OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

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MEMORANDUM

SUBJECT: **Acetamiprid**: DRAFT Biological Evaluation and Associated Effects Determination for Endangered and Threatened Species and Their Designated Critical Habitats

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The Environmental Fate and Effects Division (EFED) has completed a DRAFT Biological Evaluation (BE) and associated effects determinations for Federally listed threatened and endangered ("listed") species based on the currently registered uses of acetamiprid. This DRAFT BE only considers what is currently specified on registered labels and does not reflect additional mitigation measures that may be developed as the BE is finalized and which are likely to impact listed species determinations. Where EFED has determined that acetamiprid is likely to adversely affect (LAA) one or more individuals of a species or a designated critical habitat; EFED has included predictions of the likelihood of jeopardy (J) for the listed species or for adverse modification (AM) of designated critical habitats. These predictions help to inform the consultation process with U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) (collectively referred to as "the Services"). However, the Services will, in their respective Biological Opinions (BiOp), make the final determination regarding jeopardy to listed species and adverse modification to designated critical habitats. EFED will finalize this draft assessment after receiving and considering public comments.

Acetamiprid Biological Evaluation and Associated Effects Determinations for Federally Listed Endangered and Threatened Species and Their Designated Critical Habitats

October 27, 2023

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EXECUTIVE SUMMARY

The purpose of this assessment is to complete draft effects determinations including predictions of whether there is a potential likelihood that acetamiprid registrations (PC Code: 099050) could lead to a future jeopardy or adverse modification finding by U.S. Fish and Wildlife Service or the National Marine Fisheries Service (collectively referred to as the Services) for federally listed endangered and threatened ("listed") species and any designated critical habitats (CHs).

A BE is EPA's document that includes an analysis used to support EPA's effects determinations conducted when it takes action subject to review under the Endangered Species Act (ESA). EPA prepares a draft BE to evaluate the potential effects of an agency's action (here, registered uses of acetamiprid) on federally threatened and endangered species and designated critical habitat. This draft BE encompasses the review of all the registered uses and the approved product labels for all pesticide products containing acetamiprid.

In this draft BE, EPA first evaluated whether the registered uses of acetamiprid will have No Effect (NE) or if the registered uses May Affect (MA) an individual of such species or habitat (separate determinations are made for each species and critical habitat). For listed species and CHs where EPA makes a MA determination, EPA performs additional analyses to determine if acetamiprid registrations are likely to adversely affect (LAA) or not likely to adversely affect (NLAA) those listed species. EPA makes NLAA determinations when effects are either discountable (highly unlikely to occur), insignificant, or wholly beneficial. For those listed species and CHs where EPA determined that there is likelihood to adversely affect one or more individuals or the CH, EPA also included in its effects determinations its prediction as to whether the registered uses of acetamiprid has a potential likelihood of jeopardizing (J) a listed species or adversely modifying (AM) any CH (collectively abbreviated as J/AM), consistent with 50 C.F.R. §402.40(b)(1). While EPA is not required to include J/AM analyses in its effects determinations, EPA is including this analysis to improve the consultation process. EPA used the draft and final biological opinion (BiOp) for malathion (USFWS, 2021; USFWS, 2022) as a guide in this assessment to predict those species and CHs where the Services are likely to determine the use of acetamiprid results in jeopardy or adverse modification. This draft BE also considered elements from recent NMFS BiOps for malathion, diazinon, and chlorpyrifos (NMFS, 2022) as they pertain to listed species under the purview of NMFS.

Details on the method, models, and tools used for making NE, NLAA, LAA and predictions of the potential likelihood of J/AM are in **Section 3** and **Section 4** of this BE. While EPA predicted potential likelihood of J/AM as part of its effects determinations, the Services are responsible for making the final J/AM findings and have the sole authority to do so.

Practically, the LAA threshold for an effects determination is very conservative as the likely "take" of even one individual of a species triggers LAA (even if that species is almost recovered). This often results in a high number of LAA determinations in a BE. An LAA determination in the BE, however, should not be interpreted to mean that EPA has made a determination that acetamiprid is putting a species in jeopardy. Those determinations are made by the National Marine Fisheries Service and the Fish and Wildlife Service (referred to as the Services) during formal consultation. Here, the Services prepare a biological opinion (BiOp), which builds upon EPA's BE to determine whether the potential adverse effect will jeopardize the continued existence of a species or destroy or adversely modify critical habitat. The predictions of the potential likelihood of future J/AM analysis considers whether the likely adverse effects to individuals described in the BE have the potential to negatively affect populations and the species they comprise such that EPA predicts there is a potential likelihood to jeopardize the future continued existence of the species. As noted earlier, EPA is including analyses to help facilitate these determinations by the Services.

The draft BE is specific to listed species, is a comprehensive analysis of all currently registered uses of acetamiprid including FIFRA section 3 registrations, applicable FIFRA section 18 emergency exemptions, and any FIFRA section 24c special local need registrations, and relies on the best available science (*i.e.*, all currently submitted toxicity and environmental fate data and suitable open literature, updates modeling of exposure, and current label language).

Use Overview

Acetamiprid is a chloronicotinyl insecticide active ingredient (ai) belonging to the cyano-substituted sub-class of the neonicotinoid pesticides. Similar to other neonicotinoids including nitroguanidine-substituted compounds (*i.e.*, imidacloprid, clothianidin, dinotefuran and thiamethoxam), acetamiprid is systemic in plants and is intended as a broad-spectrum insecticide. The compound acts as an agonist of the nicotinic acetylcholine receptor (nAChR) at the postsynaptic membrane of nerve cells and interrupts the function of the insect nervous system.

Acetamiprid was first registered in 2002 (USEPA, 2012a). It is an insecticide used to control a variety of insects including aphids, beetles, caterpillars, leafhoppers, stinkbugs, thrips, whiteflies, boll worms, fleahoppers, earwigs, silverfish, termites, ants, cockroaches, weevils, Colorado potato beetles, potato psyllids, wireworms, household pests, bedbugs, Lygus bug, carpenterworm, apple maggots, borers (excluding the Emerald ash borer) and scale insects. Acetamiprid is currently registered for aerial and ground applications to foliage, surface and subsurface soil applications, impregnated materials, bait stations, tree injections, and seed treatments. It may be applied to a wide range of agricultural, residential, and commercial areas.

Ecological Effects Overview

Acetamiprid is classified as practically non-toxic to freshwater fish and slightly toxic to estuarine/marine fish on an acute exposure basis. On a chronic exposure basis, there are effects to freshwater fish survival and growth (measured by weight). No chronic toxicity data were submitted for estuarine/marine fish. However, given the low acute toxicity to both freshwater and estuarine/marine fish and the low likelihood of adverse chronic effects to freshwater fish identified in previous assessments, the available data are sufficient to assess effects in estuarine/marine fish. Acetamiprid is very highly toxic to freshwater and estuarine/marine invertebrates on an acute exposure basis, and there are chronic effects on aquatic invertebrate survival, growth (length and weight) and reproduction. Available data indicate no effects on growth or survival to vascular and non-vascular aquatic plants up to 1 mg ai/L.

For terrestrial organisms, acetamiprid is very highly toxic to passerine birds and moderately toxic to other birds (*e.g.*, waterfowl) on an acute exposure basis. Chronic exposure of birds resulted in reduced body weight; however there were also effects observed on number of eggs laid, eggs set, viable embryos, and hatchling body weight at higher exposure concentrations. No chronic data are available for the more sensitive passerine species; however, it is not a requirement of registration. For mammals, acetamiprid is classified as highly toxic on an acute oral exposure basis. On a chronic exposure basis, there are reductions in growth (as measured by bodyweight, weight gain and food consumption) in the 2-year chronic feeding study. While measures of growth are the most sensitive, there are also reductions in reproductive endpoints (*e.g*., pup weight, litter size and viability). Acetamiprid is moderately toxic to adult honey bees (*Apis mellifera*) based on an acute oral and contact exposure basis and also to larval honey bees based on a single dose exposure basis. Also, there is evidence of impaired survival from chronic exposure in both adult and larval honey bees. While there is additional evidence of adverse effects on bees from incident reports, semi-field (tunnel) studies suggest that there are no detectable adverse colony-level effects from acetamiprid applications ≤0.089 lb ai/A. Based on seedling emergence and vegetative vigor studies with terrestrial plants, as well as reported incidents, there is evidence of toxicity to monocot and dicotyledonous terrestrial plant species from acetamiprid uses.

Available data on acetamiprid degradates indicated similar or reduced toxicity in aquatic invertebrates, birds, and mammals relative to parent in the same test species. Acute and chronic toxicity to several non-bee terrestrial invertebrate species is also reported for one acetamiprid degradate; however, acceptable studies on the same species are not available for the parent precluding comparison of relative toxicity. Degradate toxicity data are not available for other taxa.

