UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF
PREVENTION, PESTICIDES AND TOXIC
SUBSTANCES

Date: February 03, 2006
Chemical: ADBAC/DDAC
PC Codes: 069105/069149
Barcode: D322872/D325481

MEMORANDUM

SUBJECT: Ecological Risk Assessment in Support of the Antimicrobials Division's Reregistration of ADBAC and DDAC

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Risk Assessment Summary and Conclusions

The Environmental Fate and Effects Division has completed its ecological risk assessment for the outdoor uses of ADBAC and DDAC in support of the Antimicrobials Division Reregistration Eligibility Decision (RED) for these chemicals. DDAC is an active ingredient in only one of the formulations assessed, and it does not appear to pose high risk to wildlife when used according to the label. Several ADBAC uses pose acute and chronic risk to aquatic and terrestrial wildlife. Risk to terrestrial and aquatic plants cannot be evaluated due to a lack of data, but risk is presumed. Based on this screening-level assessment, risk to Federally listed species also cannot be precluded. Further work is necessary to develop a refined risk assessment evaluating endangered species. Although primarily used as antimicrobial agents, uses which are not assessed in this document, outdoor applications of ADBAC and DDAC included in this assessment were ornamental nurseries, residential and commercial turf, mosquito larvicide and algacide in ornamental pools and puddles.

Data gaps identified include chronic toxicity studies of estuarine/marine fish and invertebrates, as well as avian wildlife. The toxicity of ADBAC to terrestrial and aquatic nontarget plants is not assessed either, due to lack of data.

1 Problem Formulation

1.1 Stressor Source and Distribution

The Environmental Fate and Effects Division (EFED) has evaluated the outdoor uses of the quaternary ammonium compounds being considered for reregistration by the Antimicrobial Division (AD). The compounds being considered are alkyl dimethyl benzyl ammonium chlorides (ADBAC) and didecyl ammonium chlorides (DDAC). ADBAC and DDAC are used primarily as disinfectants, sanitizers, and microbiocides/microbiostats. They are also used as algaecides, bacteriocides/bacteriostats, fungicides/fungistats, insecticides, miticides, virucides, and feeding suppressants. Use sites for ADBAC and DDAC include agricultural premises and equipment, food handling equipment, commercial, industrial and institutional settings, residential areas or areas of public access, pets and kennels, medical facilities, swimming pools, aquatic areas, and industrial water systems. Although primarily used as antimicrobial agents for these diverse uses, several labeled outdoor uses are being assessed by EFED because of the potential for environmental exposures and ecological effects. Specifically, ADBAC uses include ornamental plants and shrubs in nurseries, residential lawns and commercial turf (not sod farms) and golf course greens, tees and fairways. Both ADBAC and DDAC are labeled for use in puddles and decorative pools to control algae. ADBAC is also labeled for use as mosquito larvicide in standing waters, including decorative ponds and pools, inactive spas and hot tubs, as well as 'old tires, empty tin cans, puddles and water drains around buildings' (RD 20 label). Only the ADBAC and DDAC uses that appear likely to result in environmental exposures and effects are being evaluated in this assessment (Table 1.1).

Table 1.1. ADBAC and DDAC products and uses being evaluated.

Class	Trade Name	Reg. #	% ai	Agricultural/Outdoor Uses
DDAC	TC 192	499-482	12	Decorative ponds, pools, puddles
ADBAC	TC 192	499-482	8	Decorative ponds, pools, puddles
ADBAC	Consan	58044-3	20	Nursery/ornamentals Turf, golf courses
ADBAC	RD 20	53642-1	20	Decorative ponds, pools, puddles Nursery/ornamentals, Turf, golf courses, Mosquito control
ADBAC	Timsen	507-3	40	Nursery/ornamentals
ADBAC	PT 2000	499-368	20	Decorative ponds, pools, puddles

1.2 Receptors

Ecological effect endpoints are derived from registrant-submitted guideline studies as required for registration under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA; 40 CFR Part 158), as well as a review of acceptable open literature (ECOTOX), when available. The most sensitive endpoints (described below) from each study of surrogate species are used to estimate risk to the taxonomic group(s) represented by the surrogate tested. Toxicity testing reported in this document represents all terrestrial and aquatic organisms. However, 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. In addition, neither reptiles nor amphibians are tested. Birds are used as surrogates for reptiles and terrestrial-phase amphibians; fish are used as surrogates for aquatic-phase amphibians. The Norway rat is typically the surrogate for all mammal species.

1.3 Identification of Assessment Endpoints

Assessment endpoints are defined, per Agency guidelines, as “explicit expressions of the actual environmental value that is to be protected” which are “operationally defined by an ecological entity and its attributes” (USEPA, 2004). The ecological entity can be a species, a functional group of species, a community, an ecosystem, or another entity of importance or concern. An attribute is the characteristic of the entity that is important to protect and is potentially at risk.

Defining an assessment endpoint involves two steps: 1) identifying the valued attributes of the environment that are considered to be at risk, and 2) operationally defining the assessment endpoint in terms of an ecological entity (*e.g.*, a community of fish and aquatic invertebrates) and its attributes (*i.e.*, survival and reproduction). Therefore, selection of the assessment endpoints is based on valued entities (*i.e.*, ecological receptors), the ecosystems potentially at risk and the routes by which ecological receptors are exposed to pesticide-related contamination. The selection of clearly defined assessment endpoints is important because they provide direction and boundaries in the risk assessment for addressing risk management issues of concern.

Typical assessment endpoints for screening-level pesticide ecological risk assessments include reduced survival and/or reproductive impairment for both aquatic and terrestrial animal species from direct acute or direct chronic exposures. Aquatic animal groups that are typically characterized in the risk assessment include: freshwater fish and invertebrates, estuarine/marine fish and invertebrates. Terrestrial animal groups include birds, mammals, and beneficial insects. All assessment endpoints are characterized at the individual level in order to protect threatened and endangered species. However, risks to higher biological levels (*i.e.*, populations and communities) can be inferred from this approach (*e.g.*, pesticide effects on individual survival and fecundity may impact both population stability, growth, and habitat carrying capacity). Indirect effects to listed species and critical habitat must also be characterized in a species-specific assessment conducted after the screening-level risk assessment is completed.

For terrestrial and semi-aquatic plants, the screening assessment endpoint is the perpetuation of populations of non-target species (crops and non-crop plant species). Existing testing requirements only evaluate emergence of seedlings and vegetative vigor of annuals. Although it is recognized that the endpoints of seedling emergence and vegetative vigor may not address all terrestrial and semi-aquatic plant life cycle components, it is assumed that impacts on plant emergence and/or on active growth have the potential to impact individual competitive ability and reproductive success, from which population effects can be inferred.

For aquatic plants, the assessment endpoint is the maintenance and growth of standing crop or biomass. Measurement endpoints for this assessment endpoint focus on algal and vascular plant (*i.e.*, duckweed) growth rates and biomass measurements.

The ecological relevance of the assessment endpoints assumes that complete exposure pathways exist for these receptors, that the receptors may be sensitive to pesticides in affected media and/or forage items and that the receptors could potentially inhabit areas where pesticides are applied, or areas where runoff and/or spray drift may impact the sites because suitable habitat is available.

Ecological measurement endpoints for this screening-level risk assessment are based on a suite of registrant-submitted toxicity studies performed on a limited number of organisms, supplemented by the open literature where applicable, in the following broad groupings:

1. Birds (bobwhite quail), also used as surrogate species for terrestrial-phase amphibians and reptiles,
2. Mammals (laboratory rat),
3. Freshwater Fish (bluegill sunfish, rainbow trout and fathead minnow), also used as a surrogate for aquatic-phase amphibians,
4. Freshwater invertebrates (*Daphnia magna*),
5. Estuarine/marine fish (sheepshead minnow, inland silverside),
6. Estuarine/marine invertebrates (*Mysidopsis bahia*, Eastern oyster),
7. Terrestrial plants (no data available)
8. Algae and aquatic plants (no data available).

Within each of these very broad taxonomic groups, an acute and chronic endpoint is selected from the available test data. The selection is made from the most sensitive species tested within a particular surrogate group. If additional toxicity data are available from other sources, the selection of an endpoint may not be limited to the surrogate species listed above, but may be expanded to include those data for other groups or species which has been deemed of sufficient quality by OPP scientists for use in the risk assessment.

1.4 Conceptual Model

In order for a chemical to pose an ecological risk, it must reach ecological receptors in biologically significant concentrations. Exposure pathways are defined as the means by which a contaminant moves in the environment from a source to an ecological receptor. For an ecological exposure pathway to be complete, it must have a source, an environmental transport medium, a point of exposure for ecological receptors, and a feasible route of exposure.

Ecological receptors that may potentially be exposed to ADBAC include terrestrial and semiaquatic wildlife (*i.e.*, mammals, birds, amphibians and reptiles), terrestrial and semi-aquatic plants, and terrestrial soil and aquatic sediment invertebrates. Additionally, aquatic organisms (*i.e.*, freshwater and estuarine/marine fish and invertebrates, amphibians, and aquatic plants) are potential receptors in adjacent water bodies through the off-site transport of ADBAC from the application site through runoff, erosion and spray drift. The primary route of wildlife exposure to DDAC appears to be through drinking treated water, though amphibians may be at risk from these applications.

1.4.1 Risk Hypothesis

At maximum application rates for the previously described uses exposure of terrestrial, aquatic and semi-aquatic wildlife and plants to ADBAC and/or DDAC may be sufficiently high to result in direct effects (i.e., mortality due to acute exposure or impaired reproduction, growth, or survival from chronic exposure). Additionally, endangered and threatened species may be indirectly affected by ADBAC and/or DDAC due to a loss of food resources and/or changes to critical habitat resulting from proposed uses.

1.5 Analysis Plan

This screening level ecological risk assessment characterizes the environmental fate and transport of ADBAC to assess the extent to which non-target organisms may be exposed through the current proposed uses of these pesticides. EFED relied on AD's evaluation of the environmental fate and transport of ADBAC and DDAC, which can be found in the AD RED document. The toxicity of ADBAC is also characterized, based primarily on registrant-submitted guideline toxicity tests and additional information from open literature available through the Agency's ECOTOX database (http://www.epa.gov/ecotox/), and evaluated by AD scientists. Estimated exposure and effects are integrated to calculate risk quotients (RQs) for non-target Federally listed endangered/threatened and other non-target animals and plants. RQs are compared to pre-determined levels-of-concern (LOCs) to screen out those taxa to which ADBAC is not likely to pose unacceptable risk. Because of the limited use and low expected exposure of wildlife to DDAC, as detailed later in this document, ADBAC is primarily considered in this document.

Although risk, in the context intended here, is often defined as the likelihood and magnitude of adverse ecological effects, the risk quotient-based approach does not provide a quantitative estimate of likelihood and/or magnitude of adverse effects. Such estimates may be possible through a more refined, probabilistic assessment. However, this is beyond the scope of this screening-level assessment.

1.6 Routes of Exposure

Routes of exposure to terrestrial and aquatic organisms can occur from direct deposition, spray drift and/or runoff. Exposure may be through ingestion of contaminated food or water sources, dermal contact or absorption, and inhalation. The Agency assumes terrestrial organisms are present and feeding on the use site. All routes of aquatic exposure are assumed to be accounted for.

This assessment does not take into account atmospheric transport in estimating environmental concentrations, nor does it account for ingestion of ADBAC or DDAC residues by animals in contaminated grit, ingestion through preening activities, or uptake through inhalation or dermal absorption by terrestrial animals. Exposure to terrestrial animals is based primarily on dietary consumption of foliar residues and, in this case, drinking water. Aquatic assessments assume that all potential routes of direct exposure are accounted for. While ADBAC and DDAC are registered for use in greenhouses, this use is typically conducted indoors and, thus, exposure to non-target animals is limited and is therefore not considered in this assessment.

2 Analysis

2.1 Use Characterization

ADBAC and DDAC are used primarily as antimicrobial agents; evaluation of these uses can be found in the Antimicrobials Division risk assessment in support of the reregistration eligibility decision (RED) for these compounds. Additionally, ADBAC is used on ornamental plants and shrubs, residential lawns and commercial turf and golf course greens, tees and fairways. Both ADBAC and DDAC are labeled for use in puddles and decorative pools to control algae. ADBAC is also labeled for use as mosquito larvicide in standing waters, including decorative ponds and pools, inactive spas and hot tubs, as well as 'old tires, empty tin cans, puddles and water drains around buildings' (RD20® label). Only the ADBAC/DDAC uses which could result in potential environmental exposures and effects are being evaluated in this assessment. These uses are described below.

Puddles, Ornamental Ponds and Pools

Three products are labeled for the control of algae in puddles and ornamental ponds and pools, RD20®, TC192® and PT2000®. All three products contain ADBAC; TC192 also contains DDAC (the only DDAC use considered in this assessment). These uses are labeled for direct application to water with a target maximum concentration of 5 ppm for the first application. Subsequent applications can be made weekly at concentrations of 2.5 ppm. There are no label limits on the number of applications that can be made in a year. These applications can be a source of exposure to terrestrial wildlife making use of the water for drinking or bathing, as well as amphibians making use of these waterbodies for all or part of their lifecycle. Because the product is applied directly into the water, exposure via forage items is not expected (emergent vegetation is assumed not to be present). The labels specifically state that application should not be made where fish are present; therefore exposure to fish is not expected when used in accordance with the label. However, because there is no explicit prohibition on the labels, exposure to amphibians is possible, especially during the aquatic phase. Because of the persistence of ADBAC and DDAC, the weekly maintenance applications could, at least in some instances, result in increased concentrations throughout the year, leading to the potential for exposure at concentrations greater than 5 ppm. This assessment assumes, as suggested on the labels, that the target waterbodies are ornamental or periodic and disconnected from the larger watershed. The label should be more explicit regarding this assumption. Further work would need to be done to evaluate potential wildlife exposure if the registrants do not support this assumption.

Mosquito control

The mosquito control uses (RD20® product label) specify that treated bodies of all sizes receive an initial treatment at a target concentration of 200 ppm and allow weekly maintenance dose at a concentration of 100 ppm. There are no label limits on the number of applications that can be made in a year. Because of the types of standing waters indicated on the label (from empty tin cans to decorative ponds), this use could be a source of exposure to terrestrial wildlife making use of the water for drinking or bathing, or by amphibians for completion of a lifecycle phase, such as tadpoles. Since the product is applied directly into the water, exposure via forage items is not expected (emergent vegetation is assumed not to be present). The label specifically states that application should not be made where fish are present; therefore, exposure to fish is not expected when used in accordance with the label. However, because there is no explicit prohibition on the labels, exposure to amphibians is possible, especially during the aquatic phase. Because of the persistence of ADBAC, the weekly maintenance applications could, at least in some instances, result in increased concentrations throughout the year, leading to the potential for exposure at doses far greater than 200 ppm for other wildlife. This assessment assumes, as suggested on the label, that the target waterbodies are ornamental or periodic and disconnected from the larger watershed. The label should be more explicit regarding this assumption. Further work would need to be done to evaluate potential wildlife exposure if the registrants do not support this assumption.

Turf and Golf Courses

Two ADBAC products (Consan® and RD20®) are labeled for use on residential lawns, commercial turf and golf courses. These uses control algal build-up and fungal diseases such as fusarium blight (*Fusarium* spp.) and brown patch (*Rhizoctonia* spp.). Smaller use sites, such as residential lawns, are labeled for a concentration of 790 ppm which is equivalent to a rate of 6.8 lb ai/A. This rate is also used for golf courses and commercial (nonagricultural) turf unless a commercial power sprayer is used. If a commercial power sprayer is used, the application rate is reduced to 512 ppm (0.82 lb ai/A). Presumably, as implied on the labels, smaller areas would be treated at the higher rate, while larger-scale applications would be treated at the lower rate. However, this assumption is not fully clear from the label and should be explicitly expressed. Further assessment would be required if this assumption is not supported.

