 0.98 lb ai/A, ASAE fine to medium/coarse *ground* spray and a zero-foot buffer, AgDrift calculated that 12.6% of the applied mass or 0.12 lb ai/A would reach the pond or wetland, resulting in an initial average concentration of 6.9 µg/L in the pond and 92.6 µg/L in the wetland; Tier 1 *aerial* analysis was performed, assuming ASAE coarse to very coarse indicated 6.88% of the applied mass or 0.067 lb ai/A would reach the pond or wetland, resulting in concentrations in the pond and wetland of 3.77 µg/L and 50.35 µg/L, respectively. These results suggest the EECs predicted for estimation of risk to aquatic species were underestimates because Tier II aquatic modeling with PRZM/EXAMS only assumes drift of 1% from ground applications and 5% from aerial applications. The results of the AgDrift model at an application rate of 0.98 lb ai/A dimethenamid are tabulated in Table IV-B7 for exposure to terrestrial and aquatic plants. Bold values in the table are LOC exceedances (RQ>1.0).

Using low-end EEC assumptions at the application rate of 0.98 lb ai/A dimethenamid (Table IV-B7), the AgDrift model predicts exceedances of LOC for *listed* terrestrial plant species inhabiting ponds and wetlands exposed from spray drift due to agricultural use at distances up to 1000 feet for aerial applications. Likewise, the model predicts LOC exceedances for *listed* aquatic plants inhabiting wetlands exposed from spray drift at distances of zero up to greater than 750 feet from treated areas as the result of aerial spray applications. AgDrift predicts LOC exceedances for *non listed* terrestrial plants inhabiting ponds and wetlands from zero to 500 feet and *non listed* aquatic plants inhabiting wetlands from zero to 250 feet and *listed* aquatic plants inhabiting ponds exposed from aerial spray drift at distances of 0 to 250 feet for dimethenamid applications.

The estimated spray buffers (0.98 lb ai/A application rate) for non-target terrestrial plants (*non listed*) was 10 feet for ground spray and 364 for aerial spray applications. The estimated spray buffers for non-target terrestrial plants (*listed*) were 121 feet (ground spray) and 1000 feet (aerial). The estimated spray buffer for non-target aquatic plants (*non listed)* inhabiting ponds and wetlands was 0 feet for both ground and aerial spray applications. The estimated spray buffer for non-target aquatic plants (*listed*) inhabiting ponds was 0 feet for ground application and 72 feet for aerial application. The estimated spray buffer for non-target aquatic plants (*listed*) inhabiting wetlands was 262 feet for ground application and greater than 1000 feet for aerial application.

TABLE IV-B 7. Spray Drift Aquatic Assessment at 0.98 lb ai/A for Listed and Non-Listed Plant Species [a,b]						
No. of application (0.98 lb ai/A)	**distance from edge of field**	**% of application rate**	**EEC**	**Non-listed RQ**	**Listed RQ**	**Spray Method**
TERRESTRIAL PLANTS INHABITING PONDS and WETLANDS [1]						
1	0 feet	6.9	0.068 lb ai/A	**11**	**27**	Aerial
1	250 feet	0.8	0.008lb ai/A	**1.4**	**3.2**	Aerial
1	500 feet	0.5	0.005 lb ai/A	0.8	**2.0**	Aerial
1	750 feet	0.3	0.003 lb ai/A	0.5	**1.2**	Aerial
1	1000 feet	0.2	0.002 lb ai/A	0.3	1.0	Aerial
1	0 feet	1.0	0.010 lb ai/A	**1.7**	**4**	Ground
1	250 feet	0.2	0.002 lb ai/A	0.3	0.8	Ground
1	500 feet	0.1	0.001 lb ai/A	0.2	0.4	Ground
1	750 feet	<0.1	<0.001 lb ai/A	<0.2	<0.4	Ground
1	1000 feet	<0.1	<0.001 lb ai/A	<0.2	<0.4	Ground
AQUATIC PLANTS INHABITING PONDS [2]						
1	0 feet	6.9	3.78 µg/L	0.42	**3.15**	Aerial
1	250 feet	0.8	0.44 µg/L	0.05	0.37	Aerial
1	500 feet	0.5	0.25 µg/L	0.03	0.21	Aerial
1	750 feet	0.3	0.18µg/L	0.02	0.15	Aerial
1	0 feet	1.0	0.59 µg/L	0.06	0.49	Ground
1	250 feet	0.2	0.09 µg/L	0.01	0.07	Ground
1	500 feet	0.1	0.05 µg/L	<0.01	0.04	Ground
1	750 feet	<0.1	0.04 µg/L	<0.01	0.03	Ground
AQUATIC PLANTS INHABITING WETLANDS [2]						
1	0 feet	6.9	50.35 µg/L	**5.66**	**42**	Aerial
1	250 feet	0.8	5.86 µg/L	0.66	**4.9**	Aerial
1	500 feet	0.5	3.35 µg/L	0.38	**2.8**	Aerial
1	750 feet	0.3	2.43 µg/L	0.27	**2.0**	Aerial
1	0 feet	1.0	7.98 µg/L	0.89	**6.6**	Ground
1	250 feet	0.2	1.23 µg/L	0.14	1.0	Ground
1	500 feet	0.1	0.75 µg/L	0.08	0.62	Ground
1	750 feet	<0.1	0.53 µg/L	0.06	0.44	Ground

[a]Based on ryegrass EC_{25} of 0.0059 lb ai/A and NOAEC of 0.0025 lb ai/A.
[b] Based on duckweed EC_{25} of 8.9 µg/L and NOAEC of 1.2 µg/L.