Environmental Fate Overview

Acetamiprid is registered for direct application to foliage and soil where residues may result in dietary or contract exposure for terrestrial organisms. The offsite transport routes to aquatic and terrestrial habitats include drift, runoff, and erosion. The Residues of Concern (ROC) for assessing plant and aquatic animal exposure include the parent compound (acetamiprid) along with its degradate IM 1-4 which was observed with >10% applied radioactivity and exhibited similar toxicity in aquatic animals to that of the parent. No empirical degradate toxicity data are available for plants. Consequently, a Total Toxic Residues (TTR) approach was used to model exposure to aquatic organisms and plants in this assessment. The ROCs for assessing terrestrial animal exposure are parent only.

Acetamiprid is classified as moderately mobile using the Food and Agriculture Organization (FAO) classification system (K_{OC} = 157- 298 L/kg-organic carbon) and may be transported to surface water and/or groundwater via runoff, leaching, and spray drift. Aerobic soil metabolism is the primary route of degradation of acetamiprid with 50% degradation time (DT_{50}) values on the order of days in aerobic soil studies (DT_{50} range: 1.85 to 3.20 days) and months in aerobic aquatic metabolism studies (DT_{50} range: 87 to 96 days). Acetamiprid is stable to hydrolysis at pH 5, 7, and 9 and 25 °C but undergoes some hydrolysis at pH 9 under higher temperatures (≥35°C). Acetamiprid may undergo aqueous photolysis (DT_{50} = 34 days) if present for sufficient periods in clear and shallow surface water. Anaerobic aquatic metabolism was much slower than aerobic aquatic metabolism, with DT_{50} values ranging from 477 to 585 days in two sediment/water systems. Based on its low log octanol-water partition coefficient (log K_{ow} = 0.8 at 25 °C), acetamiprid is not expected to bioconcentrate significantly.

Scope of the Draft Effects Determination for Acetamiprid

The scope of the draft effects determination contained in this BE establishes the species and CH under consideration, the animal and plant taxa that are of concern, and the federal action area.

This BE considers species federally listed as endangered and threatened and CHs that are designated final as of February 16, 2022. As part of registration review, EPA conducted a Preliminary Risk Assessment (PRA) for all currently registered uses in 2017. This assessment included a screening level analysis of listed species and, with additional documents published between 2019 and 2022 pertaining to the PRA, was used to establish the scope of direct effects and effects to prey, pollination, habitat, or dispersal (PPHD) that need to be considered in this BE. Based on those analyses, EPA identified risks of concern for mammals, birds, reptiles, terrestrial-phase amphibians, terrestrial and aquatic invertebrates, and upland and semi-aquatic plants species. Consequently, this BE considers the potential for direct effects to listed species within these taxa as well as the potential for PPHD effects for all listed species that rely on these taxa. Direct effects to fish and aquatic-phase amphibians are not a concern based on the screening-level assessment; however, PPHD effects need to be considered for listed species from these taxa that rely on terrestrial vertebrates, invertebrates, and/or plants. Neither direct nor PPHD effects were identified as a concern for aquatic plants.

The action area for acetamiprid encompasses the geographic space within the conterminous United States (CONUS) and its territories outside the conterminous states (referred to as non-lower 48; NL48) where potential effects to listed species may occur as a result of current uses of the insecticide. The action area is developed from 10 agricultural use data layers (UDL; Alfalfa, Citrus, Cotton, Other Crops, Other Grains, Other Orchards, Other Row Crops, Soybeans, Vegetable and Ground Fruit, and NL48_Ag) and 6 non-agricultural UDLs (CONUS and NL48 Developed, Open Spaced Developed, and Nurseries) which capture all registered uses for acetamiprid. These UDLs were buffered out 1,500 meters to account for transport of the ai in runoff from the use site to vulnerable waterbodies within a catchment. All other potential direct and PPHD effects identified in the screening-level assessment are expected to occur at distances less than 1,500 meters and, thus, are captured within the action area. The action area is the starting point for the analysis, and refinements to the exposure areas and potential for exposure were incorporated as EPA moved through the species/CH determinations and to the predictions of likely J/AM.

Summary of Effects Determinations Including Predictions of Potential Likelihood of Future Jeopardy and Adverse Modification

Two species, one of which also had designated critical habitat, were delisted due to recovery since February 2022. EPA determined NE for 277 species and 290 designated critical habitats (CH), based primarily on no overlap (<1%) due to occuring only outside of the action area, no direct toxicity, and/or no dependency on terrestrial vertebrates, aquatic and terrestrial invertebrates, or plants for PPHD. For those listed species and CHs with MA determinations, EPA distinguished whether acetamiprid is likely to affect an individual when considering the species-specific habitat, life history, and other considerations of exposure and toxicity. EPA made NLAA determinations for 432 listed species and 224 CHs. A majority of the NLAA determinations were based upon unlikely exposure due to the habitat or when specific physical and biological factors (PBFs) for the CHs are not expected to be impacted by acetamiprid. EPA made LAA determinations for 1,005 listed species and 311 CHs. These listed species were either: invertebrate, terrestrial vertebrate, or plant species that may be directly affected; listed animals that rely upon invertebrates for prey; or listed plants that rely upon insects or birds for pollination or dispersal. For all CHs with LAA determinations, PBFs related to habitat quality for listed invertebrates and birds, and invertebrates and birds that serve as prey, pollinators or dispersers were the primary factors leading to the determination.

EPA further evaluated the LAA species and designated CH and made predictions about the potential likelihood of future jeopardy to any listed species or adverse modification of any designated CH from the use of acetamiprid. Of the species with LAA determinations, EPA predicted a potential likelihood of future jeopardy for 169 listed species. EPA also predicted a potential likelihood of future adverse modification of 51 designated CHs. These were identified primarily for terrestrial invertebrates, birds, fish, plants, and CHs that are either directly impacted and/or are highly dependent on terrestrial or aquatic non-mollusk invertebrates and have a high to medium overlap. The predicted potential likelihood of future J/AM for listed species and designated CHs is summarized in **Table 1.**

Table 1. Number of Listed Species Effects Determinations Including Predictions of Potential Likelihood of Future Jeopardy or Adverse Modification by Taxon Based on Current Uses of Acetamiprid.[1]

Taxon	NE	MA-NLAA	MA-LAA	Predicted Likely J/AM	Total
Amphibians[2]	0	4	34	4	38
Aquatic Invertebrates	1	140	33	9	174
Birds	4	28	66	2	99*
Fish	0	47	122	10	170*
Mammals	8	33	53	1	94
Plants	234	116	588	122	938
Reptiles[3]	3	17	25	1	45
Terrestrial Invertebrates[4]	27	47	83	20	157
Total Listed Species	277	432	1,005	169	1715
Percent of Species	16%	25%	59%	10%	
Designated Critical Habitat	290	224	311	51	826*
Percent of Critical Habitats	35%	27%	38%	6%	

*Total is higher than the sum of the determinations/predictions of likely J/AM because one or more species from this taxa were delisted due to recovery since February 2022.

[1] CH = critical habitat; NE = no effect; NLAA = not likely to adversely affect; LAA = likely to adversely affect; J = jeopardy; AM = adverse modification

[2] Reflects the species and critical habitats listed as of February 16, 2022.

[3] "Amphibians" and "Reptiles" include those species that have both a terrestrial and aquatic phase.

[4] "Terrestrial Invertebrates" includes damselflies which have both a terrestrial and aquatic phase.

1 Overview

1.1 The Biological Evaluation Process and Document Organization

In its biological evaluations (BEs), EPA considers the potential impacts of a pesticide registration (action) on listed species and their critical habitat, and subsequently predicts the likelihood of jeopardy (J) to a listed species' existence or adverse modification (AM) of a species' designated critical habitat (CH[1]). The listed species assessments are divided into two sections: the effects determination and predictions of likely jeopardy/adverse modification (J/AM).

[1] Henceforth in this document, the acronym CH is used to represent designated critical habitat.

The effects determination considers whether the pesticide registration action poses any reasonable expectation of discernible effects to listed species and/or CH[2] that are within the action area. In making the effects determinations for species, EPA considers direct effects to the listed species as well as impacts to organisms on which the listed species depends for prey, pollination, habitat and/or dispersal (PPHD). The term "direct effects" refers to decreases in the survival, growth, or reproduction of individuals of a listed species due to exposure to the pesticide. When making effects determinations for CHs, EPA considers whether there may be potential effects to listed species within the CH or effects to the physical and biological features (PBF) of the CH.