The product labels do not specify seasonal or yearly limits on the maximum number of applications or pounds per acre. The label does specify 10-14 days between applications. The label states applications should be made during the warm growing season, so the number of applications may vary depending on the geographic area where it is used. Without a limit, a hypothetical Florida golf course could apply ADBAC every ten days all year long. Without data indicating otherwise, this seems plausible given the wide range of target organisms for which ADBAC controls (semi-terrestrial alga species, numerous species of fungi). These organisms are generally a greater problem under warm wet conditions, so some use sites may need appreciably fewer applications to achieve desired control. However, it is unclear what a typical number of applications would be; maximum applications per year should be explicitly stated on the labels.

Terrestrial wildlife exposure could occur from these uses, whether through foraging in the treated area or by feeding on organisms affected by spray drift, runoff and or erosion. Aquatic organisms could be affected by spray drift, runoff and/or erosion. This assessment evaluates these potential routes of exposure.

Nursery Uses (bedding plants, ornamental shrubs and trees)

The products Timsen®, Consan® and RD20® are all labeled for nursery uses to control various fungal and bacterial pathogens that can cause damage to ornamental plants. The uses appear to be limited to spray and drench applications, and are assessed accordingly. However, the intended application methods should be explicitly stated on the labels. In 2002, there were 68,214 acres of floriculture (bedding/garden plants, cut flowers and cut florist greens, foliage plants, and potted flowering plants) grown in 14,579 outdoor nurseries in the US (www.nass.usda.gov/census/). The labels allow for use on a variety of herbaceous annuals, such as fuchsia and snapdragons, as well as larger perennials such as ash and sycamore trees. Because different ornamental species have different pathogen pressures, different rates are recommended for each pathogen targeted. For instance, palms needing protection from heart rot and *penicillium* leaf base rot are treated with Consan® at a concentration of 1563 ppm while crepe myrtle and fruit trees being treated for fireblight are treated at a concentration of 781 ppm. Differences in amount of product that will potentially be available for exposure to non-target organisms depends on the quantity of solution applied. The palm treatment uses a small amount of solution poured into the 'cup' formed at the base of the leaves; this treatment is repeated weekly until control is achieved. For fireblight control, the entire tree is sprayed at two-week intervals, with some phenological limitations (e.g., early spring and fall after harvest; Consan® label only). For some larger ornamentals, such as ash or sycamore, the label states that 50-60 gallons of solution (528 ppm) may be required to achieve full coverage. These applications can be repeated up to three times, at intervals determined by leaf emergence and development. These treatments are equivalent to application of 0.25 lbs ai/tree/treatment. If 40 gallons is assumed to be required for adequate coverage of somewhat smaller trees, such as fruit trees (781 ppm), the mass applied is also 0.25 lbs ai/tree/treatment. Wildlife could be exposed through runoff or drift contaminating food or water sources, or foraging on either the treated plant or nontarget plants in the vicinity of the treatment.

2.2 Exposure Characterization

2.2.1 *Environmental Fate and Transport Characterization*

ADBAC is immobile and persistent; while it is not likely to leach in to groundwater, it may enter surface water through erosion. The available soil mobility study shows that ADBAC has a strong tendency to bind to sediment/soil with Freundlich K_{ads} values of 6,172 for sand soil, 10,797 for silt loam, 5,123 for sandy loam soil, and 32,429 for clay loam. The corresponding K_{oc} values are 6,171,657 for sand soil, 2,159,346 for silt loam, 640,389 for sandy loam soil, and 1,663,039 for clay loam (MRID 424148-01). There are no guideline data for aerobic soil degradation of ADBAC. Because of its strong adsorption to soils, the potential to reach aquatic water bodies via runoff or leaching is limited. ADBAC may, however, be transported off-site to aquatic water bodies as entrained sediment or via spray drift during aerial or ground spray applications. Once in aquatic environments, ADBAC is hydrolytically stable under abiotic and buffered conditions over the pH 5-9 range (MRID 408356-02). ADBAC is also stable to photodegradation in pH 7 buffered aqueous solutions (MRID 408356-03).

Aquatic metabolism studies under aerobic and anaerobic conditions indicate that ADBAC is stable to microbial degradation. ADBAC did not degrade in flooded sand loam soil that was incubated at 24-27°C in the dark for up to 30 days in an aerobic aquatic metabolism study (MRID 408356-04). Under anaerobic conditions, ADBAC was found to be very resistant to degradation with a calculated half-life of 1,815 days (MRID 424151-01).

Bioaccumulation of ADBAC in freshwater fish is not likely to occur. Maximum bioconcentration factors (BCF) were 33X for edible tissues (muscle, skin), 160X for nonedible tissues (viscera, head, carcass), and 79X for whole fish tissues (MRID 410268-01). ADBAC is not expected to pose a concern for bioconcentration in aquatic organisms.

Major degradates were not identified in any of the available studies. The environmental fate and physical-chemical properties, based on submitted guideline studies, are summarized in Table 2.1. Details of individual studies can be found in the ADBAC Environmental Fate Assessment conducted by the AD.

Table 2.1 General fate and physical-chemical data for ADBAC.

Parameter	Value	Source
Molecular Weight	*377.83*	Product chemistry
Solubility (25º C)	Completely Soluble	Product chemistry
Vapor Pressure (25º C)	3.53×10^{-12} torr	Product chemistry
Hydrolysis Half-life (25º C) pH 5 pH 7 pH 9	 150 d 183 d 379 d	MRID *408356-2, 424152-01*
Aqueous Photolysis Half-life	stable	MRIDs 411055-01, 424152-01
Soil Photolysis Half-life	no data	
Aerobic Soil Metabolism Half-life	no data	
Aerobic Aquatic Metabolism Half-life	stable (sand loam)	MRIDs 408356-04, 424149-01
Anaerobic Aquatic Metabolism Half-life	1,815 d (sandy loam)	MRIDs *411055-01*, 424150-02
Organic Carbon Partitioning Coefficient (K_{oc}, L/kg_{oc})	6.2×10^6, 2.2×10^6, 6.4×10^5, 1.7×10^6	MRID *408356-05*
Soil Partitioning Coefficient (k_d, L/kg)	6172, 10797, 5123, 32429	MRID *408356-05*
Bioconcentration Factors (BCF) Edible tissue Nonedible tissue Whole fish tissue	 33X 160X 79X	MRID 410268-01

2.2.2 Measures of Aquatic Exposure

This assessment involves Tier II modeling (PRZM/EXAMS) for selected scenarios representing all proposed outdoor uses. Monitoring data were not considered because national-scale monitoring studies were not identified. For Tier II, two models are used in tandem. The Pesticide Root Zone Model, (PRZM, Carsel et al., 1997) simulates fate and transport on the agricultural field. The version of PRZM used was PRZM 3.12 beta dated May 24, 2001. The water body is simulated with Exposure Analysis Modeling System (EXAMS), version 2.98, dated July 18, 2002 (Burns, 1997). Simulations are run for multiple (usually 30) years and the estimated environmental concentrations (EECs) represent peak values that are expected once every ten years based on the thirty years of daily values generated during the simulation.

For aquatic endpoints, the exposure is estimated for the maximum application pattern to a 10-ha field bordering a 1-ha pond, 2-m deep (20,000 m^3) with no outlet. Exposure estimates generated using this standard pond are intended to represent a wide variety of vulnerable water bodies that occur at the top of watersheds including prairie pot holes, playa lakes, wetlands, vernal pools, man-made and natural ponds, and intermittent and first-order streams. As a group, there are factors that make these water bodies more or less vulnerable than the standard surrogate pond. Static water bodies that have larger ratios of drainage area to water body volume would be expected to have higher peak EECs than the standard pond. These water bodies will be either smaller in size or have large drainage areas. Smaller water bodies tend to have limited storage capacity and thus tend to overflow and carry pesticide in the discharge whereas the standard pond has no discharge. As watershed size increases beyond 10-ha, it becomes increasingly unlikely that the entire watershed is planted with a non-major single crop that is all treated with the pesticide. Headwater streams can also have peak concentrations higher than the standard pond, but they tend to persist for only short periods of time and are then carried downstream.

OPP standard PRZM crop or orchard scenarios, which consist of soils, weather and cropping practices that are location-specific, are used in the simulations to represent labeled uses of ADBAC. These scenarios are developed to represent high-end exposure sites in terms of vulnerability to runoff and erosion and subsequent off-site transport of pesticide.

2.2.2.1 Aquatic exposure modeling

Tier II EECs are estimated using EFED's aquatic models PRZM and EXAMS (described in previous section). PRZM is used to simulate pesticide transport as a result of runoff, erosion and spray drift from a 10-ha agricultural field and EXAMS considers environmental fate and transport of pesticides in surface water and predicts EECs in a standard pond (10,000-m^2 pond, 2-m deep), with the assumption that the small field is cropped at 100%. Simulations are carried out with the linkage program shell, PE4V01.pl (dated 8/13/2003), which incorporates the standard crop and orchard scenarios developed by EFED. Additional information on these models can be found at: http://www.epa.gov/oppefed1/models/water/index.htm.

All horticultural or aquatic ADBAC/DDAC uses are considered in this assessment (puddles, ornamental ponds and pools; mosquito control; turf and golf courses; ornamental shrubs and trees). For aquatic exposures, it is assumed that the direct applications to puddles, ornamental ponds and pools and the mosquito control uses result in minimal exposure to aquatic environments since the labels specify that applications should not be made where fish are present and it is implied on the label that the application sites are ornamental or periodic and disconnected from the greater watershed. However, even small, ephemeral puddles can be used wildlife for drinking water and, as in the case of amphibians, for critical life stages. Labels need to explicitly state any restrictions. For the turf and golf course uses, two standard scenarios were used for PRZM/EXAMS modeling, FL turf and PA turf. For the ornamental uses, two standard scenarios were used as surrogates for ornamental trees, OR Xmas tree and GA pecan. A summary of the crop scenarios used to estimate ADBAC concentrations in the aquatic systems for ecological risk assessment are listed in **Table 2.2**, along with some characterization of why the scenario was chosen.

Table 2.2. Summary of crop scenarios used in estimating EECs.

ADBAC Uses (EPA Reg. #)	Crop Scenario	MLRA/ Met Station	Scenario Characterization
Turf and golf courses (58044-3, 53642-1)	**FL turf**: Osceola County, Adamsville sand	MLRA 156A; W12834	Selected based on geographical location, agricultural practices, and use patterns.
	PA turf: York County, Glenville silt loam	MLRA 148; W14737	
Ornamental trees (58044-3, 53642-1, 507-3)	**OR Xmas tree**: Benton County, Pilchuck fine sand	MLRA A2; W24232	Selected as a surrogate for ornamental trees in Pacific northwest
	GA pecan: Mitchell County; Greenville fine sandy loam	MLRA 133A; W93805	Selected as a surrogate for ornamental trees in the southeast

PRZM/EXAMS modeling of ADBAC uses four PRZM scenarios identified in Table 2.2 at the current maximum label rate, maximum number of applications per year and the minimum application interval of the ADBAC use represented by each scenario. For the turf/golf course uses application rates for use with a commercial sprayer and for more limited residential use are both modeled at 0.8 and 6.8 lbs ai/A, respectively). The maximum number of applications per year is currently not specified on product labels for the turf/golf course use. Therefore a number of application scenarios, ranging from 1 application per year to 26 applications per year (Table 2.3), are simulated to cover the range of possibilities. Although, the label specifies a maximum of 3 applications per year for the ornamentals use, the minimum application interval is not specified. A minimum application interval of 7 days is assumed (Table 2.3). The modeled application rate for the ornamental use (302 lbs ai/A) assumes a tree spacing of 6' x 6' and a maximum application of 60 gallons (0.25 lbs a) per tree. For both the ornamental and residential turf uses the default 10 ha (25 A) field scenario is modeled in addition to a number of smaller fields (10, 1, and 0.5 A) since it is possible that these uses are limited in area and the default 25-A scenario may result in unrealistically high exposure concentrations.

Where applicable, modeling input parameters are selected according to current guidance (*Guidance for Selecting Input Parameters in Modeling the Environmental Fate and Transport of Pesticides Version II*, EFED, February 28, 2002). Application-specific and chemical-specific input parameters for PRZM/EXAMS modeling are listed in **Table 2.3** and **Table 2.4**, respectively. All scenarios simulate aerial spray applications (PRZM chemical application method, CAM = 2), with corresponding application efficiency and drift fractions equal to 0.95 and 0.05, respectively. The condition for disposition of the pesticide remaining on foliage after harvest (PRZM variable IPSCND) is set to 1 (pesticide remaining on foliage is converted to surface application) for all uses consistent with turf and nursery practices. Application dates are chosen based on the label information when available.

A soil organic carbon partitioning coefficient (K_{oc}) of 2.7 x 10^6 L/kg_{oc}, the mean of four soils, is used. The aerobic soil metabolism is assumed stable since there are no available guideline studies. The aquatic metabolism and aerobic aquatic metabolism are assumed stable as indicated by the submitted guideline studies. Since there is only one study for the anaerobic aquatic metabolism, three times the half-life was used to account for variability in the environment (5445 days). The hydrolysis half-life of 183 days is used since the ecological water body is a constant pH 7.

Table 2.3 PRZM/EXAMS application-specific input parameters.

ADBAC Use(s) (EPA Reg. #)	PRZM scenarios	Maximum app. rate (lbs a.i./A)	No. of app. per year/ interval (d)[1]	App. method drift/ app. efficiency	Application timing	First application date
Turf and golf courses (58044-3, 53642-1)	FL turf PA turf	0.8	26/10 10/10 5/10 1	aerial spray 0.05/ 0.95	Warm growing season	June 1
Ornamental trees (58044-3, 53642-1, 507-3)	OR Xmas tree GA Pecans	302	3/7	aerial spray 0.05/ 0.95	Not specified	May 10

[1] Number of applications not specified on label for turf uses; four scenarios considered: 26, 10, 5 and 1 application per year. Minimum interval between applications not specified on labels for ornamental uses; a 7 day interval was assumed.

Table 2.4 Chemical-specific PRZM/EXAMS inputs.

Parameter	Value	Source (MRID # or citation)	Comment
Soil Partition Coefficient (K_{oc} mL/g)	2.7 x 10^6	MRID *408356-05*	average value
Aerobic Soil Metabolism Half-life (days)	0	no data	stable to aerobic soil metabolism
Molecular Weight (g/mol)	*377.83*	Product chemistry	
Vapor Pressure (torr)	3.53 x 10^{-12}	Product chemistry	
Henry's Law Constant (atm-m^3-mol)	7.76 x 10^{-13}	Product chemistry	
Solubility in Water at 25°C (ppm)	Completely sol.	Product chemistry	10X solubility
Aerobic Aquatic Metabolism Half-life (days)	0	MRIDs 408356-04, 424149-01	stable to aerobic aquatic metabolism
Anaerobic Aquatic Metabolism Half-life (days)	5445	MRIDs *411055-01*, 424150-02	one study: 3x 1,815 d
Hydrolysis Half-life @ pH 7 (days)	183	MRID*408356-02*	water body constant pH 7
Aquatic Photolysis Half-life (days)	0	MRIDs 408356-03, 424152-01	stable to aquatic photolysis
Foliar extraction	0.5	Default	
Foliar decay rate	0	Default	stable to foliar degradation

Simulated EECs for all scenarios are presented in Table 2.5. Copies of the input and output files are in Appendix A. Acute EECs range from 0.67 - 1473 µg/L, 21-day chronic EECs range from 0.37 - 920 µg/L and 60-day average EECs range from 0.36 - 903 µg/L.

Table 2.5 Estimated Aquatic Exposure Concentrations Calculated with PRZM/EXAMS.