TABLE IV-B 1. Spray Drift Aquatic Assessment at 1.5 lb ai/A for Listed and Non-Listed Plant Species [a,b]						
No. of application (1.5 lb ai/A)	**distance from edge of field**	**% of application rate**	**EEC**	**Non-listed RQ**	**Listed RQ**	**Spray Method**
TERRESTRIAL PLANTS INHABITING PONDS and WETLANDS [1]						
1	0 feet	6.9	0.103 lb ai/A	**17**	**41**	Aerial
1	250 feet	0.8	0.012 lb ai/A	**2.0**	**4.8**	Aerial
1	500 feet	0.5	0.007 lb ai/A	**1.2**	**2.8**	Aerial
1	750 feet	0.3	0.005 lb ai/A	0.8	**2.0**	Aerial
1	1000 feet	0.2	0.004 lb ai/A	0.7	**1.6**	Aerial
1	0 feet	1.0	0.016 lb ai/A	**2.7**	**6.4**	Ground
1	250 feet	0.2	0.003 lb ai/A	0.5	**1.2**	Ground
1	500 feet	0.1	0.002 lb ai/A	0.4	0.8	Ground
1	750 feet	<0.1	0.001 lb ai/A	0.2	0.4	Ground
1	1000 feet	<0.1	<0.001 lb ai/A	<0.2	<0.4	Ground
AQUATIC PLANTS INHABITING PONDS [2]						
1	0 feet	6.9	5.78 µg/L	0.65	**4.8**	Aerial
1	250 feet	0.8	0.67 µg/L	0.07	0.56	Aerial
1	500 feet	0.5	0.38 µg/L	0.04	0.32	Aerial
1	750 feet	0.3	0.28 µg/L	0.03	0.23	Aerial
1	0 feet	1.0	0.92 µg/L	0.10	0.77	Ground
1	250 feet	0.2	0.14 µg/L	0.02	0.12	Ground
1	500 feet	0.1	0.08 µg/L	<0.01	0.06	Ground
1	750 feet	<0.1	0.06 µg/L	<0.01	0.05	Ground
AQUATIC PLANTS INHABITING WETLANDS[2]						
1	0 feet	6.9	77.07 µg/L	**8.7**	**64**	Aerial
1	250 feet	0.8	8.97 µg/L	1.0	**7.5**	Aerial
1	500 feet	0.5	5.13 µg/L	0.58	**4.3**	Aerial
1	750 feet	0.3	3.72 µg/L	0.42	**3.1**	Aerial
1	0 feet	1.0	12.2 µg/L	**1.4**	**10**	Ground
1	250 feet	0.2	1.89 µg/L	0.21	**1.6**	Ground
1	500 feet	0.1	1.15 µg/L	0.13	0.96	Ground
1	750 feet	<0.1	0.81 µg/L	0.09	0.67	Ground

[a]Based on ryegrass EC_{25} of 0.0059 lb ai/A and NOAEC of 0.0025 lb ai/A.
[b] Based on duckweed EC_{25} of 8.9 µg/L and NOAEC of 1.2 µg/L.

Assuming 1.5 lb ai/A, ASAE fine to medium/coarse *ground* spray and a zero-foot buffer, AgDrift calculated that 1% of the applied mass or 0.02 lb ai/A would reach the pond or wetland, resulting in an initial average concentration of 0.92 µg/L in the pond and 12.2 µg/L in the wetland; Tier 1 *aerial* analysis was performed, assuming ASAE coarse to very coarse indicated 6.88% of the applied mass or 0.10 lb ai/A would reach the pond or wetland, resulting in concentrations in the pond and wetland of 5.78 µg/L and 77.07 µg/L, respectively. These results suggest underestimation of EECs used in calculation of risk to aquatic species from aerial applications, for which PRZM/EXAMS modeling assumes drift of 5%. The results of the

AgDrift model at an application rate of 1.5 lb ai/A dimethenamid are tabulated in Table IV-B8. for exposure to terrestrial and aquatic plants. Bold values in the table are LOC exceedances (RQ>1.0).

Using low- end EEC assumptions at the application rate of 1.5 lb ai/A dimethenamid (Table IV-B8), the AgDrift model predicts exceedances of LOC for *listed* terrestrial plant species inhabiting ponds and wetlands exposed from spray drift due to agricultural use at distances of 0 up to 1000 feet for aerial applications. Likewise, the model predicts LOC exceedances for *listed* aquatic plants inhabiting wetlands exposed at distances of zero up to greater than 750 feet from treated areas as the result of aerial spray applications. AgDrift predicts LOC exceedances for *non listed* terrestrial plants inhabiting ponds and wetlands from zero to 750 feet and *non listed* aquatic plants inhabiting wetlands from zero to 250 feet and *listed* aquatic plants inhabiting ponds exposed from aerial spray drift at distances of 0 to 250 feet for dimethenamid applications.

The estimated spray buffers (1.5 lb ai/A application rate) for non-target terrestrial plants (*non listed*) was 39 feet for ground spray and 597 for aerial spray applications. The estimated spray buffers for non-target terrestrial plants (*listed*) were 255 feet (ground spray) and greater than 1000 feet (aerial). The estimated spray buffer for non-target aquatic plants (*non listed)* inhabiting ponds was 0 feet for both ground and aerial spray applications. The estimated spray buffer for non-target aquatic plants (*listed*) inhabiting ponds was 0 feet for ground application and 127 feet for aerial application. The estimated spray buffer for non-target aquatic plants (*non listed*) inhabiting wetlands was 3 feet for ground application and 252 feet for aerial application. The estimated spray buffer for non-target aquatic plants (*listed*) inhabiting wetlands was 472 feet for ground application and greater than 1000 feet for aerial application.

The AgDrift exposure assessment to non-target plants inhabiting ponds and wetlands may be under-estimated if the ASAE spray nozzles are more fine than the ones used in the model and the ground application boom was above the low setting in the aquatic assessment. These factors lend an uncertainty to the estimate.