In the effects determination, EPA evaluates whether the registration of the pesticide (*i.e.*, the federal action) will have "No Effect" (NE) on a given listed species or CH or any effect that "May Affect" (MA) the species and/or CH. The U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS), hereafter referred to collectively as the Services, regulations stipulate that a consultation obligation is triggered when a federal action may affect one or more listed species and/or CH. For those species and CH for which EPA determined MA, EPA further determines whether the action: "may affect but is not likely to adversely affect" (NLAA) the listed species or CH; or "may affect and is likely to adversely affect" (LAA) the listed species or CH. An LAA determination for an action means that there is a discernible adverse effect to one or more individuals of a listed species or their CH.

It is EPA's obligation under Section 7 of the Endangered Species Act (ESA) to ensure that the registered uses of acetamiprid do not jeopardize the continued existence of listed species or adversely modify CH. To inform consultation with the Services, for those species and CHs with LAA determinations, EPA also predicts the likelihood that the pesticide action could lead to jeopardy of listed species or destruction or adverse modification of CH.[3] The J/AM predictions consider adverse direct effects to the listed species and adverse effects to the species' PPHD as well but reframe the evaluation in terms of impacts at the population-level. The Services will make the final determinations as to jeopardy to listed species and adverse modification to CHs.

This BE uses the best available scientific information on the use, environmental fate and transport, and ecological effects of acetamiprid. The BE is organized into seven sections:

- **Section 1** provides an overview of the BE process, background on the chemical, and short history of previous risk assessments.
- **Section 2** describes the action, and the scope of the assessment which covers the number of species evaluated and a summary of the taxa-based screening-level conclusions.
- **Section 3** discusses the methodology for the species effects determination and predictions of likely J.
- **Section 4** discusses the methodology for the CH effects determination and predictions of likely AM.
- **Section 5** describes the environmental fate of acetamiprid and discusses the modeling results for aquatic and terrestrial environments.
- **Section 6** summarizes the direct and PPHD effects analysis including a discussion of ecotoxicity data and description of endpoints selected for each level of biological organization, and presents

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[2] This assessment focuses upon currently listed endangered and threatened species and designated critical habitats. During consultation, EPA may confer with the Services to identify any additional species or critical habitats that are relevant to this action.
[3] 50 CFR 402.40(b)(1) provides that EPA may describe in its effects determination the likelihood of jeopardy to a listed species or adverse modification of any designated critical habitat.

the conclusions of the effects determinations and predictions of likely J for each listed species by taxa.

- **Section 7** summarizes the conclusions of the effects determinations and predictions of likely AM for all CH designated as final.

More detail on the quantitative analyses and qualitative considerations that lead to the effects determinations and predictions of likely J/AM for each species and CH can be found in the **Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification**

1.2 Background on Acetamiprid

1.2.1 Mode of Action

Acetamiprid is a chloronicotinyl insecticide belonging to the cyano-substituted sub-class of the neonicotinoid pesticides. Similar to other neonicotinoids including nitroguanidine-substituted compounds (*e.g*., imidacloprid, clothianidin, dinotefuran and thiamethoxam), acetamiprid is a broad-spectrum insecticide which is systemic in plants. The chemical acts as an agonist of the nicotinic acetylcholine receptor (nAChR) at the postsynaptic membrane of nerve cells interrupting the function of the insect nervous system. As reported in the original environmental fate and ecological risk assessment in support of the Section 3 registration of acetamiprid, biochemical radio-ligand binding studies show that acetamiprid interacts with high affinity at the nAChR binding site in insects, and with relatively low affinity at the nAChR in vertebrates (USEPA, 2002, DP270368).

1.2.2 Summary of Recent Agency Risk Assessments

EPA completed a Preliminary Ecological Risk Assessment (PRA) in support of the Registration Review of acetamiprid in 2017 (USEPA, 2017) and published two documents addressing public comments received on the 2017 PRA (USEPA 2019; USEPA, 2021). The PRA identified acute and chronic risks for non-listed and listed aquatic invertebrates, terrestrial invertebrates, birds, reptiles, terrestrial-phase amphibians and mammals (risk to listed mammals only) and risks to terrestrial plants from foliar applications of acetamiprid at the maximum registered application rates. In addition, acute and chronic risks from seed treatment uses were identified for listed and non-listed aquatic invertebrates, birds, reptiles, terrestrial-phase amphibians, and mammals. Since the 2017 PRA, EPA received and evaluated additional ecological effects data for terrestrial plants, and terrestrial invertebrates, identified and evaluated additional toxicity data for aquatic invertebrates from the open literature, and updated the bird risk assessment for foliar and seed treatment uses. The analysis of the aquatic and terrestrial invertebrate data and updated risk assessment for this taxa are captured in the 2019 response to comment (RTC) memo (USEPA, 2019). A PRA addendum completed in 2022 (USEPA, 2022) summarizes the re-analysis of the chronic avian toxicity data and the updated foliar and seed treatment risk assessment for birds, reptiles, and terrestrial-phase amphibians. Although the new data and updates to the risk assessment did not alter the broader risk conclusions for terrestrial plants, aquatic invertebrates, birds, reptiles, and terrestrial-phase amphibians from previous assessments, it reduced the uncertainty associated with the risk assessment of these taxa and provides additional characterization for evaluating listed species in this BE.

Across all previous assessments, a total toxic residue (TTR) approach was used to collectively account for both parent compound and combined residues of concern (ROC) in aquatic environments (*i.e*., parent plus degradate IM 1-4[4].) For terrestrial environments, the residue of concern was considered to be the parent compound only.

2 Description of the Action and Scope of the Assessment

This section describes the currently registered uses of acetamiprid evaluated in this BE, establishes the scope of the BE in terms of number of species and critical habitat assessed and the direct and PPHD effects that are the focus of the BE, and defines the Action Area.

2.1 Description of the Federal Action

In October 2017, following publication of the 2017 PRA, EPA entered into litigation on acetamiprid based on a ruling that EPA violated Section 7(a)2 of the Endangered Species Act (ESA) by not consulting with the Services on the potential impacts of the registered uses of acetamiprid to federally listed threatened and endangered species during Registration Review. In 2021, EPA and the plaintiffs agreed to a partial settlement in which EPA committed to publishing by October 2024 a final BE with species and CH effect determinations that consider all registered products containing acetamiprid (USEPA, 2021). Based on the agreement, this draft BE presents effects determinations (*i.e.,* the MA/NE and NLAA/LAA determinations) for listed species and CH. After publication of the final BE, EPA will initiate consultation with the Services on this action, if necessary, in accordance with EPA's obligations under Section 7(a)2 of the ESA.

The federal action relevant to this BE is the Registration Review of acetamiprid, which encompasses the review of all registered uses and the approved product labels for all pesticides products containing the active ingredient (ai) acetamiprid including Section 3, Section 18, and Section 24c registrations. The Registration Review process was established under the Food Quality Protection Act (FQPA 1996)[5]. In accordance with EPA's Endangered Species Act (ESA) workplan (USEPA 2022) and in addition to effects determinations, in this BE EPA is predicting the likelihood that the currently registered uses of acetamiprid could lead to jeopardy of listed species or adverse modification of CH that received Likely to Adversely Affect determinations. These predictions are meant to inform consultation with the Services; however, the Services will make the final determinations as to jeopardy to listed species and adverse modification to CHs.

2.2 Characterization of Acetamiprid Uses

The currently registered uses for acetamiprid that are assessed in this BE are summarized below based on information presented in the 2017 PRA (USEPA, 2017). A full list of registered acetamiprid products considered in this BE and details on the use patterns for each registered use are presented in

Appendix C. Label Summary and UDL Crosswalk

Acetamiprid, an insecticide first registered in 2002 (USEPA, 2012a) is used to control a variety of insect pests (*e.g.*, aphids, beetles, caterpillars, and scale insects) in agricultural and non-agricultural settings.

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[4] N-methyl(6-chloro-3-pyridyl)methylamine

[5] https://www.epa.gov/pesticide-reevaluation/registration-review-process

Acetamiprid is approved for foliar use on various crops including several crop groups covering fruit and fruit trees, tree nuts, vegetables, tuberous crops, alfalfa, canola, sweet corn, cotton, soybean, ornamentals, and tobacco. Seed treatments are also allowed on potatoes, canola/oil seed rape, and mustard. In addition, acetamiprid is registered for use on ornamentals (plants, non-bearing fruit and nut trees, residential ornamentals, and landscape ornamentals), indoor and outdoor of residential and commercial structures, nurseries, vegetables grown for transplant (grown in greenhouses, lath and shade houses and containers). Two products (EPA Reg. No. 100-1552 and 1574) are registered for indoor uses on ornamentals, greenhouses and interior plantscapes. Lastly, acetamiprid is also registered as a bait (granule).