ADBAC Uses/EPA Reg. #	Scenario	App. Rate (lbs ai/A)	# Apps.	Interval	Area treated (A)	Acute (μg/L)	21-day Chronic (μg/L)	60-day Chronic (μg/L)
Turf	FL turf	0.8*	26	10	25**	15.6	9.4	9.1
			10	10		6.0	3.6	3.5
			5	10		3.1	1.8	1.8
			1	--		0.67	0.37	0.36
Turf	PA turf	0.8*	26	10	25**	20.6	10.9	10.6
			10	10		7.8	4.2	4.1
			5	10		3.9	2.1	2.0
			1	--		0.80	0.43	0.41

ADBAC Uses/EPA Reg. #	Scenario	App. Rate (lbs ai/A)	# Apps.	Interval	Area treated (A)	Acute (μg/L)	21-day Chronic (μg/L)	60-day Chronic (μg/L)
Turf	Fl turf	6.8***	10	10	25**	49.2	26.5	25.5
					10	19.7	10.6	10.2
					1	1.97	1.06	1.02
					0.5	0.98	0.53	0.51
Turf	PA turf	6.8***	10	10	25**	62.5	30.3	29.3
					10	25.0	12.1	11.7
					1	2.50	1.21	1.17
					0.5	1.25	0.61	0.59
Ornamental	GA pecan	302****	3	7	25**	1473	920	903
					10	589	368	361
					1	58.9	36.8	36.1
					0.5	29.5	18.4	18.1
Ornamental	OR Christmas tree	302****	3	7	25**	557	361	339
					10	223	144	136
					1	22.3	14.4	13.6
					0.5	11.2	7.2	6.8

* Golf course tees, greens and fairways and commercial turf applications
** Standard default scenario, 10 ha field, 100% treated
*** Residential turf applications
**** Assumes 6’ x 6’ spacing of trees, 0.25 lbs ai/tree

2.2.2.2 Aquatic exposure monitoring data

No monitoring data are identified for either ADBAC or DDAC.

2.2.3 Terrestrial Exposure Assessment

Application methods for ADBAC include spray and drench treatments of individual plants and flats as well as turf spray. Both ADBAC and DDAC are labeled for direct application into small waterbodies, such as puddles, ornamental ponds, old tires, etc. The combination of many uses and assorted application methods can potentially result in various routes of non-target exposure to terrestrial organisms. However, the only use of DDAC is labeled for 5 ppm formulated product (3 ppm ai DDAC).

The EEC values used for terrestrial exposure from direct application are calculated using the TREX model (Version 1.2.3), and are derived from the Kenaga nomograph, as modified by Fletcher *et al.* (1994), based on a large set of actual field residue data. The upper limit values from the nomograph represent the 95th percentile of residue values from actual field measurements (Hoerger and Kenaga, 1972). The Fletcher *et al.* (1994) modifications to the Kenaga nomograph are based on measured field residues from 249 published research papers, including information on 118 species of plants, 121 pesticides, and 17 chemical classes. These modifications represent the 95th percentile of the expanded data set. Risk quotients are based on the most sensitive LC_{50} and NOAEC for birds (in this instance, bobwhite quail) and LD_{50} for mammals (based on lab rat studies). Dietary EECs, unadjusted for organism type or size, range from 42 ppm on fruits/pods/large insects for turf application, five times per year at 10-day intervals to 180,814 ppm on short grass for ornamental applications three times per year at 10-day intervals (Table 2.6). Since the labels do not limit the number of applications for most uses, modeled exposure scenarios may not represent the most conservative assumptions. More scenarios are considered in the Risk Description section of this document.

Table 2.6. Unadjusted dietary-based EECs for two possible application scenarios.

Use Pattern	Forage Item	Upper bound EEC (ppm)
Turf	Short Grass	1062
0.8 lbs ai/A	Tall Grass	487
26 applications/year	Broadleaf plants/sm insects	598
10 day interval	Fruits/pods/seeds/lg insects	66
Ornamentals	Short Grass	180713
302 lbs ai/A	Tall Grass	82827
3 applications/year	Broadleaf plants/sm insects	101651
10 day interval	Fruits/pods/seeds/lg insects	11295

Since direct application to small waterbodies is prescribed for some uses, drinking water is likely to be a route of exposure for wildlife of various sizes. Therefore drinking water exposure is estimated using allometric equations (Appendix C) from The Wildlife Exposure Factors Handbook (USEPA 1994). Because birds and mammals have different water requirements, estimates of exposure are considered separately (Table 2.7). The modeled concentrations are those resulting from initial direct application of ADBAC/DDAC to small waterbodies according to the labels. Additionally, amphibians may be exposed at critical stages in their lifecycle. Exposure may be greater following subsequent applications due to the persistence of the chemicals.

Table 2.7. Estimated exposure to total active ingredient to wildlife through drinking water.

	Avian Daily Exposure Estimate (mg/kg-bw)		
Concentration (ppm)	**20g**	**100g**	**1000g**
5*	1.1	0.6	0.3
200	43	25	12
	Mammalian Daily Exposure Estimate (mg/kg-bw)		
	15g	**35g**	**1000g**
5*	0.8	0.7	0.5
200	30	28	20

*Formulation is 12% DDAC, 8% ADBAC

3 Ecotoxicity

The ecotoxicological endpoints used in this assessment are those used by AD in their assessment. The endpoints are summarized and briefly described here. Greater detail is provided in Appendix B. Only ADBAC is considered in this section, as DDAC endpoints were not provided. However, a previous EFED assessment of DDAC (Review of Data Submitted to Support the New Use of BARDAC MOLLUSCICIDE® (Didecyl dimethyl ammonium chloride) for Salt Water Cooling Systems; DP Barcode: D215429) suggests similar toxicity to wildlife. Nevertheless, the toxicity of DDAC remains an uncertainty in this assessment. As described in other parts of this document, wildlife exposure to DDAC is expected to be limited.

3.1 Toxicity to Terrestrial Animals

3.1.1 Avian, Acute and Chronic

An acute toxicity study was conducted with Bobwhite quail (*Colinus virginianus*; MRID 428859-01). The results of one acute oral toxicity study, submitted for ADBAC established an LD_{50} of 136 mg/kg-bw. The results from the acceptable study indicate that ADBAC is moderately toxic to avian species on an acute oral basis. The study fulfills guideline requirements. No data are available to assess the toxicity of ADBAC on a subacute dietary exposure basis though and this represents a data gap.

No data are available regarding the chronic toxicity of ADBAC to birds. Chronic risk to avian species cannot be precluded in the absence of data; chronic risk to birds is presumed.

3.1.2 Mammals, Acute and Chronic Toxicity

The endpoints used in this risk assessment were chosen by AD and used without details of the studies available. The acute LD_{50} for rats exposed to ADBAC is *304.5* mg/kg-bw (MRID *451092-04*). Based on these data, ADBAC is classified as slightly toxic to mammals on an acute oral exposure basis. The NOAEL from a chronic toxicity study with rats (MRID 41947501) is 44 mg/kg/day (*1000 ppm*).

3.2 Toxicity to Aquatic Animals

The Agency requested that aquatic toxicity studies be conducted with ADBAC since, under typical use conditions, it may be introduced into the aquatic environment.

3.2.1 Freshwater Fish, Acute

The most sensitive result from freshwater fish acute studies submitted for ADBAC established an LC_{50} of 280 µg a.i./L (fathead minnow; MRID 437401-03). The results indicate that ADBAC is highly toxic to on an acute exposure basis.

3.2.2 Freshwater Invertebrates, Acute

An acceptable study (MRID 419472-03) with the freshwater invertebrate, *Daphnia magna*, established an LC_{50} of 5.9 µg a.i./L. Results of the studies indicate that ADBAC is very highly toxic to freshwater invertebrates on an acute exposure basis. The guideline requirement has been fulfilled.

3.2.3 Estuarine and Marine Organisms, Acute

The most sensitive estuarine/marine fish to acute exposure to ADBAC was the inland silverside (*Menidia beryllina*), selected from open literature (Dobbs, M.G. et al., 1995), with an LC_{50} = 310 µg a.i./L. The most sensitive invertebrate was the Eastern oyster (*Crassostrea virginica*), with an EC_{50} = 55 µg a.i./L (MRID 424795-03).

3.2.4 Aquatic Organisms, Chronic

The results from an early life stage study with the warmwater fathead minnow (*Pimephales promelas*) indicate that exposure to ADBAC on a chronic basis results in measurable effects at a concentration of 32.2 µg a.i./L (MRID 423021-02). This study fulfills guideline requirements for a fish early life stage chronic test (72-4(a)/OPPTS 850.1400). In a chronic study with the waterflea (*Daphnia magna*), no measurable effects were noted at a concentration of 4.15 µg/L (MRID 423021-01). However, an MATC could not be determined in this study. Therefore, the study was classified as supplemental and does not fulfill guideline requirements for an aquatic invertebrate life cycle test (72-4b/OPPTS 850.1300). The lack of chronic toxicity data on ADBAC represents a data gap.

No data on the chronic toxicity of ADBAC on estuarine/marine organisms are available for this assessment. The potential chronic toxicity of ADBAC is uncertain; therefore, chronic toxicity is presumed.

3.2.5 Non-target Plants

No data regarding the toxicity of ADBAC to non-target plants were available for review.

4 Risk Characterization

4.1 Risk Estimation

In a screening-level deterministic (point estimate) approach to evaluating potential risk to non-target organisms from the proposed uses of ADBAC, risk quotients (RQs) are calculated from the ratio of estimated environmental concentrations (EECs) to ecotoxicity values. RQs are then compared to levels of concern (LOCs) used by OPP to indicate potential risk to non-target organisms and the need to consider regulatory action. For studies on taxa where no effects are observed (with no endpoint established), the highest dose tested is used in RQ calculation. As discussed in other sections, DDAC is not expected to occur at biologically relevant concentrations in the environment when applied according to the label directions, IF the toxicity of DDAC is similar to ADBAC.

Chronic risk to estuarine/marine organisms, chronic risk to birds and risk to non-target plants cannot be estimated due to lack of data. When data are absent, risk to the organism in question in presumed.

Nursery Ornamentals

Use of ADBAC on ornamentals can lead to wildlife exposure via direct ingestion of contaminated food items, drift exposure to food items or water sources, and through runoff to adjacent waterbodies. Therefore, exposure is possible to both aquatic and terrestrial organisms. The maximum label rate, calculated assuming a 6' x 6' spacing of trees, is 302 lbs ai/A. There are annual limits on some applications; some applications have no annual limits. It is beyond the scope of this document to assess all possible exposure scenarios; therefore risk to wildlife for this use may be underestimated.

Aquatic Risk

Acute RQs are calculated by dividing the peak EEC by the LC_{50}/EC_{50} for the most sensitive species tested. Acute risk LOCs (0.5) are exceeded by four- to 500-fold for both freshwater and estuarine/marine fish and invertebrates for both scenarios modeled (Table 4.1.). The LOC for acute risk to endangered species ($RQ \geq 0.05$) is exceeded by factors as high as 5,000X.

Table 4.1. Acute RQs for aquatic organisms resulting from use of ADBAC on nursery ornamentals at the maximum rate of 302 lb ai/A, applied three times at seven day intervals, assuming entire 10-ha area is treated. All RQs exceed LOCs.

Scenario	FW fish	FW invert	Est/Mar fish	Est/Mar invert
GA pecan	5.26	249.66	4.75	26.78
OR Christmas tree	1.99	94.41	1.80	10.13

Chronic RQs are calculated by dividing the 21-day EEC (for invertebrates) or the 60-day EEC (for fish) by the LC_{50}/EC_{50} for the most sensitive species tested. Chronic LOCs (1.0) are exceeded by 10- to over 200-fold for freshwater organisms for both scenarios modeled (Table 4.2). Due to lack of data on the chronic toxicity of ADBAC to estuarine/marine organisms, risk cannot be estimated and therefore chronic risk to estuarine/marine organisms is presumed.

Table 4.2. Chronic RQs for aquatic organisms resulting from use of ADBAC on nursery ornamentals at the maximum rate of 302 lb ai/A, applied three times at seven day intervals. All RQs exceed LOCs.

Scenario	chronic FW fish	chronic FW invert	chronic Est/Mar fish	chronic Est/Mar invert
GA pecan	28.04	221.69	unknown	unknown
OR Christmas tree	10.53	86.99	unknown	unknown

Terrestrial Risk-Avian

The avian acute LOC (0.5) is exceeded 38- to 4200-fold for all forage items for all size birds (Table 4.3). Chronic risk to birds cannot be estimated due to lack of toxicity data. In the absence of data, chronic risk to birds is presumed.

Table 4.3. Acute RQs for avian wildlife resulting from use of ADBAC on nursery ornamentals at the maximum rate of 302 lb ai/A, applied three times at 10 day intervals.

	20 g	100 g	1000 g
Short Grass	**2101**	**941**	**298**
Tall Grass	**963**	**431**	**137**
Broadleaf plants/sm insects	**1182**	**529**	**168**
Fruits/pods/seeds/lg insects	**131**	**59**	**19**

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.2)
Exceeds listed spp LOC (0.1)

Terrestrial Risk-Mammalian

The acute LOC (0.5) for mammals is exceeded 3- to 360-fold in all size classes for all forage items. The chronic LOC (1.0) is exceeded for mammals in all size classes for all forage items 10- to 1780-fold (Table 4.4).

Table 4.4. Acute and chronic dose-based RQs for mammalian wildlife resulting from use of ADBAC on nursery ornamentals at the maximum rate of 302 lb ai/A, applied three times at 10-day intervals.

	15 g mammal		35 g mammal		1000 g mammal	
	Acute	**Chronic**	**Acute**	**Chronic**	**Acute**	**Chronic**
Short Grass	**182**	**1782**	**156**	**1522**	**83**	**816**
Tall Grass	**84**	**817**	**71**	**698**	**38**	**374**
Broadleaf plants/sm insects	**103**	**1002**	**88**	**856**	**47**	**459**
Fruits/pods/lg insects	**11**	**111**	**9.73**	**95**	**5.22**	**51**
Seeds	**2.5**	**25**	**2.2**	**21**	**1.2**	**11**

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.2)
Exceeds listed spp LOC (0.1) or chronic risk LOC (1.0)

Turf and Golf Courses

Use of ADBAC on turf and golf courses can lead to wildlife exposure via direct ingestion of contaminated food items, drift exposure to food items or water sources, and through runoff to adjacent waterbodies. Therefore, exposure is possible to both aquatic and terrestrial organisms. The maximum label rate for ground commercial power spray application is 0.8 lbs ai/A. A higher rate is allowed for non-commercial sprayers (6.8 lbs ai/A) and is presumably intended for smaller areas such as residential lawns.

Aquatic Risk

Acute RQs are calculated by dividing the peak EEC by the LC_{50}/EC_{50} for the most sensitive species tested. Acute risk LOC ($RQ \geq 0.5$) is exceeded for freshwater invertebrates for both scenarios modeled (Table 4.5.), and for estuarine/marine invertebrates for the higher rate. The acute risk to endangered species LOC ($RQ \geq 0.05$) is exceeded for freshwater fish in both scenarios and the restricted use LOC (0.1) is exceeded at the higher rate for both freshwater and estuarine/marine fish.

Table 4.5. Acute RQs for aquatic organisms resulting from use of ADBAC on golf courses and turf applied 26 times at 10 day intervals for the 0.8 lbs ai/A rate and 10 times at 10 day intervals for the 6.8 lb ai/A rate.

Scenario	FW fish	FW invert	Est/Mar fish	Est/Mar invert
FL turf (0.8 lbs ai/A)	**0.06**	**2.64**	**0.05**	**0.28**
PA turf (0.8 lbs ai/A)	**0.07**	**3.49**	**0.07**	**0.37**
FL turf (6.8 lbs ai/A)	***0.18***	**8.34**	***0.16***	**0.89**
PA turf (6.8 lbs ai/A)	***0.22***	**10.59**	***0.20***	**1.14**

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.1)
Exceeds listed spp LOC (0.05) or chronic risk LOC (1.0)

Chronic LOCs (1.0) are exceeded for freshwater invertebrates for both scenarios modeled and for freshwater fish at the higher application rate (Table 4.6). Due to lack of data on the chronic toxicity of ADBAC to estuarine/marine organisms, risk cannot be estimated and is therefore presumed.