The results of this screening risk assessment indicate that direct effects to plant species could present an indirect risk at the higher levels of organization (i.e. population, trophic level, community, and ecosystem). Field studies are not available to quantify actual risk to plant and animal communities in forest/edge and wetland/riparian habitats. However, in terrestrial and shallow-water aquatic communities, plants are the primary producers upon which the succeeding trophic levels depend. If the available plant material is impacted due to the effects of dimethenamid, this may have negative effects not only on the herbivores, but throughout the food chain. Also, depending on the severity of impacts to the plant communities [i.e., forests, wetlands, ecotones (edge and riparian habitats)], community assemblages and ecosystem stability may be altered (i.e. reduced bird populations in edge habitats; reduced riparian vegetation resulting in increased light penetration and temperature in aquatic habitats, loss of cover and food for fish). In addition, riparian vegetation, which is a significant component of the food supply for aquatic herbivores and detritivores provides habitat (i.e. leaf packs, materials for case-building for invertebrates) may also be affected.

4. Review of Incident Data

The National Pesticide Information Center (NPIC) prepares summaries of information provided by individuals who have contacted the NPIC for information or to report a pesticide incident. None of this information has been verified or substantiated by independent investigations of NPIC staff, laboratory analysis, or any other means. Thus, if a person alleges/reports a pesticide incident, it will likely be recorded as an incident by NPIC. NPIC qualifies the information by assigning a Certainty Index (CI), which is an indication of the degree of certainty that an incident that the purported incident was related to a pesticide exposure. CIs, range from 1 = "definite" to 5 = "unrelated". NPIC makes no claims or guarantees as to the accuracy of the CI or other information presented in its reports, other than that NPIC has done its best to accurately document/record the information provided to NPIC.

FIFRA 6(a)(2) incident data add lines of evidence to risk predictions from the screening level assessment thus supporting the risk predictions with actual effects in the field. Incidents recorded in the Ecological Incident Information System (EIIS) as of June 6, 2006 include damage to terrestrial plants, especially food crops as a result of exposure following application of formulations containing dimethenamid. No incidents have been reported in EIIS since 2003.

a. Incidents Involving Aquatic Animals

There are no reported incidents involving aquatic animals.

b. Incidents Involving Terrestrial Animals

(1) *Animals*

There are no reported incidents involving terrestrial animals.

(2) *Plants*

Below lists the wildlife incidents attributed to the approved agricultural uses of s-dimethenamid (Outlook) that have been reported to the Agency. Three incidents have been documented on two crops following the use of registered s-dimethenamid. The majority of the plant damage (i.e., mortality, discoloration, and uneven height) were associated with the previously approved uses of dimethenamid on corn**.**

Formulation	Crop	Date and Location	Species Affected	Number Found	Residue and ChE Analysis	Miscellaneous, App. Rate, Method, etc.	Citation
Outlook	Corn, field	May 2003. Cedar Co., IA	Corn	385 acres	No	Ground application	I014702-030
Outlook	Corn, sweet	July 2003. WA	Corn	515 and 145 acres	No	Not reported	I014796-001 and I014796-002
Unknown	Peanut	May 2001, Bertie Co., NC	Peanut	all 80 acres treated	No	Not reported	I011838-056

In addition, Frontier, a registered use with the r/s-dimethenamid racemic mixture was shown to be similar in toxicity to the purified isomer, s-dimethenamid. Based on the relative toxicity of both enantiomers, there are 22 incident reports in the Agency Pesticide Incident Data Base for Frontier. Five out of twenty-one incident reports have been documented on two crops following the use of the registered use. The legality of the 16 remaining incident reports is undetermined. Below lists the wildlife incidents attributed to the approved agricultural uses of r/s-dimethenamid (Frontier) that have been reported to the Agency.

Formulation	Crop	Date and Location	Species Affected	Number Found	Residue and ChE Analysis	Miscellaneous, Appl. Rate, Method, etc.	Citation
Frontier	Corn, field	May 2003. Cedar Co., IA	Corn	385 acres	No	Ground application	I014702-030
Frontier	Corn, sweet	July 2003. WA	Corn	515 and 145 acres	No	Not reported	I014796-001 and I014796-002
Frontier	Peanuts	June 2001. Bertie Co., NC	Peanuts	114.2 acres	No	Not reported	I012684-009
Frontier	Peanuts	June 2001. Bertie Co., NC	Peanuts	10 acres	No	Not reported	I011838-055
Undetermined	Agricultural site	Outagamie Co., WI	Peonies	Unknown	No	Not reported	I005880-024
			Roses				
			Trees				
Undetermined	Agricultural site	Outagamie Co., WI	Ornamentals	Unknown	No	Spray	I005880-037
			Trees				
Undetermined	Agricultural site	Waushara Co., WI	Alfalfa	Unknown	No	Ground spray	I005880-020
			Corn	Unknown			
Undetermined	Agricultural site	Outagamie Co., WI	Ornamentals	Unknown	No	Not reported	I005880-038
			Trees				
Undetermined	Agricultural site	Outagamie Co., WI	Ornamentals	Unknown	No	Pre-tilled	I005880-041
			Trees				
Undetermined	Not reported	June 2000. Lee Co., IL	Corn	ALL	No	Not reported	I010837-067
Undetermined	Not reported	Lafayette Co., WI	Raspberries	10 acres	No	Spray	I005880-008
Undetermined	Not reported	Green Co., WI	Raspberries	Unknown	No	Ground application	I005880-012
Undetermined	Not reported	Fond du Lac Co., WI	Ornamentals	Unknown	No	Ground application	I005880-017
Undetermined	Not reported	Outagamie Co., WI	Organic farm	Unknown	No	Spray	I005880-018
Undetermined	Not reported	Dodge Co., WI	Trees	Unknown	No	Spray	I005880-030
			Shrubs				
Undetermined	Not reported	Monroe Co., WI	Trees	Unknown	No	Spray	I005880-009
			Shrubs				
Undetermined	Peanuts	May 2001. Northampton Co., NC	Peanuts	55.3 acres of 63.5	No	Not reported	I012457-007
Undetermined	Peanuts	May 2001. Bertie Co., NC	Peanuts	80 acres	No	Not reported	I011838-056
Undetermined	Peanuts	May 2001. Hertford Co., NC	Peanuts	26 acres	No	Not reported	I012457-006
Undetermined	Peanuts	May 2001. Northampton Co., NC	Peanuts	114 acres of 135	No	Not reported	I012457-011
Undetermined	Agricultural site	May 2000. Columbia Co., WI	Perch	2000 acres	No	Not reported	I010274-002