Acetamiprid products are formulated as water dispersible granules (WDG), emulsifiable concentrates (EC), soluble concentrates (SC), flowable concentrate (FLC), wettable powder (WP), ready to use solution, water soluble packets (WSP), impregnated stickers, impregnated bait stations, gels, and an attract-and-kill bait. The WDG, EC, SC, FLC, WP, and WSP formulations are applied as ground, airblast, or aerial sprays and may result in spray drift. Gels are used as spot treatments, beads, and thin films to control ants and cockroaches. The WDG formulations are all applied as a liquid. It can also be used to treat potatoes, canola, and mustard seeds. Liquid formulations may also be injected into tree trunks. Termiticides may be applied as a liquid or foam, and may be applied on soil surfaces as a perimeter treatment, crack and crevice treatment, brush, and spray. Termiticides may also be applied into soil using trenching, rodding, sub-slab injection, and soil excavation techniques, and some products are applied to sub-surfaces into piping, injections, and reticulation delivery systems. The impregnated materials are generally stickers used to control flies. The “attract-and-kill” device includes a pheromone that is attractive to the target organism and is mixed with acetamiprid and hung in trees.

The following use patterns are assumed to result in minimal (*de minimis*) environmental exposure to aquatic and terrestrial non-target organisms:

- Acetamiprid applied to dogs as a spot-on treatment.
- EPA Reg No. 8033-117 is a house fly bait used in tamper-resistant bait stations around the outside of confined animal feeding operations such as stables, dairies, poultry houses, feed lots, swine buildings, animal pens, and kennels. It may also be applied as a scatter bait indoors (including on walkways inside caged layer houses) or in enclosed outdoor areas that prevent access to the bait by birds.

A majority of currently registered formulations containing acetamiprid include it as the sole active ingredient. Registered multiple ai formulations include acetamiprid in combination with fungicides, other insecticides (*i.e.,* bifenthrin, novaluron, etofenprox, S-methoprene), insect pheremones (*i.e.,* cis-9-Tricosene), and/or insecticide synergists *(i.e.,* piperonyl butoxide). A list of currently registered products with multiple ais is provided in **Appendix C. Label Summary and UDL Crosswalk**

For agricultural foliar spray applications, acetamiprid has maximum single application rates of 0.249 lb ai/A and a maximum annual application rate of 0.55 lb ai/A. For non-agricultural applications, acetamiprid has a maximum single application rate of 0.52 lb ai/A for ornamentals and a maximum annual application rate of 0.55 lb ai/A. Chemigation application to agricultural crops has a maximum single application rate of 0.15 lb ai/A and annual application rate of 0.50 lb ai/A. Seed treatments have maximum annual application rate ranging from 0.03 to 0.30 lb ai/A/year.

Several special local needs (SLN) Section 24(c) registrations were completed prior to this BE for the following uses:

- Alfalfa in ID, OR, and AZ
- Cotton, in AR, AZ, LA, MS
- Apple, crab apple, pear, tree nuts, ornamentals and other non-bearing or dormant fruit trees in residential, recreational, institutional, and retail areas in WA.

These uses are extensions of nationally registered uses but allow higher application rates and, in the case of the WA SLNs, application methods that are not permitted on the national label for those use sites (*i.e.,* broadcast ground and aerial applications in residential settings). Although these SLNs expired prior to the initiation of this BE, the labels remain active and EPA assumes they were converted to Section 3 registrations.

Many of the currently registered labels indicate that the product should not be applied while bees are actively foraging and include spray drift mitigations that restrict droplet size distribution to medium or coarser. Labels for soybean and several residential uses also require buffers from 25 to 300 feet from freshwater and estuarine waterbodies, and waterbodies containing aquatic organisms for human consumption.

Proposed Mitigation in the Preliminary Interim Decision

In the preliminary interim decision (PID), EPA recommended pollinator advisory language to warm users of the risks that acetamiprid products pose to bees and other pollinating insects. No explicit restrictions were recommended on applications around the time of flowering. Such a restriction would limit but not eliminate potential dietary exposure to bees and other pollinating insects from residues on the target plants and non-target flowering plants given that the chemical is systemic in plants. EPA also recommended addition of advisory language to the label for the acetamiprid seed treatment uses to encourage adoption of best management practices for handling and planting acetamiprid-treated seeds and limit exposure to terrestrial vertebrates and aquatic wildlife. While labels have adopted this language, they do not represent an enforceable restriction on the use of the product. Consequently, these statements are not considered in estimating exposure in aquatic and terrestrial environments from the currently registered uses of acetamiprid.

EPA further proposed language in the PID to be added to the labels to address exposure from spray drift to areas adjacent to use sites. EPA proposed implementing a buffer between the edge of the application site and waterbodies of 25 feet for ground application and 150 feet for aerial application. The following spray drift management language was also proposed for aerial and ground applications of liquid formulations:

Aerial Applications

- Applicators must not spray during temperature inversions.
- For aerial applications, do not apply when wind speeds exceed 15 mph at the application site. If the windspeed is greater than 10 mph, the boom length must be 65% or less of the wingspan for fixed wing aircraft and 75% or less of the rotor diameter for helicopters. Otherwise, the boom length must be 75% or less of the wingspan for fixed-wing aircraft and 90% or less of the rotor diameter for helicopters.
- For aerial applicators, if the windspeed is 10 miles per hour or less, applicators must use ½ swath displacement upwind at the downwind edge of the field. When the windspeed is between 11-15 miles per hour, applicators must use ¾ swath displacement upwind at the downwind edge of the field.

- For aerial applications, the release height must be no higher than 10 feet from the top of the crop canopy or ground, unless a greater application height is required for pilot safety.
- Specify spray droplet size of Medium or coarser (ASABE S572.1)

Ground Applications

- Applicators must not spray during temperature inversions.
- Do not apply when wind speeds exceed 15 mph at application site
- For air blast applications, nozzles directed out of the orchard must be turned off in the outer row.
- For air blast applications, applications must be directed into the canopy foliage.
- For ground boom applications, apply with the release height no more than 4 feet above the ground or crop canopy.
- Specify spray droplet size of medium or coarser (ASABE S572.1).

In contrast with the advisory statements, the spray drift language and aquatic waterbody buffers are intended to be mandatory and enforceable. At the time of this assessment, these proposals have not been implemented across all labels. Since most labels already include the mitigations for medium droplet size, this is considered as the default droplet sized in this BE; however, buffers from waterbodies are not incorporated in exposure modeling since this restriction applies to only a small number of uses based on current label language.

2.3 Scope of the Biological Evaluation

This section describes the scope of the BE for acetamiprid including the number of species and CH assessed and the results of the generic taxa-based screening level risk assessment which identify the direct and PPHD effects that need further evaluation in the BE.

2.3.1 Species and Critical Habitat List

The acetamiprid BE considers only species the Services list as endangered and threatened and CH that is designated final. EPA last updated its species range and CH shapefiles[6] in February 16, 2022. At that time, 1,715 species were listed as endangered and threatened and 823 CHs were designated final. This BE focuses on those species and CH captured in the last update. This BE does not evaluate species federally listed as endangered or threatened and CH designated final after that date; however, species that have since been delisted [*e.g.* San Clemente sage sparrow (*Amphispiza belli clementeae*)] are identified in **Appendix KAppendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse ModificationAppendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification** and not considered further in BE.

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[6] A shapefile is a simple, nontopological format for storing geometric location and attribute information of geographic features. Geographic features in a shapefile can be represented by points, lines or polygon (areas). See https://desktop.arcgis.com/en/arcmap/latest/manage-data/shapefiles/what-is-a-shapefile.htm#:~:text=A%20shapefile%20is%20a%20simple,%2C%20or%20polygons%20(areas).

2.3.2 Generic Taxa-Based Screening Level Assessment

The 2017 PRA, the 2019 and 2021 RTCs, and 2022 PRA addendum (USEPA 2017, 2019, 2021, 2022) serve collectively as the generic taxa-based screening-level analysis for this BE. The approach taken in these assessments relies upon risk quotients (RQs) and levels of concern (LOCs) (**Table 2**) that are designed to identify a potential for effects on taxa, and distinguish those taxa where refinements may be needed to better understand whether there may be effects of concern. EPA uses the taxa-based assessment to focus the species-specific analysis in this BE on types of direct or PPHD effects that may be relevant to listed species or CH. When EPA's screening-level assessment shows that a RQ exceeds a listed species LOC, it does not automatically mean that the action may affect a species. Instead, it means further species-specific review is needed to determine whether the action may affect a listed species or its CH. Also, when a RQ does not exceed the listed species LOC for a taxon representing a listed species, it does not necessarily mean that the determination is NE, because potential effects to PPHD also need consideration. Therefore, EPA considered the life history, distribution of the species, and magnitude of effects of acetamiprid on organisms on which the listed species depends for PPHD before making effects determinations and predictions of likely J/AM.

Table 2. Risk Quotient (RQ) and Levels of Concern (LOC) by Taxon for the Generic Taxa-based Screening Level Assessment.