Table 4.6. Chronic RQs for aquatic organisms resulting from use of ADBAC on golf courses and turf applied 26 times at 10 day intervals for the 0.8 lbs ai/A rate and 10 times at 10 day intervals for the 6.8 lb ai/A rate.

Scenario	FW fish	FW invert	Est/Mar fish	Est/Mar invert
FL turf (0.8 lbs ai/A)	***0.28***	**2.27**	unknown	unknown
PA turf (0.8 lbs ai/A)	***0.33***	**2.63**	unknown	unknown
FL turf (6.8 lbs ai/A)	**0.79**	**6.39**	unknown	unknown
PA turf (6.8 lbs ai/A)	**0.91**	**7.30**	unknown	unknown

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.1)
Exceeds listed spp LOC (0.05) or chronic risk LOC (1.0)

Terrestrial Risk-Avian

At the 0.8 lb ai/A rate, the avian acute risk LOC is exceeded for all forage items for all size birds (Table 4.7), except for the 1000g size class foraging on fruits/pods/large insects. Chronic risk to birds cannot be estimated due to lack of toxicity data. In the absence of data, chronic risk to birds is presumed.

Table 4.7. Acute RQs for avian wildlife resulting from use of ADBAC on nursery ornamentals at the maximum rate of 0.8 lb ai/A, applied 26 times at 10 day intervals.

	20 g	100 g	1000 g
Short Grass	**12.35**	**5.53**	**1.75**
Tall Grass	**5.66**	**2.54**	**0.80**
Broadleaf plants/sm insects	**6.95**	**3.11**	**0.99**
Fruits/pods/seeds/lg insects	**0.77**	***0.35***	**0.11**

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.2)
Exceeds listed spp LOC (0.1)

At the 6.8 lb ai/A rate, the avian acute risk LOC is exceeded for all forage items for all size birds (Table 4.8). Chronic risk to birds cannot be estimated due to lack of toxicity data. In the absence of data, chronic risk to birds is presumed.

Table 4.8. Acute RQs for avian wildlife resulting from use of ADBAC on lawns/turf at the maximum rate of 6.8 lb ai/A, applied 10 times at 10 day intervals.

	20 g	100 g	1000 g
Short Grass	**91.02**	**40.77**	**12.92**
Tall Grass	**41.72**	**18.69**	**5.92**
Broadleaf plants/sm insects	**51.20**	**22.93**	**7.27**
Fruits/pods/seeds/lg insects	**5.69**	**2.55**	**0.81**

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.2)
Exceeds listed spp LOC (0.1)

Terrestrial Risk-Mammalian

At the 0.8 lbs ai/A rate, the acute LOC is exceeded for mammals in the 15g and 35g size classes foraging on short grass and broadleaf plants/small insects (Table 4.9). The acute risk to endangered species LOC is exceeded for all mammal size classes foraging on short grass, tall grass and broadleaf plant/small insects. The chronic risk LOC is exceeded for all mammal size classes on the short grass, tall grass and broadleaf plant/small insect forage items.

Table 4.9. Acute and chronic dose-based RQs for mammalian wildlife resulting from use of ADBAC on turf/golf courses at the maximum rate of 0.8 lb ai/A, applied 26 times at 10 day intervals.

	15 g mammal		35 g mammal		1000 g mammal	
	Acute	**Chronic**	**Acute**	**Chronic**	**Acute**	**Chronic**
Short Grass	**1.07**	**10.47**	**0.92**	**8.95**	***0.49***	**4.80**
Tall Grass	***0.49***	**4.80**	***0.42***	**4.10**	***0.22***	**2.20**
Broadleaf plants/sm insects	**0.60**	**5.89**	**0.52**	**5.03**	***0.28***	**2.70**
Fruits/pods/lg insects	0.07	0.65	0.06	0.56	0.03	0.30
Seeds	0.01	0.15	0.01	0.12	0.01	0.07

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.2)
Exceeds listed spp LOC (0.1) or chronic risk LOC (1.0)

At the 6.8 lbs ai/A rate, the acute risk LOC is exceeded for mammals in all size classes foraging on short grass, tall grass and broadleaf plants/small insects (Table 4.10). The acute risk to endangered species LOC is exceeded for all mammal size classes foraging on short grass, tall grass and broadleaf plant/small insects. The chronic risk LOC is exceeded for all mammal size classes foraging on any of the food items evaluated, except medium and large size classes foraging on seeds.

Table 4.10. Acute and chronic dose-based RQs for mammalian wildlife resulting from use of ADBAC on nursery ornamentals at the maximum rate of 6.8 lb ai/A, applied 10 times at 10 day intervals.

	15 g mammal		35 g mammal		1000 g mammal	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	**7.90**	77.20	**6.75**	**65.94**	**3.62**	**35.35**
Tall Grass	**3.62**	**35.38**	**3.09**	**30.22**	**1.66**	**16.20**
Broadleaf plants/sm insects	**4.44**	**43.42**	**3.80**	**37.09**	**2.03**	**19.88**
Fruits/pods/lg insects	***0.49***	**4.82**	***0.42***	**4.12**	***0.23***	**2.21**
Seeds	**0.11**	**1.1**	0.09	0.92	0.05	0.49

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.2)
Exceeds listed spp LOC (0.1) or chronic risk LOC (1.0)

Mosquito control

For mosquito control uses, drinking water is presumed to be the most likely route of exposure to wildlife. At the labeled rate of 200 ppm in the target waterbody, RQs exceed the acute risk to endangered species LOC for birds in the 20g and 100g size classes (Table 4.11.). The restricted use LOC (0.2) is exceeded for 20g birds. Due to lack of data on chronic toxicity of ADBAC to birds, chronic RQs cannot be calculated and chronic effects are assumed. Neither acute nor chronic mammalian RQs are exceeded. Equations are included in Appendix C.

Since it is possible that amphibians would use many of the potentially treated waterbodies for at least their reproductive stage, RQs were calculated using the most sensitive freshwater fish endpoint. Assuming a concentration of 200 ppm, RQs were 0.71 for acute risk and 6.2 for chronic risk, both of which exceed the LOCs. It is possible that, due to additional applications indicated on the label, concentrations greater than 200 ppm may be attained. In such instances, RQs would be higher.

Table 4.11. Wildlife drinking water RQs for ADBAC use in mosquito control applications.

Birds	**20g**	**100g**	**1000g**
DWIR[a]	0.004	0.013	0.059
DPE[b]	42.91	25.23	11.80
RQ[c]	*0.32*	*0.19*	0.09
Mammals	**15g**	**35g**	**1000g**
DWIR[a]	0.002	0.005	0.099
DPE[b]	30.13	27.69	19.80
RQ[c]	0.07	0.06	0.05

[a]DWIR-drinking water ingestion rate (L/day)
[b]DPE-daily pesticide exposure (mg/kg-bw/day)
[c]RQ-risk quotient

Puddles, Ornamental Ponds and Pools

For the of ADBAC/DDAC in puddles, ornamental ponds and pools, drinking water is presumed to be the most likely route of exposure to terrestrial wildlife At the labeled rate of 5 ppm in the target waterbody, acute avian and mammalian RQs are all below 0.01, using toxicity endpoints from ADBAC. The acute risk LOC for terrestrial animals is 0.5 and the acute endangered LOC is 0.1. The RQs were calculated using the total active ingredient. The formulations for these applications are 12% DDAC and 8% ADBAC. Unless the wildlife endpoints for DDAC are more than 10 times more sensitive than for ADBAC, acute environmental risk from this use appears to be unlikely. Mammalian chronic risk quotients are also all below the LOC of 1.0; chronic risk to birds cannot be estimated due to lack of data. Chronic risk to birds cannot be precluded.

Since it is possible that amphibians would use many of the potentially treated waterbodies for at least their reproductive stage, RQs were calculated using the most sensitive freshwater fish endpoint. Assuming a concentration of 5 ppm, RQs were 0.02 for acute risk and 0.2 for chronic risk, neither of which exceed the LOCs. It is possible that, due to additional applications indicated on the label, concentrations greater than 5 ppm may be attained. In such instances, RQs would be higher.

4.2 Risk Description

As presented in the previous section, LOCs are exceeded for several of the outdoor uses of ADBAC. The one outdoor use of DDAC appears to result in low exposure to wildlife. It is not possible to evaluate whether this exposure results in risk to organisms due to the lack of toxicity data. However, DDAC toxicity would need to be considerably greater than that of ADBAC to pose a risk to wildlife based on this screening-level assessment, and further discussion of DDAC is not warranted included in this document. Risk from the various uses of ADBAC, as estimated in the previous section, is highly dependant on the assumption of the model. In the risk estimation section, conservative assumptions are used to provide a protective assessment. Because the labels for these uses are not explicitly directive, a variety of assumptions were explored to give the risk manager a better sense of the range of possible exposure, and therefore risk, to wildlife species under the current labels.

Nursery Ornamentals

This use has the highest application rates of any outdoor uses, and subsequently results in the highest RQs. Because the labels have no restrictions on the amount of product applied per unit area per year, several assumptions are made. The RQs vary with differing assumptions. For this document, it is assumed that large- and medium-sized shrubs/trees represent the greatest use of the products, that the trees are treated with 0.25 lbs ai each, for each application. Though the concentration in ppm varies among tree/shrub, the volume needed for adequate coverage is assumed to be less for smaller trees (higher concentration), thus the 0.25 lbs ai/tree is used to calculate RQs. Many of the applications are limited to three per year, i.e., the number used in the modeling. It is possible that, in some instances, more applications will be made. It is also assumed that the shrubs/trees were evenly spaced at 6’x6’; however, changing the spacing would affect the maximum application rate (lbs ai/A).

Aquatic

Aquatic RQs from nursery uses exceed the acute risk LOC for freshwater fish by a factor of four to 10, and exceed the acute risk LOC for estuarine marine fish by a similar magnitude. The acute risk LOC is exceeded by up to 500-fold for freshwater invertebrates, and up to 54-fold for estuarine/marine invertebrates. Chronic risk LOCs for freshwater organisms are exceeded factors ranging from 10 to over 200-fold. While data on chronic toxicity to estuarine/marine organisms were not available for review, the lines of evidence strongly suggest potential chronic risk to these animals. These RQs are based on EECs derived from standard scenarios that assume 25 acres treated. It may not be realistic to assume 25 acres of treated shrubs and trees in a given nursery are treated at the same time, so RQs assuming 10, one and 0.5 acres are also calculated (Table 4.12). These adjustments assume a linear relationship between EEC and area treated. If only one acre were treated, following the stated assumptions, the acute risk to endangered species LOC would still be exceeded for fish in both PRZM/EXAMS scenarios and the restricted use LOC would still be exceeded in the GA pecan scenario. The freshwater chronic risk LOC would still be exceeded in the GA pecan scenario. If only a half acre were treated, the restricted use LOC would still be exceeded for fish in the GA pecan scenario. The freshwater invertebrate acute and chronic risk LOCs are exceeded regardless of the size of the treated area. The estuarine/marine invertebrate acute risk LOC is exceeded for treated areas of all sizes in the GA pecan scenario, and the restricted use LOC is exceeded for treated areas of all sizes in the OR Christmas tree scenario.

Table 4.12. Aquatic RQs adjusted for area treated.

Scenarios	Area treated (acres)	acute FW fish	chronic FW fish	acute FW invert	chronic FW invert	acute Est/Mar fish	acute Est/Mar invert
GA pecan	25	**5.26**	**28.04**	**249.66**	**221.69**	**4.75**	**26.78**
	10	**2.10**	**11.21**	**99.83**	**88.67**	**1.90**	**10.71**
	1	***0.21***	**1.12**	**9.98**	**8.87**	***0.19***	**1.07**
	0.5	***0.11***	.0.56	**5.00**	**4.43**	***0.10***	**0.54**
OR Christmas tree	25	**1.99**	**10.53**	**94.41**	**86.99**	**1.80**	**10.13**
	10	**0.80**	**4.22**	**37.80**	**34.70**	**0.72**	**4.05**
	1	**0.08**	0.42	**3.78**	**3.47**	**0.07**	***0.41***
	0.5	**0.04**	0.21	**1.90**	**1.73**	**0.04**	***0.20***

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.1)
Exceeds listed spp LOC (0.05) or chronic risk LOC (1.0)

Terrestrial

Acute avian RQs are exceeded from this use, by a minimum of 38-fold, and both acute and chronic risk LOCs mammalian RQs are exceeded 10- to 1700-fold, and even a single application results in LOC exceedances four- to 1400-fold. Chronic RQs for birds cannot be calculated due to lack of data and is therefore presumed. The labels do make some effort to minimize wildlife exposure, by limiting applications to before and after fruit production, though the flowers and foliage would remain potentially attractive forage. Even at an application rate of one half of one percent of the modeled rate (0.5%; 1.5 lbs ai/A), an amount less than is typically modeled for off-site drift, there are exceedances for almost all size classes and forage items for birds and most mammal size categories. It is presumed that nursery ornamentals are not intended to present forage, and that efforts are made by operators to make the plants unappealing to wildlife. However, non-target plants may receive unintentional exposure and may be used by wildlife as forage. While the areal extent of ADBAC application in nurseries is not known, these uses may present a risk to wildlife in proximity to nurseries.

Turf and Golf Courses

These uses have two considerably different maximum application rates. The type of sprayer used determines which maximum rate can be used. For commercial power sprayers, presumably used on golf course fairways and larger commercial lawns, the label allows a rate of 0.8 lbs ai/A. For other sprayers, the labels allow a rate of 6.8 lbs ai/A. The distinction between these types of sprayers is not further delineated, which presumably leaves interpretation to the applicator.

Because the labels lack limits on the number of applications that can be made per year, the scenarios presented in the Risk Estimation section of this document represent high-end usage patterns, though not necessarily the maximum allowable. For example, the 0.8 lbs ai/A rate is modeled assuming 26 applications at 10 day intervals, the minimum allowable interval for this use on the label. However, there could be situations where 36 applications could occur, since there is no restriction on the maximum number of applications. Since many of the target pathogens thrive in warm humid weather, applicators in areas with such climatic conditions year round could choose to apply ADBAC at the limit. In such situations, the RQs for all wildlife would increase by about 25%. In areas where growth conditions for the target pathogens are less ideal, fewer applications may be necessary, with an associated decrease in the RQs for wildlife.

Aquatic

As the number of applications decline, so do the aquatic RQs. At 26 applications at the 0.8 lbs ai/A rate, acute RQs meet or exceed the acute risk to endangered species LOC for freshwater and estuarine/marine fish. Applications of ten, five and one per year were also modeled (Table 4.13) and the LOC is not exceeded. The same pattern of decreasing RQs is found for invertebrates, but exceedances are not fully mitigated by limiting the number of applications. Acute freshwater invertebrate RQs remain above the acute risk LOC at five applications and the acute risk to endangered species LOC is exceeded after a single application. Acute estuarine/marine RQs remain above the restricted use LOC at after 10 applications, and above the acute risk to endangered species LOC after five applications.

Table 4.13. Acute and chronic RQs from different numbers of applications per year, assuming a rate of 0.8 lbs ai/A over 25 acres.