5. Endocrine Effects

EPA is required under the Federal Food, Drug, and Cosmetic Act (FFDCA), as amended by the Food Quality Protection Act (FQPA), to develop a screening program to determine whether certain substances (including all pesticide active and other ingredients) "*may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen, or other such endocrine effects as the Administrator may designate.*" Following the recommendations of its Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC), EPA determined that there was a scientific basis for including, as part of the program, the androgen and thyroid hormone systems, in addition to the estrogen hormone system. EPA also adopted EDSTAC's recommendation that the Program include evaluations of potential effects in wildlife. For pesticide chemicals, EPA will use the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) and, to the extent that effects in wildlife may help determine whether a substance may have an effect in humans, FFDCA authority to require the wildlife evaluations. As the science develops and resources allow, screening of additional hormone systems may be added to the Endocrine Disruptor Screening Program (EDSP). When the appropriate screening and/or testing protocols being considered under the Agency's EDSP have been developed, dimethenamid may be subjected to additional screening and/or testing to better characterize effects related to endocrine disruption.

6. 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 so conservatively assumes that listed species within those broad groups are co-located with the pesticide treatment area. This means that terrestrial plants and wildlife are assumed to be located on or adjacent to the treated site and aquatic animals 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 which has the relatively highest potential exposure to the pesticide, and that exposures are likely to decrease with distance from the treatment area. Section II.A.4. of this risk assessment presents the pesticide use sites that are used to establish initial collocation of species with treatment areas.

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. Consequently, for this risk assessment for dimethenamid, a "no effect" determination can be made for listed species of aquatic fish and invertebrates; since the acute RQs for these taxonomic groups did not exceed the Endangered Species LOCs. 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 and could be considered along with available information on the fate and transport properties of the pesticide 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 preliminary risk assessment for endangered species indicates that dimethenamid exceeds the Endangered Species LOCs for the specified use scenario for the following taxonomic groups:

- Birds, reptiles, and terrestrial-phase amphibians foraging short grass, broadleaves/small insects, and tall grass coated with dimethenamid residues for crop and non-crop uses at maximum and minimum application rates, including granular application.
- Mammals foraging short grass, broadleaves/small insects, and tall grass coated with dimethenamid residues for crop and non-crop uses at maximum and minimum application rates, including granular application.
- Terrestrial plants adjacent to treated areas, in semi-aquatic areas, and drift for crop and non-crop uses at both maximum and minimum application rates by aerial spray; plant adjacent to treated areas and in semi-aquatic areas for crop and non-crop uses at both maximum and minimum application rates by ground spray and granular application.
- Freshwater, estuarine, and marine aquatic plants adjacent treated areas for crop and non-crop uses at both maximum and minimum application rates by spray and granular applications.

The Endangered Species LOC was not exceeded for fish, invertebrates, and aquatic-phase amphibians. For more details on taxonomic groups potentially at risk based on weight classes and use patterns can be found in Appendix D and E.

(1) *Discussion of Risk Quotients*

For a screening level risk assessment, EFED determines what endangered species may be affected by performing a screening level assessment. If the RQs from this assessment do not exceed the listed species LOCs, endangered species may not to be effected. However, the Agency's LOC for endangered and threatened birds, mammals, reptiles, terrestrial-phase amphibians, aquatic vascular plants, and non-target terrestrial plants is exceeded for the use of dimethenamid as outlined in previous sections. Should estimated exposure levels occur in proximity to listed resources, the available screening level information suggests a potential concern for direct effects on listed species within these taxonomic groups listed above associated with the use of dimethenamid as described in Section II.A.4

(2) ***Probit Dose Response Relationship***

A probit dose response analysis was performed for toxicity studies for which slopes with 95% confidence intervals were available, including freshwater invertebrate (daphnid), marine invertebrates (mysid shrimp), birds (bobwhite quail) and non-target terrestrial plants. The probit slope response relationship is evaluated to calculate the chance of an individual event corresponding to the listed species acute LOCs. The analysis uses the EFED spreadsheet IECv1.1.xls, developed by Ed Odenkirchen (6/22/04). It is important to note that the IEC model output can go as high as 1×10^{16} or as low as 1×10^{-16} in estimating the event probability. 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.

Freshwater Invertebrates: Based on an assumption of a probit dose response relationship with a mean estimated slope of 15, the corresponding estimated chance of individual mortality associated with the listed species LOC of 0.05 the acute toxic endpoint for freshwater invertebrates is >1 in 1×10^{16}. It is recognized that extrapolation of very low probability events is associated with considerable uncertainty in the resulting estimates. To explore possible bounds to such estimates, the upper and lower values for the mean slope estimate (10 – 13) were used to calculate upper and lower estimates of the effects probability associated with the listed species LOC. These values are both >1 in 1×10^{16}.

Estuarine/Marine Invertebrates: Based on an assumption of a probit dose response relationship with a mean estimated slope of 4.1, the corresponding estimated chance of individual mortality associated with the listed species LOC of 0.05 and the acute toxic endpoint for estuarine/marine invertebrates is 1 in 2.08×10^{7}. It is recognized that extrapolation of very low probability events is associated with considerable uncertainty in the resulting estimates. To explore possible bounds to such estimates, the upper and lower values for the mean slope estimate (2.7 to 3.9) were used to calculate upper and lower estimates of the effects probability associated with the listed species LOC. These values are 1 in 4.51×10^{3} and 1 in 5.13×10^{6}, respectively.

Bird: Based on an assumption of a probit dose response relationship with a mean estimated slope of 6, the corresponding estimated chance of individual mortality associated with the listed species LOC of 0.1 and the acute toxic endpoint for birds is 1 in 1.01×10^{9}. It is recognized that extrapolation of very low probability events is associated with considerable uncertainty in the resulting estimates. To explore possible bounds to such estimates, the upper and lower values for the mean slope estimate (845 to 1356) were used to calculate upper and lower estimates of the effects probability associated with the listed species LOC. These values are both >1 in 1×10^{16}.