Taxon	Exposure duration	Listed/non-listed	RQ[1]	LOC[1]
Fish and aquatic-phase amphibians	Acute	Non-listed, general PPHD effects	1-in-10-year, Daily EEC/LC_{50}	0.5
		Listed direct effects & obligate PPHD effects	1-in-10-year, Daily EEC/LC_{50}	0.05
	Chronic	Listed and non-listed, general and obligate PPHD effects	1-in-10-year, 60-day EEC/NOAEC	1
Aquatic invertebrates	Acute	Non-listed, general PPHD effects	1-in-10-year, Daily EEC/LC_{50}	0.5
		Listed direct effects & obligate PPHD effects	1-in-10-year, Daily EEC/LC_{50}	0.05
	Chronic	Listed and non-listed, general and obligate PPHD effects	1-in-10-year, 21-day EEC/NOAEC	1
Birds, terrestrial-phase amphibians, reptiles	Acute	Non-listed, general PPHD effects	Upper bound EEC/LC_{50} (Dietary) Upper bound EEC /LD_{50} (Dose)	0.5
		Listed direct effects & obligate PPHD effects	Upper bound EEC /LC_{50} (Dietary) Upper bound EEC /LD_{50} (Dose)	0.1
	Chronic	Listed and non-listed, general and obligate PPHD effects	Upper bound EEC /NOAEC	1
Mammals	Acute	Non-listed, general PPHD effects	Upper bound EEC /LD_{50} (Dose)	0.5
		Listed direct effects & obligate PPHD effects	Upper bound EEC /LD_{50} (Dose)	0.1
	Chronic	Listed and non-listed, general and obligate PPHD effects	EEC[1]/NOAEC (Dietary) EEC[1]/NOAEL (Dose)	1

Taxon	Exposure duration	Listed/non-listed	RQ[1]	LOC[1]
Terrestrial invertebrates	Acute	Non-listed, general PPHD effects	EEC/LD_{50} (contact) EEC/LD_{50} (diet)	0.4[2]
		Listed direct effects & obligate indirect effects	EEC/LD_{50} (contact) EEC/LD_{50} (diet)	0.05[3]
	Chronic	Listed and non-listed, general and obligate PPHD effects	EEC/NOAEC (diet)	1[2]
Aquatic plants	Not applicable	Non-listed, general PPHD effects	1-in-10-year, Daily EEC/ IC/EC_{50}	1
		Listed direct effects & obligate PPHD effects	1-in-10-year, Daily EEC/ NOEC	1
Terrestrial plants	Not applicable	Non-listed, general PPHD effects	EEC/ IC_{25}	1
		Listed direct effects & obligate PPHD effects	EEC/ NOEC	1

EC_{50}= 50% effect concentration; EEC=estimated environmental concentration; IC_{25}=Concentration resulting in 25% inhibition; LC_{50}=lethal concentration for 50% of the organisms tested; LD_{50}=lethal dose for 50% of the organisms tested; NOAEC=no-observed adverse effect concentration.

[1]USEPA 2004.

2USEPA, PMRA, CDPR 2014.

[3]USEPA 2007.

A summary of the risk conclusions from the PRA and accompanying RTC memos is provided in **Section 1.2.2** and **Table 3** summarizes how these risk conclusions inform direct and PPHD effects concerns for listed species from each taxa. Based on the screening-level analysis, RQs exceed the listed species LOCs for mammals, birds, reptiles, terrestrial-phase amphibians, terrestrial invertebrates, aquatic invertebrates, and upland (*i.e.,* occupy terrestrial habitat above flood plain where soil does not remain saturated) and semi-aquatic (*i.e.,* occupy permanent or ephemeral aquatic habitat but is not fully submerged) plants. Consequently, EPA considered the potential for direct effects to listed species within these taxa in this BE. In addition, EPA considered the potential for PPHD effects for all listed species that rely on these taxa. Direct effects to fish and aquatic-phase amphibians are not a concern based on the screening-level assessment; however, PPHD effects need to be considered for species from these taxa that rely on terrestrial vertebrates, invertebrates, and/or plants. Direct and PPHD effects are not a concern for aquatic plants (*i.e.,* fully submerged in aquatic habitat). Notably, the screening-level assessment did not evaluate exposure to aquatic animals or plants in low-volume waterbodies and thus direct effects cannot be ruled out to listed species that occupy these habitats based on the screening level analysis. Consequently, this BE includes an analysis of the potential for direct effects to fish, aquatic-phase amphibians, and aquatic plants in low-volume waterbodies.

Table 3. Summary of Direct and for Prey, Pollination, Habitat and/or Dispersal (PPHD) Effects Considerations by Taxon for Listed Species Based on the Screening Level Analysis.

Taxon	Screening-level RQs Exceed LOC?	Potential Direct Effects	Potential PPHD Effects	Direct Effects Taxa Relevant to Prey, Pollination, Habitat, and Dispersal
Mammals	Listed and Non-listed	Yes	Yes	**Prey/Diet:** Invertebrates, Terrestrial/Semi-Aquatic Plants, Mammals, Birds, Reptiles, and Amphibians **Habitat:** Terrestrial/Semi-Aquatic Plants
Birds	Listed and Non-Listed	Yes	Yes	
Reptiles	Listed and Non-Listed	Yes	Yes	

Taxon	Screening-level RQs Exceed LOC?	Potential Direct Effects	Potential PPHD Effects	Direct Effects Taxa Relevant to Prey, Pollination, Habitat, and Dispersal
Amphibians	Listed and Non-listed	Yes (terrestrial-phase only)	Yes	
Fish	No risk concerns*	No	Yes	**Prey/Diet:** Invertebrates **Habitat:** Terrestrial/Semi-Aquatic Plants
Aquatic Invertebrates	Listed and Non-listed	Yes	Yes	
Terrestrial Invertebrates	Listed and Non-listed	Yes	Yes	
Terrestrial/Semi-Aquatic Plants	Listed and Non-listed	Yes	Yes	**Pollination and Dispersal:** Terrestrial Invertebrates, Mammals, Birds **Habitat**: Terrestrial/Semi-Aquatic Plants
Aquatic Plants	No risk concerns*	No	No	None

*The screening-level assessment evaluated exposure to aquatic species based on farm pond EECs only which represent medium or larger waterbodies. Since the screening level analysis did not include considerations of exposure in low volume waterbodies, the BE considered the potential for direct effects to listed and non-listed species from these taxa in those habitats.

2.3.3 Action Area

The action area represents all potential exposure areas for this pesticide action which includes currently registered use sites of acetamiprid and potential non-target areas where acetamiprid exposure may occur (*e.g.,* due to spray drift, runoff, and erosion) from registered uses. The registered uses of acetamiprid (**Section 2.2**) served to identify spatial data that represent potential application sites of acetamiprid. These data are referred to as Use Data Layers (UDLs; see **Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)** for additional information on the generation of the UDLs). The UDLs (**Table 4)** represent the potential locations of acetamiprid applications in the contiguous US (CONUS) and states and US territories outside of CONUS (referred to as non-lower 48 or NL48).

Several restrictions on the label for registered uses limit the extent of the action area within CONUS. Applications to clover (which is within the Other Crops UDL) are permitted only in Washington, Idaho, and Oregon. No restrictions are placed on other uses (*i.e.*, mustard seed) in the Other Crops UDL; therefore, this UDL was included in the action area without restriction. In addition to national registrations, there are several SLN registrations that are limited to the states where those actions were approved. In all cases there are national labeled uses for the same crops or ornamentals covered under the SLNs; therefore, no geographic restrictions were placed on those UDLs. There are no geographical restrictions for the uses outside of the CONUS; therefore, it is assumed that acetamiprid may be applied in Alaska, Hawaii, Puerto Rico, Guam, the Mariana Islands, America Samoa, and the Virgin Islands (NL48) with the same use patterns considered for CONUS use sites.

Table 4. Crosswalk of the Use Data Layer (UDL) with the Crop Use Patterns Registered for Acetamiprid.