Scenario	Number of App.	acute FW fish	chronic FW fish	acute FW invert	chronic FW invert	acute Est/Mar fish	acute Est/Mar invert
FL turf	26	**0.06**	0.48	**2.64**	**2.27**	**0.05**	***0.28***
	10	0.02	0.19	**1.02**	0.87	0.02	***0.11***
	5	0.01	0.10	**0.53**	0.43	0.01	**0.06**
	1	0.00	0.02	***0.11***	0.09	0.00	0.01
PA turf	26	**0.07**	0.64	**3.49**	**2.63**	**0.07**	***0.37***
	10	0.03	0.24	**1.32**	**1.01**	0.03	***0.14***
	5	0.01	0.12	**0.66**	0.51	0.01	**0.07**
	1	0.00	0.02	***0.14***	0.10	0.00	0.01

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.1)
Exceeds listed spp LOC (0.05) or chronic risk LOC (1.0)

At the 6.8 lbs ai/A rate, allowed by the label if the applicator is not using 'commercial power sprayers', RQs exceed the restricted use and chronic risk LOCs for fish and both the acute and chronic LOCs for invertebrates. These RQs are calculated assuming 10 applications per year, though the label doesn't limit the number of applications per year. Therefore, if additional applications are made, the RQs would be higher. However, there is uncertainty about how much area will actually be treated at this rate. Several different application areas are modeled to explore the effect area treated would have on the RQs, assuming a linear relationship between area applied and EEC (Table 4.14). It is conceivable that aggregate use in a community could approach 25 acres treated in a given area, and a half acre treated is considered a reasonable low-end assumption. Like the previous scenario, RQs are greatest for aquatic invertebrates, where even at the smallest treatment area, the restricted use LOC is exceeded.

Table 4.14. Acute and chronic RQs from different size areas treated, assuming a rate of 6.8 lbs ai/A and 10 applications per year.

Scenario	Acres treated	acute FW fish	chronic FW fish	acute FW invert	chronic FW invert	acute Est/Mar fish	acute Est/Mar invert
FL turf	25	***0.18***	**1.53**	**8.34**	**6.39**	***0.16***	**0.89**
	10	**0.07**	0.61	**3.34**	**2.55**	**0.06**	***0.36***
	1	0.01	0.06	***0.33***	0.26	0.01	0.04
	0.5	0.00	0.03	***0.17***	0.13	0.00	0.02
PA turf	25	***0.22***	**1.94**	**10.59**	**7.30**	***0.20***	**1.14**
	10	**0.09**	0.78	**4.24**	**2.92**	**0.08**	***0.45***
	1	0.01	0.08	***0.42***	0.29	0.01	**0.05**
	0.5	0.00	0.04	***0.21***	0.15	0.00	0.02

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.1)
Exceeds listed spp LOC (0.05) or chronic risk LOC (1.0)

Terrestrial

The avian and mammalian model, TREX assumes wildlife is present and foraging on the treated area; therefore no area adjustment is necessary. For these scenarios, drift is not considered for exposure; it would be some fraction of the application rate but is not routinely considered in screening-level assessments. The terrestrial RQ values are based on upper bound exposure estimates. The mean exposure values are somewhat lower; however, 50% of the time, exposure values would be expected to exceed the means. Where multiple applications are considered, the default foliar half-life of 35 days is used. If data were submitted to show that the actual foliar half-life were shorter than the default value, the RQs would be somewhat lower.

Avian

While ADBAC is classified as moderately toxic to birds on an acute exposure basis, the avian acute LOC was exceed by two- to 24-fold for most forage items at the 0.8 lbs ai/A rate, assuming 26 applications at 10 day intervals. The acute risk to endangered species LOC is exceeded for all size birds foraging on all of the feed items evaluated. Several alternate numbers of applications are explored to see the effect on the RQs (Table 4.15). Reducing the number of applications to just one still results in RQs exceeding the acute risk to endangered species LOC for all categories except 100g and 1000g birds foraging on fruit/pods/large insects. Avian reproduction studies were not submitted for ADBAC, therefore chronic avian risk cannot be assessed. In the absence of data, risk is presumed.

Table 4.15. Acute avian RQs resulting from different numbers of applications pre year.

Use	App rate lb ai/A	Number apps	Forage Item(s)	Dose-based RQs 20g	100g	1000g
Turf	0.8	10	short grass	**10.71**	**4.80**	**1.52**
			tall grass	**4.91**	**2.20**	**0.70**
			bdlf/sm ins	**6.02**	**2.70**	**0.86**
			Fr/pods/lg ins	**0.67**	***0.30***	**0.10**
		5	short grass	**7.81**	**3.50**	**1.11**
			tall grass	**3.58**	**1.60**	**0.51**
			bdlf/sm ins	**4.39**	**1.97**	**0.62**
			Fr/pods/lg ins	***0.49***	***0.22***	0.07
		1	short grass	**2.23**	**1.00**	***0.32***
			tall grass	**1.02**	***0.46***	**0.15**
			bdlf/sm ins	**1.26**	**0.56**	**0.18**
			Fr/pods/lg ins	**0.14**	0.06	0.02

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.2)
Exceeds listed spp LOC (0.1)

For the 6.8 lbs ai/A application rate, at the assumed 10 applications per year at 10 day intervals, the acute risk LOC is exceeded for all size birds for all forage items. Since the label does not limit the number of applications, these RQs may not be indicative of actual risk, as more applications would increase the RQ values. To establish a base-line, one application is modeled at this rate (Table 4.16). One application of ADBAC at the label rate of 6.8 lbs ai/A results in exceedances of the acute risk LOC for all forage items and all size birds, except 1000g birds foraging on fruits/pods/large insects. That exception still exceeds the acute risk to endangered species LOC though. While RQs cannot be calculated for chronic risk to birds, chronic risk is presumed.

Table 4.16. Acute RQs for avian wildlife resulting from use of ADBAC on lawns/turf at the maximum rate of 6.8 lb ai/A, applied once per year.

	20 g	100 g	1000 g
Short Grass	**18.97**	**8.50**	**2.69**
Tall Grass	**8.69**	**3.89**	**1.23**
Broadleaf plants/sm insects	**10.67**	**4.78**	**1.51**
Fruits/pods/seeds/lg insects	**1.19**	**0.53**	**0.17**

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.2)
Exceeds listed spp LOC (0.1)

Mammals

As seen in the Risk Estimation section of this document, there are acute and chronic risk LOC exceedances for all size classes and most forage items when the 0.8 lbs ai/A rate is modeled assuming 26 applications at 10 day intervals. Again, since it possible to have more than 26 applications in a given year, those RQs are not entirely conservative. However, to provide a sense of perspective, RQs resulting from a single application are modeled (Table 4.17). One application results in acute risk to endangered species LOC exceedances for 15g and 35g mammals foraging on short grass, 15g mammals foraging on broadleaf plants/small insects; additionally, the chronic risk LOC is exceeded for those same categories. Given the nature of the target pathogens, it does not seem likely that one application would be sufficient to achieve control. Therefore, five applications at 10 day intervals are also modeled (Table. 4.18). Resulting RQs increase approximately three-fold and many more LOCs are exceeded. The typical number of applications at this rate is unknown for these products.

Table 4.17. Acute and chronic dose-based RQs for mammalian wildlife resulting from use of ADBAC on turf/golf courses at the maximum rate of 0.8 lb ai/A, applied once (exceedances in bold).

	15 g mammal		35 g mammal		1000 g mammal	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	**0.19**	**1.89**	**0.17**	**1.62**	0.09	0.87
Tall Grass	0.09	0.87	0.08	0.74	0.04	0.40
Broadleaf plants/sm insects	**0.11**	**1.06**	0.09	0.91	0.05	0.49
Fruits/pods/lg insects	0.01	0.12	0.01	0.10	0.01	0.05

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.2)
Exceeds listed spp LOC (0.1)

Table 4.18. Acute and chronic dose-based RQs for mammalian wildlife resulting from use of ADBAC on turf/golf courses at the maximum rate of 0.8 lb ai/A, applied five times with a 10 day interval.

	15 g mammal		35 g mammal		1000 g mammal	
	Acute	Chronic	Acute	Chronic	Acute	Chronic
Short Grass	**0.68**	**6.62**	**0.58**	**5.66**	***0.31***	**3.03**
Tall Grass	***0.31***	**3.04**	***0.27***	**2.59**	***0.14***	**1.39**
Broadleaf plants/sm insects	***0.38***	**3.72**	***0.33***	**3.18**	***0.17***	**1.71**
Fruits/pods/lg insects	0.04	0.41	0.04	0.35	0.02	0.19

Exceeds acute risk LOC (0.5)
Exceeds restricted use LOC (0.2)
Exceeds listed spp LOC (0.1)

At the higher application rate (6.8 lbs ai/A), the acute risk LOC is exceeded four- to 16-fold for all size class mammals foraging on short grass, tall grass and broadleaf plants/small insects. The restricted use LOC is exceeded for all size classes foraging on fruits/pods/large insects. The chronic risk LOC is exceeded for all size classes and forage items. These exceedances result from 10 applications at 10 day intervals. However, if only five applications are made, there would still be exceedances of acute and chronic LOCs for all forage items and all size classes. In fact, at the 6.8 lbs ai/A rate, there would still be acute, restricted use and acute risk to endangered species LOC exceedances for all categories except the 35g and 1000g size classes foraging on fruits/pods/large insects. Chronic RQs would also exceed the LOC in the same categories.

Mosquito control

Since ADBAC is applied directly to target waterbodies, disconnected from the greater watershed, limited exposure to non-target aquatic wildlife is expected; however, ephemeral pools and ornamental ponds often play an important role in the lifecycle of amphibians. The label does not preclude potential exposure to these organisms and therefore these uses may pose a significant risk to amphibians. EFED uses freshwater fish as surrogate for aquatic-phase amphibians. At the initial concentration of 200 ppm, the acute RQ would be 0.71, which exceeds LOC. The chronic RQ, based on a concentration of 200 ppm would be 6.1, which also exceeds the LOC.

As stated previously, drinking water is presumed to be the most likely route of exposure to terrestrial wildlife from these uses. Terrestrial wildlife exposure via forage items is also expected to be low, due to the application method and the limited scale of the target waterbody. Estimated exposure via drinking water is based on allometric equations, specific to birds and mammals (Appendix C), that are used to calculate daily pesticide exposure, assuming the animal gets 100% of its water from the treated water. However, it is possible that to small (15-g) mammals feeding on short grasses, an ephemeral pond could represent a sizable area in which to forage. Grasses may preferentially grow along or within these areas and attract these animals.

At the labeled rate of 200 ppm in the target waterbody, RQs exceed the acute risk to endangered species LOC for birds in the 20g and 100 g size classes. The restricted use LOC is exceeded for 20g birds. An increase in concentration to 220 ppm in the drinking water source would elevate the RQ for 1000g birds above the acute risk to endangered species LOC. Due to lack of data on chronic toxicity of ADBAC to birds, chronic RQs cannot be calculated and chronic risk is assumed.

Neither acute nor chronic mammalian RQs are exceeded at 200 ppm. The acute RQ for 15g mammals would exceed the acute risk to endangered species LOC at a concentration of 280 ppm. The acute RQs for mammals of all size classes exceed the acute risk to endangered species LOC at a concentration of 450 ppm, though at this concentration, restricted use LOC is not exceeded. The chronic risk LOC for 15g mammals would be exceeded at a concentration of 300 ppm and exceeded for mammals of all size classes at a concentration of 450 ppm.

The fate of the initial concentrations of ADBAC is unknown, and therefore subsequent weekly ‘maintenance’ applications of 100 ppm may result in cumulative concentration greater than the initial 200 ppm. If each application were wholly cumulative (i.e. no dissipation), the concentration in any given treated waterbody after five weeks would be 600 ppm. The likelihood of reaching these concentrations from these labeled uses is not known; it is clear that at such a concentration, calculable RQs would exceed LOCs for wildlife many-fold.

The labels should state specific limitations, such as size of target waterbodies and application timing, which could mitigate potential exposure to non-target organisms. Due to the lack of explicit limitations on the labels, risk to non-target organisms may be under-estimated in this assessment.

Puddles, Ornamental Ponds and Pools

The risk to terrestrial wildlife from this use appears to be minimal, based on the initial target concentration of 5 ppm. Calculable RQs all fall below 0.01, and the most conservative LOC for terrestrial animals is 0.1, for threatened and endangered species. Exposure to fish and non-target populations of aquatic invertebrates is likely to be minimal, based on label descriptions; specific limitations in number of applications and size of target waterbody should be stated on the labels. However, ephemeral waterbodies play an important role in the lifecycle of amphibians. The label does not preclude potential exposure to these organisms and therefore these uses may pose a risk to amphibians. EFED uses freshwater fish as surrogate for aquatic-phase amphibians. At the initial concentration of 5 ppm, both the acute and chronic RQs are well below the LOCs. The acute listed species LOC is exceeded at 15 ppm and the chronic LOC is exceeded at 35 ppm. Thus, multiple applications, as allowed by the label, may result in acute and/or chronic risk to listed amphibians.

Since this use is the only one identified as of concern to EFED containing DDAC, it appears that ADBAC and DDAC are of low concern for terrestrial wildlife exposure for these uses. DDAC would be of concern if avian or mammalian endpoints were significantly more sensitive (>10X) than for ADBAC; however, since toxicity of DDAC is unavailable for this assessment, potential risk due to DDAC remains an uncertainty. This use would also be of concern if concentrations in target waterbodies increase due to repeated applications.

The fate of the initial applications of ADBAC and DDAC is unknown. Since the label allows weekly application of 2.5 ppm, after the initial 5 ppm application, it is possible a cumulative concentration of greater than 5 ppm may occur. If each application were cumulative (i.e. no dissipation), the concentration in any given treated waterbody after five weeks would be 20 ppm. The LOC for listed mammals in the 15g size class is exceeded at concentrations greater than 280 ppm and for listed birds in the 20g size class at >65 ppm. The likelihood of reaching these concentrations from these labeled uses it uncertain; however, given the chemical's persistence and immobility, it is likely that concentrations would increase with repeatedly applications.

Additionally, the lack of data on the chronic toxicity of ADBAC and DDAC on birds makes quantified chronic risk estimation impossible

5 Threatened and Endangered Species Concerns

5.1 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 organisms are assumed to be located in a surface water body adjacent to the treated site. The assessment also assumes that the listed species are located within an assumed area that has the relatively highest potential exposure to the pesticide, and that exposures are likely to decrease with distance from the treatment area.

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

5.2 Taxonomic Groups Potentially at Risk

Based on available screening level information, it is possible that ADBAC may have acute and/or chronic toxic effects on endangered or threatened aquatic or terrestrial organisms. Should estimated exposure levels occur in proximity to listed resources, the available screening level information suggests a potential concern for effects on some listed species associated with the outdoor use of ADBAC. This screening assessment is based on the initial assumption that listed species within the taxonomic groups of concern are actually present in areas for which the estimated exposure levels used for RQ calculation can be expected to occur. A specific determination of “may affect” for any RQ in excess of listed species LOCs cannot be made without further refinement of the co-occurrence of listed species in ADBAC use areas.

The LOCATES database was used to identify those U.S. counties that have nurseries and have Federally listed endangered or threatened species. A count summary of listed taxa that have been known to occur in those areas is presented in **Appendix D**, by State. Further refinements to the risk assessment must be made for the Agency to be in compliance with the Endangered Species Act and to determine the need for consultation with the Services. There is no general scenario for determining the co-occurrence of turf or golf courses with listed species.