(3) ***Data Related to Under-represented Taxa***

Effects data from other analyzed sources (ECOTOX Database, PAN Database) were not obtained for this screening risk assessment.

c. Indirect Effects Analysis

The non-endangered and endangered species LOC were exceeded for terrestrial (monocots and dicots) and aquatic plants (vasculars and nonvasculars) adjacent green onion, ornamental, and grasses grown for seed fields receiving runoff and drift from aerial and ground applications. The guideline plant studies indicate direct adverse effects to seedling emergence, vegetative vigor, and aquatic vascular and non-vascular species, as well as non-lethal effects of chlorosis and necrosis in terrestrial plants. In terrestrial and aquatic ecosystems, plants are the primary producers upon which the succeeding trophic levels depend. If the available plant material is impacted due to the effects of dimethenamid, this may have negative effects not only on the herbivores, but also throughout the food chain. In addition, depending on the severity of impacting to the plant community (i.e., forests, wetlands, ecotones (edge and riparian habitats)), assemblages and ecosystem may be altered (i.e., reduced bird populations in edge habitats, reduced riparian vegetation resulting in increased light penetration and temperature in aquatic habitats, loss of cover and food for fish).

The acute risk, acute restricted use, and endangered species LOCs were exceeded for birds, terrestrial-phase amphibians and reptiles foraging in the fields. The chronic risk LOC was exceeded for mammals foraging in the fields. There are potential concerns for indirect effects on animals that eat mammals, birds, reptiles or terrestrial-phase amphibians; plants that require mammals or birds as pollinators or seed dispersers; or listed animals that use mammal or reptile burrows for shelter or breeding habitat.

d. 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 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 (risk quotients, RQs) and listed species levels of concern (LOCs) that are used to evaluate direct and indirect effects to listed animals.

The screening-level risk assessment has identified potential concerns for indirect effects on listed species for those animals dependant upon birds, mammals, reptiles, terrestrial-phase amphibians, aquatic plants, and terrestrial and semi-aquatic plants. In light of the potential for indirect effects, the next step for EPA and the Service(s) is to identify which listed species and critical habitat are potentially implicated. Analytically, the identification of such species and critical habitat can occur in either of two ways. First, the agencies could determine whether the action area overlaps critical habitat or the occupied range of any listed species. If so, EPA would examine whether the pesticide's potential impacts on non-endangered species would affect the listed species indirectly or directly affect a constituent element of the critical habitat. Alternatively, the agencies could determine which listed species depend on biological resources, or have constituent elements that fall into, the taxa that may be directly or indirectly impacted by the pesticide. Then EPA would determine whether use of the pesticide overlaps the critical habitat or the occupied range of those listed species. At present, the information reviewed by EPA does not permit use of either analytical approach to make a definitive identification of species that are potentially impacted indirectly or critical habitats that is potentially impacted directly by the use of the pesticide. EPA and the Service(s) are working together to conduct the necessary analysis.

This screening-level risk assessment for critical habitat 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 as being of potential concern for indirect effects and include the following: birds, mammals, reptiles, terrestrial-phase amphibians, aquatic plants, and terrestrial and semi-aquatic plants. This list should serve as an initial step in problem formulation for further assessment of critical habitat impacts outlined above, should additional work be necessary.

e. Direct Effect Co-occurrence Analysis

Because the Endangered Species LOC for terrestrial and aquatic plants, birds, reptiles, terrestrial-phase amphibians, and mammals is exceeded for the use of dimethenamid on grasses grown for seed, ornamental, and green onion sites, LOCATES was run for all listed terrestrial and aquatic plants, birds, reptiles, mammals, and amphibians to determine the potential for co-occurrence of listed species located nationwide where green onions, ornamentals, and grasses grown for seed are grown.

The LOCATES tool does has a crop analysis available for "green onions" but does not have one available for "ornamentals" or "grasses grown for seed"; therefore, a list of nursery crops (*aquatic plants; bedding/garden plants; bulbs/corms/rhizomes/ tubers; christmas trees cut \ acres in production; floriculture crops - bedding/garden plants; cut flowers& florist greens; foliage and potted flowering plants; flowers and florist greens; foliage plants; greenhouse vegetable; nursery and greenhouse crops – other; nursery stock; nursery; floriculture; vegetable & flower seed crops; sod harvested; grown in the open; irrigated; greenhouse; floriculture; mushrooms; flower seeds; vegetable seeds; potted flowering plants; seeds – flower; vegetable seeds; and woody crops)* and grasses (*bentgrass; Kentucky bluegrass; fescue; orchardgrass; and ryegrass)* were selected for ornamentals and grasses grown for seed, respectively, located nationwide.

LOCATES found a screening-level listing of 571 endangered/threatened species for green onions, 156 endangered/threatened species for grasses grown for seed, and 865 endangered/threatened species for ornamentals. Consequently, based on the information available, it is presumed listed species reside in counties where grasses grown for seed, ornamentals, and green onions are grown (Table IV.5).

Table IV.5. Number of Listed Species Located in Crop and Non-Crop Growing Counties of USA.

Crop	Affected Counties	Affected Species	No. of Co-occurrences
Grasses grown for seed	472	156	1754

Green onion	447	571	1920
Ornamentals	2511	865	64,715

f. Indirect Effect Co-occurrence Analysis

The screening-level RQ for terrestrial and aquatic plants, birds, reptiles, terrestrial-phase amphibian, mammals exceeds the LOC for endangered species. In accordance with established procedures such findings suggest a potential concern for indirect effects to listed species with both narrow (i.e., species that are obligates or have very specific habitat or feeding requirements) and general dependencies (i.e., cover type requirements) on plants and animals as a resource or important habitat component. LOCATES was used to preliminarily identify listed species that are located within the counties in USA where dimethenamid could be used. This analysis considered all animal taxonomic groups included (i.e. insects, fish, aquatic invertebrates, arachnids, and snails). The available screening level information allows a county-level analysis to identify species that could be potentially indirectly affected by dimethenamid effects on listed species from green onion, grasses grown for seed, and ornamental uses in counties of USA. These animal species that reside in those counties, and the basis for the designation, are in Appendix K and are summarized in Table IV-6, below. Such potential concerns are limited by the true potential for exposures of critical plants resources to modeled dimethenamid levels and the relationship between listed species and potentially affected plants, birds, reptiles, terrestrial-phase amphibians, and mammals. Consequently, additional analysis of listed species locations, refinement of the action area associated with dimethenamid regulatory decisions, and the biology of the potentially affected species would be needed before an effects determination can be made for any of the co-located species identified by this assessment for potential indirect effects.