Use Site/ Location (Variety and/or Crop Group)	CONUS Use Data Layer (UDL)	NL48 Use Data Layer (UDL)
Agricultural Uses		

Use Site/ Location (Variety and/or Crop Group)	CONUS Use Data Layer (UDL)	NL48 Use Data Layer (UDL)
Alfalfa (grown for seed)	Alfalfa	Ag
10-10 Citrus fruit group	Citrus	Ag
Cotton	Cotton	Ag
Grapes	Grapes	Ag
Clover (WA, ID, and OR only), mustard seed (ST)	Other Crops	Ag
Canola (ST)	Other Grains	Ag
11-10 Pome fruit group, 14. tree nuts, crabapple, 12. Stone fruit group	Other Orchards	Ag
Tobacco	Other Row Crops	Ag
Soybeans	Soybeans	Ag
13-07A. Caneberry subgroup, 13-07B. bushberry subgroup, 13-07F small fruit vine climbing subgroup, except fuzzy kiwifruit. 13-07G. low growing berry subgroup, 1C. Tuberous and corm vegetables subgroup, 3-07. Bulb vegetable group, 4. Leafy vegetables (except Brassica), 5A. Head and stem Brassica subgroup, 5B. Leafy brassica greens subgroup, 5. Brassica leafy vegetables, 6A. Edible-podded legumes, 6b. Succulent shelled peas and beans, 8-10. Fruiting vegetable group, 8. Fruiting vegetables (except cucurbits), 9. Cucurbit vegetables group, asparagus, sweet corn, cranberry, turnip greens, potato (ST)	Vegetable and Ground Fruit	Ag
Non-Agricultural Uses		
Ornamentals, non-bearing fruit trees, structural applications around buildings in occupational, manufacturing, processing, industrial, residential, recreational, institutional, or retail areas, impervious paved areas, residentially grown vegetables, utilities/electrical/telecom/HVAC equipment	Developed	Developed
	Open Spaced Developed	Open Spaced Developed
Ornamentals	Nurseries	Nurseries

CONUS = Contiguous United States; NL48 = Non-lower 48 states including Alaska, Hawaii, and the US territories; ST = crop is registered as a seed treatment only.

EPA determined the extent of the off-site area included in the action area by adding a buffer to the UDLs. This buffer represents the farthest distance from the treated sites where effects on listed species or CH are reasonably expected to occur. For terrestrial taxa and aquatic taxa exposed to acetamiprid as a result of spray drift and/or runoff, UDLs were conservatively buffered in all directions.[7] Since EPA's screening-level taxon-based assessment (**Section 2.3.2**) identified risk to semi-aquatic plants as both a direct and PPHD effect of concern for listed species, EPA conservatively used semi-aquatic plant exposure and toxicity data to establish the farthest off-site distance where effects of acetamiprid are reasonably expected to occur for the action area. EPA selected 1,500 meters as an upper-bound estimate of the area in which runoff could enter a wetland within a catchment based on the upper-bound distance from the edge of catchment to its main drainage network (USEPA 2022). This upper-bound estimate for runoff distance is intended to be conservative and is set for the purposes of establishing the action area. EPA expects that all other potential direct and PPHD effects identified in the screening-level assessment to occur at distances less than 1,500 meters and, thus, are captured within the action area.

3 Species Effect Determination and Predictions of Likely J Methodology

Species effects determinations and predictions of likely J for each listed species are informed by three components: 1) the magnitude of effects analysis considering how toxicity and exposure contribute to adverse direct and PPHD effects; 2) the spatial overlap of the species range or CH with the likely exposure areas for registered uses; and, 3) additional lines of evidence that modify the likelihood of exposure and effects for a given species including species vulnerability and life history characteristics. This section describes the magnitude of effect analysis (**Section 3.1**) and overlap analysis (**Section 3.2**) methodologies, and how these two components are synthesized with additional information to develop a weight-of-evidence in support of effects determinations and predictions of likely J (**Section 3.3**).

3.1 Magnitude of Effects Analysis

EPA determines the magnitude of effect for listed species individuals (in the NLAA/LAA determination) and populations (in the predictions of likely J) through an evaluation of the direct and PPHD effects likely for a listed species. To assess direct and PPHD effects, EPA first determines how the federal action will affect a taxon at different levels of biological organization by comparing the terrestrial, wetland, or aquatic estimated environmental concentrations (EEC) derived from exposure models to toxicity thresholds that represent individual, population, and community-level effects. The exposure to effects ratios are then compared to LOCs to inform an assessment of individual and population-level direct effects to the listed species and population or community-level effects to a listed species' PPHD. This section discusses the sources of fate data and models used to estimate terrestrial and aquatic exposure, the sources of toxicity data used to establish toxicity thresholds, and additional data sources. This section also describe the exposure to effects calculations and LOCs that inform the magnitude of effect analysis.

[7] The action area includes an exposure area extending from each pesticide use site found across UDLs in all directions out to this distance.

3.1.1 Terrestrial and Aquatic Models

Various models are used to estimate exposure in aquatic and terrestrial environments. Current models and their user guides can be found publicly on the web at https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment. **Table 5** summarizes the models used in this BE; **Section 5** describes these models in greater detail. Model inputs are determined from all available physical chemical property and environmental fate data for acetamiprid and its residues of concern. EPA relied on environmental fate data previously reviewed for acetamiprid in the PRA and RTC memos (USEPA, 2017). **Section 5** summarizes the environmental fate data and the inputs used for each model.

Table 5. Models Used to Assess Exposure and Identify Potential Effects from Acetamiprid.

Environment	Relevant taxa	Exposure Media	Exposure/transport Pathway	Models[1] or assumption
Aquatic	Fish Aquatic-phase amphibians Invertebrates Plants	Surface water of various water bodies representing freshwater and saltwater habitats	Offsite Transport for Standard Pond or Larger	PWC version 2.001
			Offsite Transport for Smaller than Standard Pond	Edge-of-Field Calculator
			Spray drift only to Body of Water	AgDRIFT® version 2.1.1
		Flooded cranberry field	Direct application and release into surrounding waterbodies	PFAM version 2.0
Terrestrial	Birds Terrestrial-phase Amphibians Reptiles Mammals	Dietary items (foliage, seeds/pods, arthropods, and soil)	Dietary residues from direct sprays (treatment sites)	T-REX version 1.5.2
			Dietary residues from spray drift (non-target areas)	AgDRIFT® version 2.1.1
		Direct consumption of treated seed or granule formulations	Dietary residues from treated seeds, or granule formulations (treatment sites)	T-REX version 1.5.2 - ingestion of treated seeds calculations
	Bees Terrestrial invertebrates	Contact Dietary items (foliage, seeds/pods, arthropods, and soil)	Contact and ingestion of residues in/on dietary items as a result of direct sprays (treatment sites)	BeeREX version 1.0 T-REX version 1.5.2
			Contact and ingestion of dietary residues from spray drift (non-target areas)	AgDRIFT® version 2.1.1
Terrestrial/Wetland	Terrestrial and Wetland Plants	Direct Contact and Uptake from Soil/Water	Offsite transport to terrestrial and wetland exposure zones (T-PEZ and W-PEZ)	PWC version 2.001 PAT v. 2.8[2]
			Spray drift only to terrestrial or wetland habitat	AgDRIFT® version 2.1.1

Environment	Relevant taxa	Exposure Media	Exposure/transport Pathway	Models[1] or assumption

AgDRIFT® =Agricultural Drift; BeeREX = Bee Residue Exposure; LD_{50}=lethal dose to 50% of the organisms tested; PAT=Plant Assessment Tool; PFAM=Pesticide in Flooded Application Model; PWC=Pesticide in Water Calculator; T-REX=Terrestrial Residue Exposure
[1]With the exception of PAT, Available online at: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment
[2]PAT is available online at: https://www.epa.gov/endangered-species/provisional-models-and-tools-used-epas-pesticide-endangered-species-biological

3.1.2 Ecotoxicity Data

EPA used ecological effect data to estimate the ecotoxicity of acetamiprid to surrogate species. EPA uses these data on surrogate test species and considered representative of broad taxonomic groups, to extrapolate the potential effects on a variety of species (receptors) included those under these taxonomic groupings. Title 40 Part 158 of the Code of Federal Regulations (40CFR158) specifies data required to support pesticide registrations and EPA requires guideline or non-guideline studies on one or more species for most taxa. However, data are generally not required for reptiles, amphibians, social and solitary non-*Apis* bees, and non-bee terrestrial invertebrates. EPA relies on surrogate data from other taxa for risk assessment if no additional acceptable studies are identified in the open literature. With respect to aquatic organisms, freshwater fish serve as surrogates for aquatic-phase amphibians; for terrestrial vertebrates, birds serve as surrogates for reptiles and terrestrial-phase amphibians; for terrestrial invertebrates, honey bees serve as surrogates for both social and solitary *Apis* and non-*Apis* bees as well as other non-bee terrestrial invertebrates when data are not available.

EPA relied on ecotoxicity data previously reviewed for acetamiprid in the PRA, RTC memos, and PRA addendum (USEPA, 2017, 2019, 2021, 2022). EPA also conducted a search of the ECOTOXicology (ECOTOX) Knowledgebase to identify studies that potentially had more sensitive endpoints and/or presented information on taxa or species (*e.g.*, aquatic-phase amphibians, mollusks) for which either no or limited data are available. Studies on relevant species were evaluated in accordance with the Office of Pesticide Programs' open literature guidance (USEPA, 2011)[8]; the BE incorporates those studies identified as either reliable for quantitative or qualitative use. **Appendix G. Open Literature Study Reviews** includes reviews for new open literature studies that are included in the BE.

Appendix B. Animal and Plant Effects Data summarizes the aquatic and terrestrial ecotoxicity data that EPA considered in in the effects analysis and discussed in more detail in **Section 6** of this BE.