Appendix A. PRZM/EXAMS Input Files

FL Turf (0.8 lbs ai/A; 26 applications/year)

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

Data used for this run:
Output File: FLturf26
Metfile:     w12834.dvf
PRZM scenario:      FLturfC.txt
EXAMS environment file:    pond298.exv
Chemical Name:      ADBAC
Description  Variable Name Value  Units  Comments
Molecular weight    mwt    368.05 g/mol
Henry's Law Const.  henry  7.76e-13      atm-m^3/mol
Vapor Pressure      vapr   3.53e-12      torr
Solubility   sol    184.4  mg/L
Kd     Kd           mg/L
Koc    Koc    2.7e6  mg/L
Photolysis half-life       kdp    0      days   Half-life
Aerobic Aquatic Metabolism kbacw  0      days   Halfife
Anaerobic Aquatic Metabolism      kbacs  5445   days   Halfife
Aerobic Soil Metabolism    asm    0      days   Halfife
Hydrolysis:  pH 7   183    days   Half-life
Method:      CAM    2      integer       See PRZM manual
Incorporation Depth:       DEPI          cm
Application Rate:   TAPP   0.9    kg/ha
Application Efficiency:    APPEFF .95    fraction
Spray Drift  DRFT   .05    fraction of application rate applied to pond
Application Date    Date   2-1    dd/mm or dd/mmm or dd-mm or dd-mmm
Interval 1   interval      10     days   Set to 0 or delete line for single app.
Interval 2   interval      10     days   Set to 0 or delete line for single app.
Interval 3   interval      10     days   Set to 0 or delete line for single app.
Interval 4   interval      10     days   Set to 0 or delete line for single app.
Interval 5   interval      10     days   Set to 0 or delete line for single app.
Interval 6   interval      10     days   Set to 0 or delete line for single app.
Interval 7   interval      10     days   Set to 0 or delete line for single app.
Interval 8   interval      10     days   Set to 0 or delete line for single app.
Interval 9   interval      10     days   Set to 0 or delete line for single app.
Interval 10  interval      10     days   Set to 0 or delete line for single app.
Interval 11  interval      10     days   Set to 0 or delete line for single app.
Interval 12  interval      10     days   Set to 0 or delete line for single app.
Interval 13  interval      10     days   Set to 0 or delete line for single app.
Interval 14  interval      10     days   Set to 0 or delete line for single app.
Interval 15  interval      10     days   Set to 0 or delete line for single app.
Interval 16  interval      10     days   Set to 0 or delete line for single app.
Interval 17  interval      10     days   Set to 0 or delete line for single app.
Interval 18  interval      10     days   Set to 0 or delete line for single app.
Interval 19  interval      10     days   Set to 0 or delete line for single app.
Interval 20  interval      10     days   Set to 0 or delete line for single app.
Interval 21  interval      10     days   Set to 0 or delete line for single app.
Interval 22  interval      10     days   Set to 0 or delete line for single app.
Interval 23  interval      10     days   Set to 0 or delete line for single app.
Interval 24  interval      10     days   Set to 0 or delete line for single app.
Interval 25  interval      10     days   Set to 0 or delete line for single app.
Record 17:   FILTRA
       IPSCND 1
       UPTKF
Record 18:   PLVKRT
       PLDKRT
       FEXTRC 0.5
Flag for Index Res. Run    IR     Pond
Flag for runoff calc.      RUNOFF none   none, monthly or total(average of entire run)
```

FL Turf (0.8 lbs ai/A; 10 applications/year)

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

Data used for this run:
Output File: FLturf10
Metfile:     w12834.dvf
PRZM scenario:      FLturfC.txt
EXAMS environment file:    pond298.exv
Chemical Name:      ADBAC
Description   Variable Name Value  Units  Comments
Molecular weight    mwt    368.05 g/mol
Henry's Law Const.  henry  7.76e-13      atm-m^3/mol
Vapor Pressure      vapr   3.53e-12      torr
Solubility   sol    184.4  mg/L
Kd     Kd           mg/L
Koc    Koc    2.7e6  mg/L
Photolysis half-life       kdp    0      days   Half-life
Aerobic Aquatic Metabolism kbacw  0      days   Halfife
Anaerobic Aquatic Metabolism     kbacs  5445   days   Halfife
Aerobic Soil Metabolism    asm    0      days   Halfife
Hydrolysis:  pH 7   183    days   Half-life
Method:      CAM    2      integer       See PRZM manual
Incorporation Depth:       DEPI          cm
Application Rate:   TAPP   0.9    kg/ha
Application Efficiency:    APPEFF .95    fraction
Spray Drift  DRFT   .05    fraction of application rate applied to pond
Application Date    Date   1-4    dd/mm or dd/mmm or dd-mm or dd-mmm
Interval 1   interval      10     days   Set to 0 or delete line for single app.
Interval 2   interval      10     days   Set to 0 or delete line for single app.
Interval 3   interval      10     days   Set to 0 or delete line for single app.
Interval 4   interval      10     days   Set to 0 or delete line for single app.
Interval 5   interval      10     days   Set to 0 or delete line for single app.
Interval 6   interval      10     days   Set to 0 or delete line for single app.
Interval 7   interval      10     days   Set to 0 or delete line for single app.
Interval 8   interval      10     days   Set to 0 or delete line for single app.
Interval 9   interval      10     days   Set to 0 or delete line for single app.
Record 17:   FILTRA
       IPSCND 1
       UPTKF
Record 18:   PLVKRT
       PLDKRT
       FEXTRC 0.5
Flag for Index Res. Run    IR     Pond
Flag for runoff calc.      RUNOFF none    none, monthly or total(average of entire run)
```

FL Turf (0.8 lbs ai/A; 5 applications/year)

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

Data used for this run:
Output File: FLturf5
Metfile:     w12834.dvf
PRZM scenario:      FLturfC.txt
EXAMS environment file:    pond298.exv
Chemical Name:      ADBAC
Description   Variable Name Value  Units  Comments
Molecular weight    mwt    368.05 g/mol
Henry's Law Const.  henry  7.76e-13      atm-m^3/mol
Vapor Pressure      vapr   3.53e-12      torr
Solubility   sol    184.4  mg/L
Kd     Kd           mg/L
Koc    Koc    2.7e6  mg/L
Photolysis half-life       kdp    0      days   Half-life
```

```
Aerobic Aquatic Metabolism kbacw  0      days   Halfife
Anaerobic Aquatic Metabolism      kbacs  5445   days   Halfife
Aerobic Soil Metabolism    asm    0      days   Halfife
Hydrolysis:  pH 7   183    days   Half-life
Method:      CAM    2      integer       See PRZM manual
Incorporation Depth:       DEPI          cm
Application Rate:   TAPP   0.9    kg/ha
Application Efficiency:    APPEFF .95    fraction
Spray Drift  DRFT   .05    fraction of application rate applied to pond
Application Date    Date   1-4    dd/mm or dd/mmm or dd-mm or dd-mmm
Interval 1   interval      10     days   Set to 0 or delete line for single app.
Interval 2   interval      10     days   Set to 0 or delete line for single app.
Interval 3   interval      10     days   Set to 0 or delete line for single app.
Interval 4   interval      10     days   Set to 0 or delete line for single app.
Record 17:   FILTRA
       IPSCND 1
       UPTKF
Record 18:   PLVKRT
       PLDKRT
       FEXTRC 0.5
Flag for Index Res. Run    IR     Pond
Flag for runoff calc.      RUNOFF none   none, monthly or total(average of entire run)
```

FL Turf (0.8 lbs ai/A; 1 applications/year)

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

Data used for this run:
Output File: FLturf1
Metfile:     w12834.dvf
PRZM scenario:      FLturfC.txt
EXAMS environment file:    pond298.exv
Chemical Name:      ADBAC
Description  Variable Name Value  Units  Comments
Molecular weight    mwt    368.05 g/mol
Henry's Law Const.  henry  7.76e-13      atm-m^3/mol
Vapor Pressure      vapr   3.53e-12      torr
Solubility   sol    184.4  mg/L
Kd     Kd           mg/L
Koc    Koc    2.7e6  mg/L
Photolysis half-life       kdp    0      days   Half-life
Aerobic Aquatic Metabolism kbacw  0      days   Halfife
Anaerobic Aquatic Metabolism      kbacs  5445   days   Halfife
Aerobic Soil Metabolism    asm    0      days   Halfife
Hydrolysis:  pH 7   183    days   Half-life
Method:      CAM    2      integer       See PRZM manual
Incorporation Depth:       DEPI          cm
Application Rate:   TAPP   0.9    kg/ha
Application Efficiency:    APPEFF .95    fraction
Spray Drift  DRFT   .05    fraction of application rate applied to pond
Application Date    Date   1-4    dd/mm or dd/mmm or dd-mm or dd-mmm
Record 17:   FILTRA
       IPSCND 1
       UPTKF
Record 18:   PLVKRT
       PLDKRT
       FEXTRC 0.5
Flag for Index Res. Run    IR     Pond
Flag for runoff calc.      RUNOFF none   none, monthly or total(average of entire run)
```

FL Turf (6.8 lbs ai/A; 10 applications/year)

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

Data used for this run:
```

```
Output File: FLturfRES
Metfile:     w12834.dvf
PRZM scenario:      FLturfC.txt
EXAMS environment file:    pond298.exv
Chemical Name:      ADBAC
Description   Variable Name Value  Units  Comments
Molecular weight    mwt    368.05 g/mol
Henry's Law Const.  henry  7.76e-13     atm-m^3/mol
Vapor Pressure      vapr   3.53e-12     torr
Solubility   sol    184.4  mg/L
Kd     Kd           mg/L
Koc    Koc    2.7e6  mg/L
Photolysis half-life       kdp    0      days   Half-life
Aerobic Aquatic Metabolism kbacw  0      days   Halfife
Anaerobic Aquatic Metabolism     kbacs  5445   days   Halfife
Aerobic Soil Metabolism    asm    0      days   Halfife
Hydrolysis:  pH 7   183    days   Half-life
Method:      CAM    2      integer      See PRZM manual
Incorporation Depth:       DEPI         cm
Application Rate:   TAPP   7.62   kg/ha
Application Efficiency:    APPEFF .99    fraction
Spray Drift  DRFT   .01    fraction of application rate applied to pond
Application Date    Date   1-4    dd/mm or dd/mmm or dd-mm or dd-mmm
Interval 1   interval     10     days   Set to 0 or delete line for single app.
Interval 2   interval     10     days   Set to 0 or delete line for single app.
Interval 3   interval     10     days   Set to 0 or delete line for single app.
Interval 4   interval     10     days   Set to 0 or delete line for single app.
Interval 5   interval     10     days   Set to 0 or delete line for single app.
Interval 6   interval     10     days   Set to 0 or delete line for single app.
Interval 7   interval     10     days   Set to 0 or delete line for single app.
Interval 8   interval     10     days   Set to 0 or delete line for single app.
Interval 9   interval     10     days   Set to 0 or delete line for single app.
Record 17:   FILTRA
       IPSCND 1
       UPTKF
Record 18:   PLVKRT
       PLDKRT
       FEXTRC 0.5
Flag for Index Res. Run    IR     Pond
Flag for runoff calc.      RUNOFF none   none, monthly or total(average of entire run)
```

PA Turf (0.8 lbs ai/A; 26 applications/year)

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

Data used for this run:
Output File: PAturf26
Metfile:     w14737.dvf
PRZM scenario:      PAturfC.txt
EXAMS environment file:    pond298.exv
Chemical Name:      ADBAC
Description   Variable Name Value  Units  Comments
Molecular weight    mwt    368.05 g/mol
Henry's Law Const.  henry  7.76e-13     atm-m^3/mol
Vapor Pressure      vapr   3.53e-12     torr
Solubility   sol    184.4  mg/L
Kd     Kd           mg/L
Koc    Koc    2.7e6  mg/L
Photolysis half-life       kdp    0      days   Half-life
Aerobic Aquatic Metabolism kbacw  0      days   Halfife
Anaerobic Aquatic Metabolism     kbacs  5445   days   Halfife
Aerobic Soil Metabolism    asm    0      days   Halfife
Hydrolysis:  pH 7   183    days   Half-life
Method:      CAM    2      integer      See PRZM manual
```

```
Incorporation Depth:        DEPI          cm
Application Rate:   TAPP   0.9    kg/ha
Application Efficiency:     APPEFF .95    fraction
Spray Drift   DRFT   .05    fraction of application rate applied to pond
Application Date    Date   2-1    dd/mm or dd/mmm or dd-mm or dd-mmm
Interval 1   interval      10     days   Set to 0 or delete line for single app.
Interval 2   interval      10     days   Set to 0 or delete line for single app.
Interval 3   interval      10     days   Set to 0 or delete line for single app.
Interval 4   interval      10     days   Set to 0 or delete line for single app.
Interval 5   interval      10     days   Set to 0 or delete line for single app.
Interval 6   interval      10     days   Set to 0 or delete line for single app.
Interval 7   interval      10     days   Set to 0 or delete line for single app.
Interval 8   interval      10     days   Set to 0 or delete line for single app.
Interval 9   interval      10     days   Set to 0 or delete line for single app.
Interval 10  interval      10     days   Set to 0 or delete line for single app.
Interval 11  interval      10     days   Set to 0 or delete line for single app.
Interval 12  interval      10     days   Set to 0 or delete line for single app.
Interval 13  interval      10     days   Set to 0 or delete line for single app.
Interval 14  interval      10     days   Set to 0 or delete line for single app.
Interval 15  interval      10     days   Set to 0 or delete line for single app.
Interval 16  interval      10     days   Set to 0 or delete line for single app.
Interval 17  interval      10     days   Set to 0 or delete line for single app.
Interval 18  interval      10     days   Set to 0 or delete line for single app.
Interval 19  interval      10     days   Set to 0 or delete line for single app.
Interval 20  interval      10     days   Set to 0 or delete line for single app.
Interval 21  interval      10     days   Set to 0 or delete line for single app.
Interval 22  interval      10     days   Set to 0 or delete line for single app.
Interval 23  interval      10     days   Set to 0 or delete line for single app.
Interval 24  interval      10     days   Set to 0 or delete line for single app.
Interval 25  interval      10     days   Set to 0 or delete line for single app.
Record 17:   FILTRA
       IPSCND 1
       UPTKF
Record 18:   PLVKRT
       PLDKRT
       FEXTRC 0.5
Flag for Index Res. Run    IR     Pond
Flag for runoff calc.    RUNOFF none    none, monthly or total(average of entire run)
```

PA Turf (0.8 lbs ai/A; 10 applications/year)

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

Data used for this run:
Output File: PAturf10
Metfile:     w14737.dvf
PRZM scenario:      PAturfC.txt
EXAMS environment file:    pond298.exv
Chemical Name:      ADBAC
Description   Variable Name Value  Units  Comments
Molecular weight    mwt    368.05 g/mol
Henry's Law Const.  henry  7.76e-13      atm-m^3/mol
Vapor Pressure      vapr   3.53e-12      torr
Solubility   sol    184.4  mg/L
Kd     Kd           mg/L
Koc    Koc    2.7e6  mg/L
Photolysis half-life       kdp    0      days   Half-life
Aerobic Aquatic Metabolism kbacw  0      days   Halfife
Anaerobic Aquatic Metabolism      kbacs  5445   days   Halfife
Aerobic Soil Metabolism    asm    0      days   Halfife
Hydrolysis:  pH 7   183    days   Half-life
Method:      CAM    2      integer       See PRZM manual
Incorporation Depth:       DEPI          cm
Application Rate:   TAPP   0.9    kg/ha
```