Table IV-6. Listed taxonomic groups potentially at risk associated with direct or indirect effects due to applications of dimethenamid for the proposed new uses.

Listed Taxon	**Direct Effects**	**Basis for Direct Effects Concern**	**Indirect Effects**	**Basis for Indirect Effects Concern**
Terrestrial and Semi-Aquatic Plants – monocots and dicots	Yes	The endangered LOC is exceeded for terrestrial plants.	No	
Terrestrial Invertebrates	No	Data shows flazasufluron is practically nontoxic to honeybees, no direct effect concerns for terrestrial invertebrates.	Possible	Potential concerns for terrestrial invertebrates that use plants for habitat, feeding, or cover requirements.
Birds and Reptiles[1]	Yes	The endangered species LOC is exceeded for birds.	Possible	Potential concerns for birds and reptiles that use reptile burrows for shelter or breeding habitat; use plants for habitat, feeding, or cover requirements.
Terrestrial-phase Amphibians[1]	Yes	There are direct effect concerns for terrestrial-phase amphibians since the endangered species LOC was exceeded for birds.	Possible	Potential concerns for terrestrial-phase amphibians that use plants for habitat, feeding, or cover requirements.
Mammals	Yes	The chronic LOC for endangered mammals is exceeded.	Possible	Potential concerns for mammals that use mammal burrows for shelter or breeding habitat; use plants for habitat, feeding, or cover requirements.
Aquatic Vascular Plants	Yes	The endangered species LOC is exceeded for aquatic vascular plants.	Possible	Potential concerns for plants that use animals as pollinators or seed dispersers.
Freshwater and Marine/Estuarine fish and Aquatic-phase Amphibians[2,3]	No	The LOC is not exceeded	Possible	Potential concerns for fish and aquatic-phase amphibians that use plants for habitat, feeding, or cover requirements.
Freshwater and Marine/Estuarine Crustaceans[3]	No	The LOC is not exceeded	Possible	Potential concerns for crustaceans that use plants for habitat, feeding, or cover requirements.
Mollusks	No	The LOC is not exceeded	Possible	Potential concerns for mollusks that use plants for habitat, feeding, or cover requirements.
Aquatic Nonvascular Plants – algae and diatoms	Yes	The endangered species LOC is exceeded for aquatic nonvascular plants.	No	Indirect effects to aquatic nonvasculars are possible; however, there are no listed aquatic nonvasculars in the endangered species database.

1 Birds are used as surrogate species for terrestrial-phase amphibians and reptiles; therefore, potential direct and indirect effects to endangered avian, terrestrial-phase amphibians and reptilian species are considered equivalent.
2 Fish are used as a surrogate for aquatic phase amphibians; therefore, potential direct and indirect effects to endangered fish and aquatic-phase amphibian species are considered equivalent.
3 Data in saltwater fish and invertebrates are not available; therefore, risks to freshwater and saltwater animals are considered equivalent until additional data are submitted.

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

1. Uncertainties, assumptions, and limitations associated with models

Aquatic Models

Although there are uncertainties associated with using the standard PRZM/EXAMS runoff scenario (10-ha field draining into a 20,000-m^3 pond with no outlet) for an aquatic exposure assessment, it is designed to represent pesticide exposure from an agricultural watershed impacting a vulnerable aquatic environment. Extrapolating the risk conclusions from the standard pond scenario modeled by PRZM/EXAMS may either underestimate or overestimate the potential risks.

Major uncertainties with the standard runoff scenario are associated with the physical construct of the watershed and representation of vulnerable aquatic environments for different geographic regions. The physicochemical properties (pH, redox conditions, etc.) of the standard farm pond are based on a Georgia farm pond. These properties are likely to be regionally specific because of local hydrogeological conditions. Any alteration in water quality parameters may impact the environmental behavior of the pesticide. The farm pond represents a well mixed, static water body. Because the farm pond is a static water body (no flow through), it does not account for pesticide removal through flow through or accidental water releases. However, the lack of water flow in the farm pond provides an environmental condition for accumulation of persistent pesticides. The assumption of uniform mixing does not account for stratification due to thermoclines (e.g., seasonal stratification in deep water bodies). Additionally, the physical construct of the standard runoff scenario assumes a watershed:pond area ratio of 10. This ratio is recommended to maintain a sustainable pond in the Southeastern United States. The use of higher watershed:pond ratios (as recommended for sustainable ponds in drier regions of the United States) may lead to higher pesticide concentrations when compared to the standard watershed:pond ratio.

The standard pond scenario along with the crop-specific input scenarios assume that uniform environmental and management conditions exist over the standard 10 hectare watershed. Soils can vary substantially across even small areas, and thus, this variation is not reflected in the model simulations. Additionally, the impact of unique soil characteristics (e.g., fragipan) and soil management practices (e.g., tile drainage) are not considered in the standard runoff scenario. The assumption of uniform site and management conditions is not expected to represent some site-specific conditions. Extrapolating the risk conclusions from the standard pond scenario to other aquatic habitats (e.g., marshes, streams, creeks, and shallow rivers, intermittent aquatic areas) may either underestimate or overestimate the potential risks in those habitats. In this case, the OR grass seed scenario, in particular, may underestimate exposure from that use. It was designed to be representative of a vulnerable site in the Pacific Northwest rather than a nationally representative scenario. Although there is uncertainty associated with the CA onion scenario because irrigation is not considered, the alternative GA onion scenario is likely to be adequately conservative for the use on green onions.