3.1.3 Other Data Sources Considered in the Magnitude of Effect Analysis

3.1.1.1 Water Quality Monitoring

As part of the standard tiered approach for conducting pesticide risk assessments, EPA utilizes aquatic model estimates and, when available, measured pesticide concentrations from surface water monitoring programs. EPA utilizes monitoring data to characterize model-generated EECs and to characterize the extent the EECs are representative of environmental exposures.

[8] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/guidance-identifying-selecting-and-evaluating-open

EPA evaluated available surface water monitoring data for acetamiprid from the Water Quality Portal (WQP). Data from the WQP often represent samples collected from a range of surface water types including flowing and non-flowing waterbodies, and may include samples from streams, rivers, ponds, reservoirs, wetlands, estuaries, and canals.

The temporal and spatial variability of pesticide concentrations in surface water is typically not well characterized by periodic discrete samples, which represent snapshots of pesticide occurrence in specific locations which may not coincide with the time and/or area of pesticides applications (*i.e.,* targeted versus non-targeted monitoring data). Most monitoring data are not collected on a daily basis and the number of sites is often limited. As a result, monitoring data are not expected to capture the range of potential exposure in the environment. However, when measured environmental concentrations exceed toxicity endpoints, additional analysis may be considered to allow EPA to better understand and interpret the available monitoring data. Additionally, EPA uses a weight-of-evidence approach to evaluate the spatial relevance of monitoring sites to aquatic habitats of interest.

3.1.1.2 Ecological Incident Data

EPA reviewed the Ecological Incident[9] Data System (IDS) for acetamiprid-related incidents on September 29, 2023. Excluding those incidents with certainty classification (*i.e*., the extent to which there is evidence linking a particular pesticide to an incident) of “unlikely” (7 incidents) resulted in a total of 59 incidents with certainty classifications of “possible”, “probable” or “highly probable”; incidents for which no certainty classification was assigned (2 incidents) are also included. Of these incidents, 24 occurred in Canada[10] and are excluded from the analysis. Of the remaining 35 incidents, 27 (77%) involved plants and 7 (20%) involved bees and are described further in **Section 6.7** and **Section 6.3**, respectively. Pesticide registrants also report certain types of incidents to the Agency as aggregate counts occurring per product per quarter. Ecological incidents reported in aggregate reports include those categorized as “minor fish and wildlife” (W-B), “minor plant” (P-B), and “other non-target” (ONT) incidents. “Other non-target” incidents include reports of adverse effects to insects and other terrestrial invertebrates. For acetamiprid, registrants have reported 2 minor fish and wildlife incidents, 37 minor plant incidents, and no other non-target incidents as of September 29, 2023. Several of these aggregate incidents involved multiple ais that included acetamiprid in combination with either the fungicide triticonazole or insecticide bifenthrin.

The number of actual incidents associated with any pesticide may be higher than what is reported to the Agency. Incidents can go unreported since side effects may not be immediately apparent or readily attributed to the use of a chemical. Although incident reporting is required under FIFRA Section 6(a)(2), the absence of reports in IDS does not indicate that the chemical has had no effects on wildlife; rather, it is possible that incidents are unnoticed and not reported.

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[9]An ecological incident is defined as an event(s) in which pesticide use is known or suspected of causing the death or other adverse toxicological effect to wild animals and plants other than the intended target species. Incidents for animals may include any type of free-ranging wild animal, including birds, mammals, fish, reptiles, amphibians, and invertebrates, although incidents involving invertebrates other than bees and crayfish are rarely reported. Plant incidents may include adverse effects to any wild plant, although almost all plant incident reports EFED receives are for damage to crops and ornamentals.

[10] All but one of the 24 incidents which occurred in Canada involved the loss of honey bees with losses ranging between 9 to 12,000 colonies.

3.1.4 Exposure to Effects Ratio and Levels of Concern

EPA calculates individual, population, and community exposure to effects ratios for each taxa to support the magnitude of effect analysis. The exposure to effects ratios are calculated by dividing the EEC for that level of biological organization by the corresponding threshold for adverse effects. As the evaluation moves from the individual to a community of species, different endpoints and levels of concern are selected that are considered representative of effects thresholds at that level of biological organization. Additionally, exposure models are refined (*e.g*., moving from upper-bound to mean residue EECs for terrestrial vertebrates) where possible to reflect the exposure likely to occur at the different levels of biological organization. When available, EPA selects endpoints for both acute and chronic exposure to assess short and long-term effects from the registered action except for plants, for which a single set of endpoints is selected. The thresholds developed for each level of biological organization are based on the most sensitive effects evaluated in that taxa and generally are mortality for acute exposure and sublethal effects for chronic exposure. The likelihood of other, less sensitive effects manifesting in a listed species or its PPHD are discussed when data are available.

This BE assesses adverse effects to individuals based on the same approach to endpoint selection and the listed species LOCs used in the taxa-based screening-level assessment (see **Table 2** from **Section 2.3.2**). Exposure models are, however, refined from the screening-level assessment for the individual analysis to be more species specific including incorporating terrestrial vertebrate species body weight and aligning aquatic EECs to the specific aquatic habitat(s) in which that species is known to occur.

The approach for establishing thresholds for population and community-level adverse effects varies depending on the diversity of species data available for a given taxa. Regardless of the approach, however, the endpoint selected is considered to be the threshold for adverse effects at that level of biological organization (*i.e.*, the LOC is 1.0). When available, EPA uses species sensitivity distributions (SSD) to establish acute thresholds for populations and communities. EPA selected the concentrations that would be expected to be hazardous (hazard concentration; HC_x) to a specified percentage (x%) of all species from that taxa for which data are available. Depending on the taxa, the HC may be defined as either 50% mortality (in animals), a 50% decrease in growth (in aquatic plants), or a 25% decrease in growth or survival (in terrestrial plants). For population-level effects, selection of an HC_x is based on protecting a majority of the species for which data are available. Generally the HC_{05} is the selected threshold and it represents the effect level at which 95% of the species tested are not likely to experience the hazardous effect. For community-level effects, selection of an HC_x is based on protecting enough species such that a community made up of species from that taxa can still maintain its ecological function (*e.g.*, serving as prey or habitat). Generally the HC_{25} is the selected threshold and it represents the effect level at which 75% of the species are not likely to experience the hazardous effect. While these are the most common selections for thresholds, the distribution of the species sensitivity and other data sources may dictate selection of a different HC_x to be protective. A detailed rationale is provided in the endpoint selection for taxa which deviate from selection of the HC_{05} or HC_{25} for population and community-level effects, respectively.

When a reliable SSD could not be constructed from available data, population and community acute thresholds were based on effects in the most sensitive species tested. In this BE, the concentration or dose resulting in 10% mortality (LC_{10}/LD_{10})[11] is selected to evaluate population-level effects in animals. There is uncertainty as to the extent that the loss of 10% of individuals will result in an adverse population-level effect and will depend on the species and its life history. However, EPA relies on a more protective threshold is selected (*i.e.*, LC_{10} rather than LC_{50})[12] when there are insufficient data to quantitatively evaluate the sensitivity differences among species in the taxa assuming that the most sensitive species tested does not reflect one of most sensitive species in that taxon. For community-level effects, the acute threshold for animals is based on the LC_{50}. Since the community endpoint is based on effects in the most sensitive species tested, it is uncertain whether this endpoint reflects similar responses by other species within that community. Although a quantitative evaluation of the species sensitivity distribution is not possible, available data on other species are considered to characterize the likelihood of community level effects when an SSD is not available.

The chronic threshold for animal populations and communities are based on effects observed in the most sensitive species tested. The geometric mean of the NOAEL/NOAEC[13] and the LOAEL/LOAEC[14] known as the maximum acceptable toxicant concentration/level (MATC/MATL)[15] is selected to evaluate chronic effects in both levels of biological organization. In general, few species are tested for chronic effects; however, the range of effects observed across species within a taxa can be used to assess the likelihood of chronic population and community effects. Furthermore, the LOAEC/LOAEL for the most sensitive species as well as for other species tested are considered in characterizing the likelihood of an effect.

The threshold for terrestrial and aquatic plant populations and communities are, likewise, based on effects observed in the most sensitive species tested if species sensitivity distributions cannot be developed. Data for four to ten species are required as part of the 40 CFR 158 guidelines for terrestrial and aquatic plant testing, which generally provides enough data to at least characterize sensitivity differences. For population level effects, EPA considers the most sensitive IC_{25} or IC_{50} for terrestrial and aquatic plants, respectively, or the MATC depending on the reliability of the estimates and the distribution of sensitivities (*e.g.*, the IC_{25} may be relied on in situations where there is unique sensitivity in only one species tested). The LOAEC for the most sensitive species is also considered in characterizing the likelihood of an effect. For community level effects, EPA relies on the most sensitive IC_{25}/IC_{50} for terrestrial and aquatic plants for the quantitative analysis but further considers how the relative sensitivity of other species from that taxa modify the likelihood of a community level effect.