```
Application Efficiency:    APPEFF .95    fraction
Spray Drift   DRFT   .05    fraction of application rate applied to pond
Application Date    Date   1-5    dd/mm or dd/mmm or dd-mm or dd-mmm
Interval 1    interval     10     days   Set to 0 or delete line for single app.
Interval 2    interval     10     days   Set to 0 or delete line for single app.
Interval 3    interval     10     days   Set to 0 or delete line for single app.
Interval 4    interval     10     days   Set to 0 or delete line for single app.
Interval 5    interval     10     days   Set to 0 or delete line for single app.
Interval 6    interval     10     days   Set to 0 or delete line for single app.
Interval 7    interval     10     days   Set to 0 or delete line for single app.
Interval 8    interval     10     days   Set to 0 or delete line for single app.
Interval 9    interval     10     days   Set to 0 or delete line for single app.
Record 17:    FILTRA
       IPSCND 1
       UPTKF
Record 18:    PLVKRT
       PLDKRT
       FEXTRC 0.5
Flag for Index Res. Run    IR     Pond
Flag for runoff calc.      RUNOFFnone     none, monthly or total(average of entire run)
```

PA Turf (0.8 lbs ai/A; 5 applications/year)

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

Data used for this run:
Output File: PAturf5
Metfile:     w14737.dvf
PRZM scenario:      PAturfC.txt
EXAMS environment file:    pond298.exv
Chemical Name:      ADBAC
Description   Variable Name Value  Units  Comments
Molecular weight    mwt    368.05 g/mol
Henry's Law Const.  henry  7.76e-13      atm-m^3/mol
Vapor Pressure      vapr   3.53e-12      torr
Solubility   sol    184.4  mg/L
Kd     Kd           mg/L
Koc    Koc    2.7e6  mg/L
Photolysis half-life       kdp    0      days   Half-life
Aerobic Aquatic Metabolism kbacw  0      days   Halfife
Anaerobic Aquatic Metabolism      kbacs  5445   days   Halfife
Aerobic Soil Metabolism    asm    0      days   Halfife
Hydrolysis:  pH 7   183    days   Half-life
Method:      CAM    2      integer       See PRZM manual
Incorporation Depth:       DEPI          cm
Application Rate:   TAPP   0.9    kg/ha
Application Efficiency:    APPEFF .95    fraction
Spray Drift   DRFT   .05    fraction of application rate applied to pond
Application Date    Date   1-5    dd/mm or dd/mmm or dd-mm or dd-mmm
Interval 1    interval     10     days   Set to 0 or delete line for single app.
Interval 2    interval     10     days   Set to 0 or delete line for single app.
Interval 3    interval     10     days   Set to 0 or delete line for single app.
Interval 4    interval     10     days   Set to 0 or delete line for single app.
Record 17:    FILTRA
       IPSCND 1
       UPTKF
Record 18:    PLVKRT
       PLDKRT
       FEXTRC 0.5
Flag for Index Res. Run    IR     Pond
Flag for runoff calc.      RUNOFFnone     none, monthly or total(average of entire run)
```

PA Turf (0.8 lbs ai/A; 1 applications/year)

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

Data used for this run:
Output File: PAturf1
Metfile: w14737.dvf
PRZM scenario: PAturfC.txt
EXAMS environment file: pond298.exv
Chemical Name: ADBAC
Description Variable Name Value Units Comments
Molecular weight mwt 368.05 g/mol
Henry's Law Const. henry 7.76e-13 atm-m^3/mol
Vapor Pressure vapr 3.53e-12 torr
Solubility sol 184.4 mg/L
Kd Kd mg/L
Koc Koc 2.7e6 mg/L
Photolysis half-life kdp 0 days Half-life
Aerobic Aquatic Metabolism kbacw 0 days Halfife
Anaerobic Aquatic Metabolism kbacs 5445 days Halfife
Aerobic Soil Metabolism asm 0 days Halfife
Hydrolysis: pH 7 183 days Half-life
Method: CAM 2 integer See PRZM manual
Incorporation Depth: DEPI cm
Application Rate: TAPP 0.9 kg/ha
Application Efficiency: APPEFF .95 fraction
Spray Drift DRFT .05 fraction of application rate applied to pond
Application Date Date 1-5 dd/mm or dd/mmm or dd-mm or dd-mmm
Record 17: FILTRA
IPSCND 1
UPTKF
Record 18: PLVKRT
PLDKRT
FEXTRC 0.5
Flag for Index Res. Run IR Pond
Flag for runoff calc. RUNOFFnone none, monthly or total(average of entire run)

PA Turf (6.8 lbs ai/A; 10 applications/year)
Inputs generated by pe4.pl - 8-August-2003

Data used for this run:
Output File: PAturfRES
Metfile: w14737.dvf
PRZM scenario: PAturfC.txt
EXAMS environment file: pond298.exv
Chemical Name: ADBAC
Description Variable Name Value Units Comments
Molecular weight mwt 368.05 g/mol
Henry's Law Const. henry 7.76e-13 atm-m^3/mol
Vapor Pressure vapr 3.53e-12 torr
Solubility sol 184.4 mg/L
Kd Kd mg/L
Koc Koc 2.7e6 mg/L
Photolysis half-life kdp 0 days Half-life
Aerobic Aquatic Metabolism kbacw 0 days Halfife
Anaerobic Aquatic Metabolism kbacs 5445 days Halfife
Aerobic Soil Metabolism asm 0 days Halfife
Hydrolysis: pH 7 183 days Half-life
Method: CAM 2 integer See PRZM manual
Incorporation Depth: DEPI cm
Application Rate: TAPP 7.62 kg/ha
Application Efficiency: APPEFF .99 fraction
Spray Drift DRFT .01 fraction of application rate applied to pond
Application Date Date 1-5 dd/mm or dd/mmm or dd-mm or dd-mmm
Interval 1 interval 10 days Set to 0 or delete line for single app.
Interval 2 interval 10 days Set to 0 or delete line for single app.

```
Interval 3   interval     10     days   Set to 0 or delete line for single app.
Interval 4   interval     10     days   Set to 0 or delete line for single app.
Interval 5   interval     10     days   Set to 0 or delete line for single app.
Interval 6   interval     10     days   Set to 0 or delete line for single app.
Interval 7   interval     10     days   Set to 0 or delete line for single app.
Interval 8   interval     10     days   Set to 0 or delete line for single app.
Interval 9   interval     10     days   Set to 0 or delete line for single app.
Record 17:   FILTRA
       IPSCND 1
       UPTKF
Record 18:   PLVKRT
       PLDKRT
       FEXTRC 0.5
Flag for Index Res. Run    IR     Pond
Flag for runoff calc.      RUNOFFnone     none, monthly or total(average of entire run)
```

GA Pecans

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

Data used for this run:
Output File: GApecans
Metfile:     w93805.dvf
PRZM scenario:      GAPecansC.txt
EXAMS environment file:    pond298.exv
Chemical Name:      ADBAC
Description   Variable Name Value  Units  Comments
Molecular weight    mwt    368.05 g/mol
Henry's Law Const.  henry  7.76e-13      atm-m^3/mol
Vapor Pressure      vapr   3.53e-12      torr
Solubility   sol    184.4  mg/L
Kd     Kd           mg/L
Koc    Koc    2.7e6  mg/L
Photolysis half-life       kdp    0      days   Half-life
Aerobic Aquatic Metabolism kbacw  0      days   Halfife
Anaerobic Aquatic Metabolism     kbacs  5445   days   Halfife
Aerobic Soil Metabolism    asm    0      days   Halfife
Hydrolysis:  pH 7   183    days   Half-life
Method:      CAM    2      integer       See PRZM manual
Incorporation Depth:       DEPI          cm
Application Rate:   TAPP   339    kg/ha
Application Efficiency:    APPEFF .95    fraction
Spray Drift  DRFT   .05    fraction of application rate applied to pond
Application Date    Date   10-5   dd/mm or dd/mmm or dd-mm or dd-mmm
Interval 1   interval     7      days   Set to 0 or delete line for single app.
Interval 2   interval     7      days   Set to 0 or delete line for single app.
Record 17:   FILTRA
       IPSCND 1
       UPTKF
Record 18:   PLVKRT
       PLDKRT
       FEXTRC 0.5
Flag for Index Res. Run    IR     Pond
Flag for runoff calc.      RUNOFFnone     none, monthly or total(average of entire run)
```

OR Christmas Tree

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

Data used for this run:
Output File: ORXmasstree
Metfile:     w24232.dvf
PRZM scenario:      ORXmasTreeC.txt
EXAMS environment file:    pond298.exv
Chemical Name:      ADBAC
```

Description	Variable Name	Value	Units	Comments
Molecular weight	mwt	368.05	g/mol	
Henry's Law Const.	henry	7.76e-13		atm-m^3/mol
Vapor Pressure	vapr	3.53e-12		torr
Solubility	sol	184.4	mg/L	
Kd	Kd		mg/L	
Koc	Koc	2.7e6	mg/L	
Photolysis half-life	kdp	0	days	Half-life
Aerobic Aquatic Metabolism	kbacw	0	days	Halfife
Anaerobic Aquatic Metabolism	kbacs	5445	days	Halfife
Aerobic Soil Metabolism	asm	0	days	Halfife
Hydrolysis:	pH 7	183	days	Half-life
Method:	CAM	2	integer	See PRZM manual
Incorporation Depth:	DEPI		cm	
Application Rate:	TAPP	339	kg/ha	
Application Efficiency:	APPEFF	.95	fraction	
Spray Drift	DRFT	.05	fraction of application rate applied to pond	
Application Date	Date	10-5	dd/mm or dd/mmm or dd-mm or dd-mmm	
Interval 1	interval	7	days	Set to 0 or delete line for single app.
Interval 2	interval	7	days	Set to 0 or delete line for single app.
Record 17:	FILTRA			
	IPSCND	1		
	UPTKF			
Record 18:	PLVKRT			
	PLDKRT			
	FEXTRC	0.5		
Flag for Index Res. Run	IR	Pond		
Flag for runoff calc.	RUNOFF	none		none, monthly or total(average of entire run)

Appendix B. Ecotoxicity

The ecotoxicologic endpoints used in this assessment are those used by AD in their assessments. Refer to the RED details of the studies. The endpoints are summarized and briefly described here. Only ADBAC is considered in this section, as DDAC endpoints were not provided. As described in other parts of this document, wildlife exposure to DDAC is expected to be limited.

A. Toxicity to Terrestrial Animals

(1) Avian, Acute and Chronic

In order to establish the toxicity of ADBAC to avian species for indoor, aquatic industrial, and wood preservative uses, the Agency requires an acute oral toxicity study using the technical grade active ingredient (TGAI). The preferred-test species is either mallard duck (a waterfowl) or bobwhite quail (an upland game bird). The results of one acute oral toxicity study, submitted for ADBAC, are provided in the following table (Table 1). The results from the acceptable study indicate that ADBAC is moderately toxic to avian species on an acute oral basis. The study fulfills guideline requirements.

Table 1. Acute Oral Toxicity of ADBAC to Birds

Species	Chemical, % Active Ingredient (a.i.)	Endpoint (mg/kg)	Toxicity Category	Satisfies Guidelines/ Comments	Reference (MRID No.)
Bobwhite quail (*Colinus virginianus*	ADBAC 80%	LD_{50} = 136 NOEC = 62.5 (a.i.)	Moderately toxic	Yes	428859-01

No data are available regarding the chronic toxicity of ADBAC to birds. Chronic risk to avian species cannot be precluded in the absence of data.

(2) Mammals, Acute and Chronic Toxicity

The endpoints used in this risk assessment were chosen by AD and used without details of the studies available. The acute LD_{50} for rats exposed to ADBAC is 430 mg/kg-bw (MRID 232269). The NOAEL, from a chronic toxicity study with rats (MRID 41947501), is 44 mg/kg/day (1000 ppm).

B. Toxicity to Aquatic Animals

The Agency requested that aquatic toxicity studies be conducted with ADBAC since, under typical use conditions, it may be introduced into the aquatic environment.

(1) Freshwater Fish, Acute

In order to establish the acute toxicity of ADBAC to freshwater fish, the Agency requires freshwater fish toxicity studies using the TGAI. The preferred test species are rainbow trout (a coldwater fish) and bluegill sunfish (a warmwater fish). Results of freshwater fish acute studies, submitted for ADBAC and obtained from the open literature, are presented in Table 3. The results indicate that ADBAC is highly toxic to on an acute basis. The core studies fulfill guideline requirements.

Table 3. Acute Toxicity of ADBAC to Freshwater Fish

Species	Chemical, % Active Ingredient (a.i.)	Endpoint (ppm)	Toxicity Category	Satisfies Guidelines/ Comments	Reference (MRID No.)
Bluegill sunfish (*Lepomis macrochirus)*	ADBAC 30%*	LC_{50} = 0.515 NOEC = 0.456 (a.i.)	Highly toxic	Yes core study	419472-01
Fathead minnow (*Pimephales promelas)*	ADBAC 80%	LC_{50} = 0.28 NOEC = ND (a.i.)	Highly toxic	Yes core study	437401-03
Rainbow Trout (*Oncorhynchus mykiss)*	ADBAC 30%	LC_{50} = 0.923 NOEC = 0.619 (a.i.)	Highly toxic	Yes core study	419472-02
Rainbow Trout (O*ncorhynchus mykiss*)	ADBAC 50%	LC_{50} = 1.01 (a.i.)	Highly/ moderately toxic	No open literature	Dobbs, M.G. et al.

(2) Freshwater Invertebrates, Acute

The Agency requires a freshwater aquatic invertebrate study using the TGAI to establish the acute toxicity to freshwater invertebrates. The preferred test species is *Daphnia magna*. Results of two studies, submitted for ADBAC and obtained from the open literature, are provided in the following table (Table 4). Results of the studies indicate that ADBAC is very highly toxic to freshwater invertebrates. The guideline requirement has been fulfilled.

Table 4. Acute Toxicity of ADBAC to Freshwater Invertebrates

Species	Chemical, % Active Ingredient (a.i.)	Endpoint (ppm)	Toxicity Category	Satisfies Guidelines/ Comments	Reference (MRID No.)
Waterflea (*Daphnia magna)*	ADBAC 30%*	EC_{50} = 0.0059 NOEC = ND (a.i.)	Very highly toxic	Yes core study	419472-03
Waterflea (*Daphnia magna)*	ADBAC 50%	LC_{50} = 0.02 (a.i.)	Very highly toxic	No open literature	Dobbs, M.G., et al.

(3) Estuarine and Marine Organisms, Acute

Acute toxicity testing with estuarine and marine organisms using the TGAI is required when the end-use product is intended for direct application to the marine/estuarine environment

* Comparable to typical ADBAC Manufacturing Use Product (MUP) 80% with regard to actual composition of ADBAC and its impurities

or effluent containing the active ingredient is expected to reach this environment. The preferred fish test species is sheepshead minnow. The preferred invertebrate test species are mysid shrimp and eastern oysters. This testing is required for ADBAC based on the chemical's use in aquatic sites such as pulp and paper mills, once-through cooling towers, oil field recovery systems and as a wood preservative. Results of toxicity studies, submitted for ADBAC and obtained from the open literature, are presented in Table 5.

Table 5. Acute Toxicity of ADBAC to Estuarine and Marine Organisms

Species	Chemical, % Active Ingredient (a.i.)	Endpoint (ppm ai)	Toxicity Category	Satisfies Guidelines/ Comments	Reference (MRID No.)
Sheepshead minnow (*Cyprinodon variegatus*)	ADBAC 80%	LC_{50} = 0.86 NOEC = 0.68	Highly toxic	Yes core study	424795-02
Inland silverside (*Menidia beryllina)*	ADBAC 50%	LC_{50} = 0.31	Highly toxic	No open literature	Dobbs, M.G. et al.
Mysid shrimp (*Mysidopsis bahia)*	ADBAC 80%	LC_{50} = 0.092 NOEC = 0.047	Very highly toxic	Yes core study	424795-01
Mysid shrimp (*Mysidopsis bahia*)	ADBAC 50%	LC_{50} = 0.08	Very highly toxic	No supplemental study	Dobbs, M.G. et al.
Eastern oyster (*Crassostrea virginica*)	ADBAC 80%	LC_{50} = 0.055	Very highly toxic	No supplemental study	424795-03

The results of the studies indicate that ADBAC is highly toxic to estuarine/marine fish and very highly toxic to estuarine/marine invertebrates on an acute basis. The two core studies (MRID 424795-01 and MRID 424795-02) fulfill guideline requirements for acute toxicity tests using estuarine/marine fish and shrimp. However, the one study using an estuarine/marine mollusk (MRID 424795-03) was classified as supplemental and does not fulfill guideline requirements.

(4) Aquatic Organisms, Chronic

Chronic toxicity testing (fish early life stage, 72-4a/OPPTS 850.1400 and aquatic invertebrate life cycle, 72-4b/OPPTS 850.1300) is required for pesticides when certain conditions of use and environmental fate apply. The preferred freshwater fish test species is fathead minnow (*Pimephales promelas*), but other species may be used. The preferred freshwater invertebrate is *Daphnia magna*. This testing is required for ADBAC. Results of these toxicity studies, submitted for ADBAC, are presented in Table 6. The results indicate that exposure to ADBAC on a chronic basis results in measurable effects on warmwater fish at a concentration of 75.9 µg a.i./L. This study fulfills guideline requirements for a fish early life stage chronic test (72-4(a)/OPPTS 850.1400). No measurable effects on freshwater invertebrates were noted at a concentration of 4.15 µg/L. However, an MATC could not be determined in this study. Therefore, the study was classified as supplemental and does not fulfill guideline requirements for an aquatic invertebrate life cycle test (72-4b/OPPTS 850.1300).