Monitoring data were not considered and the estimation of exposure of aquatic species to dimethenamid is based entirely on the modeled data. The output of models such as

PRZM/EXAMS is dependent upon the quality of the environmental fate input parameters. Some uncertainty comes from using inputs based on studies in r,s-dimethenamid rather than in the s-isomer alone. Bridging studies show, however, that fate properties are likely to be similar for the mixture and the individual isomer. No aquatic dissipation studies are available, and an assumption regarding the half-life of dimethenamid in aqueous bodies such as lakes, ponds, etc. had to be made from laboratory data on the aerobic soil degradation half-life. Future monitoring studies and aquatic dissipation field studies would be useful in order to determine how well the modeled results fit measured levels of dimethenamid in aquatic environments following its application in the proposed uses at appropriate rates.

Terrestrial Models

The data available to support the terrestrial exposure assessment for dimethenamid are substantially complete, with the exception of a foliar dissipation study, which is an input variable for modeling of risks to birds and mammals (i.e.,T-REX). The terrestrial modeling was conducted using a default foliar half-life value of 35 days. Use of this default value could overestimate the foliar half-life for dimethenamid, higher terrestrial EECs, and risk. However, it should be noted that because the EEC represents the concentration immediately following a direct application, the foliar half-life variable is only influential for scenarios involving multiple applications.

As discussed earlier in the exposure section of this document, the Agency relies on the work of Fletcher et al. (1994) for setting the assumed pesticide residues in wildlife dietary items. The Agency believes that these residue assumptions reflect a realistic upper-bound residue estimate, although the degree to which this assumption reflects a specific percentile estimate is difficult to quantify. It is important to note that the field measurement efforts used to develop the Fletcher estimates of exposure involve highly varied sampling techniques. It is entirely possible that much of these data reflect residues averaged over entire above ground plants in the case of grass and forage sampling. Depending upon a specific wildlife species' foraging habits, whole aboveground plant samples may either underestimate or overestimate actual exposure.

The acute and chronic characterizations of risk rely on comparisons of wildlife dietary residues with LC_{50} or NOAEC values expressed in concentrations of pesticides in laboratory feed. These comparisons assume that ingestion of food items in the field occurs at rates commensurate with those in the laboratory. Although the screening assessment process adjusts dry-weight estimates of food intake to reflect the increased mass in fresh-weight wildlife food intake estimates, it does not allow for gross energy and assimilative efficiency differences between wildlife food items and laboratory feed. On gross energy content alone, direct comparison of a laboratory dietary concentration-based effects threshold to a fresh-weight pesticide residue estimate would result in an underestimation of field exposure by food consumption by a factor of 1.25 - 2.5 for most food items. Only for seeds would the direct comparison of dietary threshold to residue estimate lead to an overestimate of exposure. Differences in assimilative efficiency between laboratory and wild diets suggest that current screening assessment methods do not account for a potentially important aspect of food requirements. Depending upon species and dietary matrix, bird assimilation of wild diet energy ranges from 23 - 80%, and mammal's assimilation ranges from 41 - 85% (U.S. Environmental Protection Agency, 1993). If it is assumed that laboratory chow is formulated to maximize assimilative efficiency (e.g., a value of 85%), a potential for underestimation of exposure may exist by assuming that consumption of food in the wild is comparable with consumption during laboratory testing. In the screening process, exposure may be underestimated because metabolic rates are not related to food consumption.

For the terrestrial organism risk assessment, the EECs on food items generated using T-REX may be compared directly with dietary toxicity data or converted to an oral dose to calculate chronic dose-based RQs, as is the case for small mammals. The screening-level risk assessment for dimethenamid uses upper bound predicted residues as the measure of exposure. For mammals, the residue concentration is converted to daily oral dose based on the fraction of body weight consumed daily as estimated through mammalian allometric relationships. Converting to the oral dose-based chronic RQs from the reported mammalian dietary chronic endpoint allows EFED to evaluate the risk to different size-classes of mammals with varying feeding habits. However, this extrapolation method for generating dose-based chronic RQs for smaller animals based on dietary-based data for larger animals, may also increase uncertainty in this risk assessment.

For the non-target, terrestrial plant risk assessment, TerrPlant modeling results are based on the assumption of a single application. The model does not have the capability to estimate exposure concentrations and risk to non-target terrestrial plants from multiple applications. If the label specifies multiple applications to target areas, risks to non-target terrestrial plants may be underestimated.

Finally, the screening procedure does not account for situations where the feeding rate may be above or below requirements to meet free living metabolic requirements. Gorging behavior is a possibility under some specific wildlife scenarios (e.g., bird migration) where the food intake rate may be greatly increased. Kirkwood (1983) has suggested that an upper-bound limit to this behavior might be the typical intake rate multiplied by a factor of 5. In contrast is the potential for avoidance, operationally defined as animals responding to the presence of noxious chemicals in their food by reducing consumption of treated dietary elements. This response is seen in nature where herbivores avoid plant secondary compounds.

2. Uncertainties, assumptions, and limitation associated with routes of exposure

Screening-level risk assessments for spray applications of pesticides consider dietary exposure alone. Other potential routes of exposure to dimethenamid for terrestrial animals, are discussed below.

Incidental soil ingestion exposure

This risk assessment does not consider incidental soil ingestion. Available data suggests that up to 15% of the diet can consist of incidentally ingested soil depending on the species and feeding strategy (Beyer et al., 1994). A simple first approximation of soil concentration of pesticide from spray application shows that ingestion of soil at an incidental rate of up to 15% of the diet would not increase dietary exposure.

Inhalation exposure

The screening risk assessment does not consider inhalation exposure. Such exposure may occur through three potential sources: (1) spray material in droplet form at the time of application (2) vapor phase pesticide volatilizing from treated surfaces, and (3) airborne particulate (soil, vegetative material, and pesticide dusts).

Available data suggest that inhalation exposure at the time of application is not an appreciable route of exposure for birds. According to research on mallards and bobwhite quail, respirable particle size in birds (particles reaching the lung) is limited to a maximum diameter of 2 to 5 microns. The spray droplet spectra covering the majority of pesticide application situations (AgDrift model scenarios for very-fine to coarse droplet applications) suggests that less than 1% of the applied material is within the respirable particle size.

Theoretically, inhalation of pesticide's active ingredient in the vapor phase may be another source of exposure for some pesticides under some exposure situations. However, volatilization of dimethenamid from water and soil surfaces is not expected; therefore, inhalation should not be an important exposure pathway.

The impact from exposure to dusts contaminated with the pesticide cannot be assessed generically because soil properties (chemical and physical), which impact the estimation of such exposures are highly site-specific.

Dermal Exposure

The screening assessment does not consider dermal exposure, except as it is indirectly included in calculations of RQs based on lethal doses per unit of pesticide treated area. Dermal exposure may occur through three potential sources: (1) direct application of spray to terrestrial wildlife in the treated area or within the drift footprint, (2) incidental contact with contaminated vegetation, or (3) contact with contaminated water or soil.

Data which address dermal exposure of wildlife to pesticides in a quantitative fashion are extremely limited. The Agency is actively pursuing modeling techniques to account for dermal exposure via direct application of spray and by incidental contact with vegetation.

Drinking Water Exposure

The exposure of a target organism to a pesticide's active ingredient may be the result of consumption of surface water, groundwater or consumption of the pesticide in dew or other water on the surfaces of treated vegetation or in puddled water on treated fields. For the active ingredients of a pesticide there is a potential to dissolve in runoff and puddles on the treated field may contain the chemical. However, dimethenamid exhibits limited solubility; consequently, the potential for drinking water exposure should not be reduced.

3. Uncertainties, assumptions, and limitation associated with the toxicity data

Species Selection and Sensitivity

There are a number of areas of uncertainty in the terrestrial and the aquatic organism risk assessments that could potentially cause an underestimation of risk. Use of toxicity data on representative species does not provide information on the potential variability in susceptibility to acute and chronic exposures. For screening terrestrial risk assessments, a generic bird or mammal is assumed to occupy either the treated field or adjacent areas receiving the pesticide at a rate commensurate with the treatment rate on the field. The actual habitat requirements of any particular terrestrial species are not considered, and it is assumed that species occupy, exclusively and permanently, the treated area being modeled. This assumption leads to a maximum level of exposure in the risk assessment.

Although the screening risk assessment relies on a selected toxicity endpoint from the most sensitive species tested, it does not necessarily mean that the selected toxicity endpoints reflect sensitivity of the most sensitive species existing in a given environment. The relative position of the most sensitive species tested in the distribution of all possible species is a function of the overall variability among species to a particular chemical. In the case of listed species, there is uncertainty regarding the relationship of the listed species' sensitivity and the most sensitive species tested.

Surrogates were used to predict potential risks for species with no data (i.e., reptiles and amphibians). It was assumed that the use of surrogate effects data is sufficiently conservative to apply to the broad range of species within taxonomic groups. If other species are more or less sensitive to dimethenamid than the surrogates, risks may be under- or overestimated, respectively.

<u>Age class and sensitivity of effects thresholds</u>
Scientists generally recognize that the age of the test organism may have a significant effect on the observed sensitivity to a toxicant. In a screening-level assessment of acute toxicity in fish, data are collected on juveniles weighing 0.1 to 5 grams. For aquatic invertebrates, the recommended acute testing is performed on immature age classes (e.g., first instar for daphnids, second instar for amphipods, stoneflies and mayflies, and third instar for midges). Similarly, acute dietary testing with birds is also performed on juveniles, with mallard ducks tested at 5-10 days of age and quail at 10-14 days of age.

Testing of juveniles may overestimate the toxicity of direct acting pesticides in adults. As juvenile animals do not have fully developed metabolic systems, they may not possess the ability to transform and detoxify xenobiotics equivalent to the older/adult organism. The screening risk assessment has no current provisions for a generally applied method that accounts for this uncertainty. In so far as the available toxicity data may provide ranges of sensitivity information with respect to age class, the risk assessment uses the most sensitive life-stage information as the conservative screening endpoint.

4. Uncertainties and assumptions associated with gaps in environmental fate and toxicity data

The following data gaps and uncertainties were identified with respect to the submitted ecotoxicity effects data:

- It is noted that no toxicity information is available for the degradation products of dimethenamid.

- Data were not provided to determine the potential exposure to birds, mammals, and pollinators from residues on foliage, flowers, and seeds.

- No edge of field studies are available. Spray drift presents a potential risk to non-target plants inhabiting edge habitats adjacent to target fields and riparian vegetation along streams and/or ponds in close proximity to sprayed fields.

- Dermal contact and soil ingestion pathways for terrestrial mammals and birds were not evaluated because these routes of exposure are not considered in deterministic risk assessments. Uncertainties associated with exposure pathways for terrestrial animals are discussed in greater detail in Section 4.4.3.

- Risks to semiaquatic wildlife via consumption of pesticide-contaminated fish were not evaluated. However, given that bioaccumulation of dimethenamid is expected to be low, ingestion of fish by piscivorus wildlife is not likely to be of concern.

- Risks to top-level carnivores were not evaluated due to a lack of data for these receptors. Ingestion of grass, plants, fruits, insects, and seeds by terrestrial wildlife was considered; however, consumption of small mammals and birds by carnivores was not evaluated. In addition, food chain exposures for aquatic receptors (i.e., fish consumption of aquatic invertebrates and/or aquatic plants) were also not considered.

- Surrogates were used to predict potential risks for species with no data (i.e., reptiles and amphibians). It was assumed that use of surrogate effects data is sufficiently conservative to apply to the broad range of species within taxonomic groups. If other species are more or less sensitive to dimethenamid than the surrogates, risks may be under or overestimated, respectively.