Table 6. Chronic Toxicity of ADBAC to Freshwater Organisms

Species	Chemical, % Active Ingredient (a.i.)	Endpoint (µg/L ai)	Satisfies Guidelines/ Comments	Reference (MRID No.)
Fathead Minnow (*Pimephales promelas*)	ADBAC 30%	LOEC = 75.9 NOEC = 32.2 MATC = 49.4	Yes acceptable study	423021-02
Waterflea (*Daphnia magna*)	ADBAC 30%	LOEC = ND NOEC = 4.15 MATC = ND	No supplemental study	423021-01

Appendix C. Wildlife Drinking Water Exposure

Problem: ADBAC is a antimicrobial pesticide used to control algae in outdoor fountains, bird baths, puddles and decorative pools. No running water uses.

Issue is wildlife exposure via drinking water.

Assumption wildlife is using puddles and bird baths as a source of drinking water.

Method will be based on daily oral exposure. Daily dose is expressed as mass of pesticide/kg-bw.

Inputs needed:

Concentration of pesticide in water source: labeled rate is 5 and 200 mg/L
Body weight of target species: Avian 20g, 100g, 1000 g
Mammalian 15, 35, 1000 g

Calculations:

Drinking water intake rate (IRw): EPA (1994) intake L/day = 0.059(bw kg)^0.67 (birds)
intake L/day = 0.099(bw kg)^0.90 (mammals)

Daily pesticide exposure (Water dose mg/kg-bw) = [(Cwater mg/L)(IRw L)]/bw kg

Caveats :

1. Does not consider additional exposure from dermal contact nor from preening after bathing events

2. Chronic exposures are likely over estimated as concentration is based on target concentration at time of application.

Acute RQ = (Water dose mg/kg-bw)/(LD50 mg/kg-bw)

Source: Wildlife Exposure Factors Handbook, USEPA, 1994.

Appendix D. Endangered Species

Species Taxa Count Report for Crops

foliage plants

No species were excluded

Minimum of 1 Acre.

AL, AK, AZ, AR, CA, CO, CT, DE, DC, FL, GA, HI, ID, IL, IN, IA, KS, KY, LA, ME, MD, MA, MI, MN, MS, MO, MT, NE, NV, NH, NJ, NM, NY, NC, ND, OH, OK, OR, PA, PR, RI, SC, SD, TN, TX, UT, VT, VA, WA, WV, WI, WY

Alabama

The taxa Amphibian has 1 species affected by indicated crops.
The taxa Bird has 4 species affected by indicated crops.
The taxa Bivalve has 20 species affected by indicated crops.
The taxa Dicot has 6 species affected by indicated crops.
The taxa Fish has 8 species affected by indicated crops.
The taxa Gastropod has 9 species affected by indicated crops.
The taxa Mammal has 4 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.
The taxa other has 2 species affected by indicated crops.
The taxa Reptile has 5 species affected by indicated crops.

Arizona

The taxa Amphibian has 1 species affected by indicated crops.
The taxa Bird has 7 species affected by indicated crops.
The taxa Bivalve has 1 species affected by indicated crops.
The taxa Dicot has 9 species affected by indicated crops.
The taxa Fish has 9 species affected by indicated crops.
The taxa Gastropod has 1 species affected by indicated crops.
The taxa Mammal has 6 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.
The taxa Reptile has 1 species affected by indicated crops.

Arkansas

The taxa Bird has 3 species affected by indicated crops.
The taxa Bivalve has 4 species affected by indicated crops.
The taxa Crustacean has 1 species affected by indicated crops.
The taxa Dicot has 1 species affected by indicated crops.
The taxa Insect has 1 species affected by indicated crops.
The taxa Mammal has 3 species affected by indicated crops.

California

The taxa Amphibian has 6 species affected by indicated crops.
The taxa Bird has 15 species affected by indicated crops.
The taxa Crustacean has 7 species affected by indicated crops.
The taxa Dicot has 135 species affected by indicated crops.
The taxa Fish has 24 species affected by indicated crops.
The taxa Gastropod has 1 species affected by indicated crops.
The taxa Insect has 19 species affected by indicated crops.
The taxa Mammal has 21 species affected by indicated crops.
The taxa Monocot has 14 species affected by indicated crops.
The taxa other has 2 species affected by indicated crops.
The taxa Reptile has 8 species affected by indicated crops.

Colorado

The taxa Bird has 2 species affected by indicated crops.
The taxa Dicot has 1 species affected by indicated crops.
The taxa Mammal has 1 species affected by indicated crops.

Connecticut

The taxa Bird has 1 species affected by indicated crops.
The taxa Bivalve has 1 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.

Florida

The taxa Bird has 10 species affected by indicated crops.
The taxa Bivalve has 1 species affected by indicated crops.
The taxa Crustacean has 1 species affected by indicated crops.
The taxa Dicot has 41 species affected by indicated crops.
The taxa Fish has 3 species affected by indicated crops.
The taxa Gastropod has 1 species affected by indicated crops.
The taxa Insect has 1 species affected by indicated crops.
The taxa Mammal has 11 species affected by indicated crops.
The taxa Monocot has 2 species affected by indicated crops.
The taxa other has 1 species affected by indicated crops.
The taxa Reptile has 10 species affected by indicated crops.

Georgia

The taxa Bird has 5 species affected by indicated crops.
The taxa Bivalve has 13 species affected by indicated crops.
The taxa Dicot has 5 species affected by indicated crops.
The taxa Fish has 7 species affected by indicated crops.
The taxa Mammal has 3 species affected by indicated crops.
The taxa Monocot has 3 species affected by indicated crops.
The taxa other has 3 species affected by indicated crops.
The taxa Reptile has 2 species affected by indicated crops.

Hawaii

The taxa Arachnid has 1 species affected by indicated crops.
The taxa Bird has 32 species affected by indicated crops.
The taxa Crustacean has 1 species affected by indicated crops.
The taxa Dicot has 233 species affected by indicated crops.
The taxa Gastropod has 39 species affected by indicated crops.
The taxa Insect has 1 species affected by indicated crops.
The taxa Mammal has 2 species affected by indicated crops.
The taxa Monocot has 22 species affected by indicated crops.
The taxa other has 12 species affected by indicated crops.
The taxa Reptile has 2 species affected by indicated crops.

Idaho

The taxa Bird has 1 species affected by indicated crops.
The taxa Fish has 3 species affected by indicated crops.

Illinois

The taxa Bird has 3 species affected by indicated crops.
The taxa Dicot has 3 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.
The taxa Insect has 2 species affected by indicated crops.
The taxa Mammal has 2 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.

Indiana

The taxa Bird has 1 species affected by indicated crops.
The taxa Dicot has 2 species affected by indicated crops.
The taxa Insect has 2 species affected by indicated crops.
The taxa Mammal has 1 species affected by indicated crops.
The taxa Reptile has 1 species affected by indicated crops.

Iowa

The taxa Bird has 3 species affected by indicated crops.
The taxa Dicot has 2 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.
The taxa Mammal has 1 species affected by indicated crops.
The taxa Monocot has 2 species affected by indicated crops.

Kentucky

The taxa Bird has 3 species affected by indicated crops.
The taxa Bivalve has 9 species affected by indicated crops.
The taxa Mammal has 2 species affected by indicated crops.

Louisiana

The taxa Bird has 4 species affected by indicated crops.
The taxa Bivalve has 2 species affected by indicated crops.
The taxa Fish has 2 species affected by indicated crops.
The taxa Mammal has 2 species affected by indicated crops.
The taxa other has 1 species affected by indicated crops.
The taxa Reptile has 7 species affected by indicated crops.

Maine

The taxa Bird has 3 species affected by indicated crops.
The taxa Fish has 2 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.

Maryland

The taxa Bird has 2 species affected by indicated crops.
The taxa Bivalve has 1 species affected by indicated crops.
The taxa Dicot has 1 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.
The taxa Insect has 1 species affected by indicated crops.
The taxa Mammal has 2 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.
The taxa Reptile has 1 species affected by indicated crops.

Massachusetts

The taxa Bird has 4 species affected by indicated crops.
The taxa Dicot has 1 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.
The taxa Mammal has 1 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.
The taxa Reptile has 1 species affected by indicated crops.

Michigan

The taxa Bird has 3 species affected by indicated crops.
The taxa Bivalve has 1 species affected by indicated crops.
The taxa Dicot has 1 species affected by indicated crops.
The taxa Insect has 2 species affected by indicated crops.
The taxa Mammal has 1 species affected by indicated crops.
The taxa Monocot has 2 species affected by indicated crops.
The taxa Reptile has 1 species affected by indicated crops.

Minnesota

The taxa Bird has 2 species affected by indicated crops.
The taxa Bivalve has 2 species affected by indicated crops.
The taxa Dicot has 1 species affected by indicated crops.
The taxa Insect has 1 species affected by indicated crops.
The taxa Mammal has 2 species affected by indicated crops.

Mississippi

The taxa Amphibian has 1 species affected by indicated crops.
The taxa Bird has 5 species affected by indicated crops.
The taxa Bivalve has 6 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.
The taxa Mammal has 1 species affected by indicated crops.
The taxa other has 1 species affected by indicated crops.
The taxa Reptile has 7 species affected by indicated crops.

Missouri

The taxa Bird has 3 species affected by indicated crops.
The taxa Bivalve has 2 species affected by indicated crops.
The taxa Dicot has 4 species affected by indicated crops.
The taxa Fish has 3 species affected by indicated crops.
The taxa Insect has 2 species affected by indicated crops.

The taxa Mammal has 2 species affected by indicated crops.

Montana

The taxa Bird has 1 species affected by indicated crops.
The taxa Dicot has 1 species affected by indicated crops.
The taxa Fish has 3 species affected by indicated crops.
The taxa Mammal has 2 species affected by indicated crops.

Nebraska

The taxa Bird has 4 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.
The taxa Insect has 1 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.

Nevada

The taxa Bird has 1 species affected by indicated crops.
The taxa Dicot has 8 species affected by indicated crops.
The taxa Fish has 7 species affected by indicated crops.
The taxa Insect has 1 species affected by indicated crops.
The taxa Reptile has 1 species affected by indicated crops.

New Hampshire

The taxa Bird has 1 species affected by indicated crops.
The taxa Insect has 1 species affected by indicated crops.
The taxa Mammal has 1 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.

New Jersey

The taxa Bird has 2 species affected by indicated crops.
The taxa Dicot has 2 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.
The taxa Mammal has 1 species affected by indicated crops.
The taxa Monocot has 2 species affected by indicated crops.
The taxa Reptile has 1 species affected by indicated crops.

New Mexico

The taxa Amphibian has 1 species affected by indicated crops.
The taxa Bird has 7 species affected by indicated crops.
The taxa Crustacean has 1 species affected by indicated crops.
The taxa Dicot has 1 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.
The taxa Gastropod has 2 species affected by indicated crops.
The taxa Mammal has 1 species affected by indicated crops.

New York

The taxa Bird has 3 species affected by indicated crops.
The taxa Dicot has 4 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.
The taxa Mammal has 1 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.
The taxa other has 1 species affected by indicated crops.
The taxa Reptile has 1 species affected by indicated crops.

North Carolina

The taxa Arachnid has 1 species affected by indicated crops.
The taxa Bird has 4 species affected by indicated crops.
The taxa Bivalve has 8 species affected by indicated crops.
The taxa Dicot has 15 species affected by indicated crops.
The taxa Fish has 3 species affected by indicated crops.
The taxa Mammal has 5 species affected by indicated crops.
The taxa Monocot has 4 species affected by indicated crops.
The taxa other has 1 species affected by indicated crops.
The taxa Reptile has 5 species affected by indicated crops.

Ohio

The taxa Bird has 2 species affected by indicated crops.
The taxa Bivalve has 1 species affected by indicated crops.

The taxa Dicot has 2 species affected by indicated crops.
The taxa Insect has 1 species affected by indicated crops.
The taxa Mammal has 1 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.

Oklahoma

The taxa Bird has 4 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.
The taxa Insect has 1 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.

Oregon

The taxa Bird has 5 species affected by indicated crops.
The taxa Dicot has 6 species affected by indicated crops.
The taxa Fish has 18 species affected by indicated crops.
The taxa Insect has 2 species affected by indicated crops.
The taxa Mammal has 1 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.

Pennsylvania

The taxa Bird has 2 species affected by indicated crops.
The taxa Bivalve has 2 species affected by indicated crops.
The taxa Mammal has 1 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.
The taxa Reptile has 1 species affected by indicated crops.

Rhode Island

The taxa Bird has 1 species affected by indicated crops.
The taxa Dicot has 1 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.
The taxa Insect has 1 species affected by indicated crops.

South Carolina

The taxa Amphibian has 1 species affected by indicated crops.
The taxa Bird has 5 species affected by indicated crops.
The taxa Bivalve has 1 species affected by indicated crops.
The taxa Dicot has 9 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.
The taxa Mammal has 7 species affected by indicated crops.
The taxa Monocot has 3 species affected by indicated crops.
The taxa Reptile has 4 species affected by indicated crops.

Tennessee

The taxa Bird has 2 species affected by indicated crops.
The taxa Bivalve has 22 species affected by indicated crops.
The taxa Crustacean has 1 species affected by indicated crops.
The taxa Dicot has 9 species affected by indicated crops.
The taxa Fish has 10 species affected by indicated crops.
The taxa Gastropod has 1 species affected by indicated crops.
The taxa Mammal has 2 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.

Texas

The taxa Amphibian has 4 species affected by indicated crops.
The taxa Arachnid has 4 species affected by indicated crops.
The taxa Bird has 12 species affected by indicated crops.
The taxa Crustacean has 1 species affected by indicated crops.
The taxa Dicot has 16 species affected by indicated crops.
The taxa Fish has 3 species affected by indicated crops.
The taxa Insect has 5 species affected by indicated crops.
The taxa Mammal has 5 species affected by indicated crops.
The taxa Monocot has 2 species affected by indicated crops.
The taxa Reptile has 5 species affected by indicated crops.

Utah

The taxa Bird has 1 species affected by indicated crops.

The taxa Dicot has 2 species affected by indicated crops.
The taxa Fish has 1 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.

Virginia

The taxa Bird has 2 species affected by indicated crops.
The taxa Bivalve has 2 species affected by indicated crops.
The taxa Dicot has 5 species affected by indicated crops.

The taxa Fish has 2 species affected by indicated crops.
The taxa Insect has 2 species affected by indicated crops.
The taxa Mammal has 2 species affected by indicated crops.
The taxa Monocot has 2 species affected by indicated crops.
The taxa Reptile has 1 species affected by indicated crops.

Washington

The taxa Bird has 3 species affected by indicated crops.
The taxa Dicot has 3 species affected by indicated crops.
The taxa Fish has 17 species affected by indicated crops.
The taxa Mammal has 4 species affected by indicated crops.

West Virginia

The taxa Amphibian has 1 species affected by indicated crops.
The taxa Bivalve has 4 species affected by indicated crops.
The taxa Dicot has 2 species affected by indicated crops.
The taxa Gastropod has 1 species affected by indicated crops.
The taxa Mammal has 3 species affected by indicated crops.

Wisconsin

The taxa Bird has 2 species affected by indicated crops.
The taxa Bivalve has 1 species affected by indicated crops.
The taxa Dicot has 2 species affected by indicated crops.
The taxa Insect has 1 species affected by indicated crops.
The taxa Mammal has 2 species affected by indicated crops.
The taxa Monocot has 1 species affected by indicated crops.