The models used to evaluate population and community-level exposure rely on many of the same refinements as those used for individuals. The only major change is a shift from upper-bound to mean residue levels to evaluate exposure in terrestrial animal species. EPA relied on the mean residue levels for the population and community-level effect analysis because EPA considers the average exposure

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[11] The LC_{10} is the lethal concentration for 10% of the organisms tested; the LD_{10} is the lethal dose for 10% of the organisms tested.

[12] The LC_{50} is the lethal concentration for 50% of the organisms tested.

[13] NOAEL=no observed adverse effect level; NOAEC=no observed adverse effect concentration.

[14] LOAEL=lowest observed adverse effect level at which there was a statistically significant difference from untreated controls; LOAEC=lowest observed adverse effect concentration at which there was a statistically significant difference from untreated controls.

[15] The MATC is the geometric mean of the NOAEC and LOAEC; the MATL is the geometric mean of the NOAEL and LOAEL.

level to better represent the spatial and temporal variability in exposure amongst individuals within the population and species within a community.

The magnitude of effect is determined for both individuals and populations of a given listed species based on the combination of adverse direct and PPHD effects. EPA evaluates adverse direct effects to individuals and populations of a listed species based on the effects analysis for their respective level of biological organization. To assess adverse effects to listed species resulting for impacts to PPHD, EPA considered how the action will impact populations and communities of species on which the listed species relies for PPHD. Population-level effects are considered in evaluating impacts to obligate relationships since these relationships are to a single species or small number of species. These rely on the same population-based analysis for direct effects to listed species. Conversely, EPA relied on the community effects analysis to evaluate impacts to generalist relationships since those relationships generally rely on a community of species either from one taxon or across taxa to meet its PPHD needs. When data are not available to assess community-level impacts, EPA considers effects at the population level to evaluate generalist relationships since those would be protective of community-level effects that would impact those relationships. Although the assessment of PPHD effects does not distinguish between impacts to the listed species individual and its population, the addition of life history modifiers (**Section 3.3.1.2**) contextualizes the likelihood that PPHD effects will result in population-level impacts. Tertiary indirect effects such as the loss of prey's habitat or prey's dietary items are not considered in the magnitude of effect analysis except where these tertiary effects impacted an obligate relationship.

3.2 Overlap Analysis

The extent of overlap for acetamiprid with likely exposure areas and the species' range or CH integrates information on potential use sites and usage data (when available) with the species locations. The exposure area represents different exposure potential based on how the range and CH are defined. The range and CH for all terrestrial species and CH for aquatic species that are defined as specific waterbodies reflect distinct areas in which the species may occur or the CH is located; therefore, the exposure area represents the potential geographic space within the action area that exposure can occur to either the species or its CH from the use site and off-site transport. The range and CH for most aquatic species, however, are defined at the watershed scale, and for these species the exposure area represents the combined area of the use site and off-site transport located within the watershed(s) that contribute to the species' aquatic habitat. An exposure area is developed for each UDL for each species/CH and encompasses the use site and off-site buffer that accounts for all off-site exposure. The potential pesticide use sites are represented using geographic information system (GIS) layers developed from multiple data sources (see **Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)**). EPA also leveraged additional non-spatial datasets to support the evaluation of initial spatial overlap results. These additional data provide refinement to the location of potential use and potential treated area and provide refinement when interpreting the results.

Overlap is considered in identifying which species and CH the action may affect or have no effect, whether the use of acetamiprid is likely or not likely to adversely affect an individual of a listed species, and when predicting the likelihood of jeopardy to the population or adverse modification of the CH. This section describes the approach for determining the exposure area including refinements for different steps of the BE as well as the methods for identifying species and CH within the exposure areas to support the effects determination and the predictions of likely J/AM.

3.2.1 Determining the Exposure Area

EPA makes separate considerations for terrestrial species and aquatic species when determining the exposure area given differences in how the ranges and CH are defined. For terrestrial species or species with a terrestrial phase (*e.g.*, terrestrial-phase amphibians), EPA assumes that there may be direct overlap of the species locations with use sites as well as sites adjacent to the field that receive spray drift and runoff. To determine the exposure area for a given use, EPA, therefore, considers whether the terrestrial species is likely to occupy, forage in, or move through the use site, and the extent to which off-site transport affects the species, directly and/or through its PPHD, at the individual and population level. Except for species that occupy treated cranberry bogs after flooding, aquatic species will not be present at registered use sites; therefore, off-site transport is the primary route of exposure for most aquatic species. However, when the range and CH for the species is at the watershed scale, the use site along with the off-site transport is considered in the overlap as both will contribute to exposure in the watershed. Separate exposure areas are established for direct effects and PPHD effects to understand how each contributes to potential adverse effects to the species or its CH and to the inform development of mitigations that may need to be separately tailored to address direct and PPHD effects.

Use Site Overlap Considerations

EPA made initial determinations as to whether a terrestrial species may be present on at use sites based on the best available information from the Services' documentation. A terrestrial species is assumed to be on-field unless available information explicitly states the species will not occupy the site of application. Similar considerations are not made for aquatic species. As mentioned above, the ranges for aquatic species are at the watershed scale and the overlap accounts for the use site and its contribution to exposure in the watershed.

EPA uses these initial on/off-field determinations in establishing the exposure area for the effects determination and predictions of the likelihood of J/AM. When a terrestrial species is not likely to be present at a use site, the on-field area is subtracted from the overall exposure area for that use. An on-field determination could represent the likelihood of single individual entering a use site or a pattern of behavior in a species that could result in a population-level exposure (*e.g.,* a listed species with a preference for pasture habitat). For many terrestrial species, movement of a single individual into a use site cannot be discounted based on life history information. However, EPA utilizes life history information to qualitatively assess the likelihood that a population-level exposure would occur at a use site to support the predictions of the likelihood of J/AM and is discussed further in **Section 3.3.1.2**. On/off-field considerations are not incorporated in the exposure area developed for assessing impacts to CH.

Off-Site Transport Considerations

EPA buffered the exposure areas out from the use site based on the farthest distance from the treated sites where effects on listed species or CH are reasonably expected to occur. The buffer distance varies in size based on the sensitivity of the listed species and its PPHD to acetamiprid and the level of biological organization considered. In defining the extent of the off-site buffer, EPA refined several of the assumptions for off-site transport used in establishing the action area. **Appendix M. Supplemental**

Overlap Information discusses the method used in the Geographic Information System (GIS) analyses to add buffers to the UDLs for establishing the exposure area.

Spray drift into terrestrial, wetland, and aquatic habitats off-field is estimated in AgDRIFT®[16] for ground and aerial applications using droplet size distribution (DSD) and boom height recommendations described on the registered acetamiprid labels (*i.e.,* boom height no greater than 48 inches above the ground or canopy and medium to coarse DSD[17]). A majority but not all labels for currently registered products specify medium DSD. Given that most labels already included the restriction and that medium or coarser DSD was recommend to be added to all labels in the PID, EPA assumed this DSD for all uses in this BE. If the medium or coarser DSD requirement is not adopted by all labels, the spray drift analysis for uses without a DSD specification will need to be revisited. The method for assessing spray drift depends on the taxa, habitat, and the level of biological organization. The spray drift analysis assumes that the exposed habitat is downwind of the treatment site during every application and there are no barriers (*e.g.,* windbreaks) impeding the pesticide residues from reaching the species habitat. Details on the spray drift analysis for each taxa are discussed in more detail in Section 5. Spray drift distances for all permitted application methods for each UDL are provided for the different levels of biological organization for each taxa in **Appendix F. Spray Drift Analysis**.

AgDRIFT® reports spray drift distances in feet which are then converted to meters and incorporated into the exposure area for a UDL using an omnidirectional buffer. Since the spray drift buffers for the action area are in 30-meter increments based on the data resolution (**Appendix M. Supplemental Overlap InformationAppendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)**), the AgDRIFT® output is rounded to the nearest 30-meter increment. Spray drift distances within 3 meters (~10 feet) of a lower increment are rounded down; otherwise, the spray drift distance is rounded up (*e.g.*, a drift distance of 33 meters would be rounded down to 30 meters, whereas a drift distance of 34 to 63 meters would be rounded to 60 meters). Drift distances within 1-3 m of the use site are considered to be indistinguishable from exposure at the use-site and, therefore, such drift distances are not considered in developing the UDL exposure area. Since the exposure area can only be buffered out in 30-meter increments, drift distances rounded up to the next 30-meter increment are overestimated in the overlap analysis. This is further compounded by the assumption of omnidirectional movement. Drift is most likely to travel off-site based on the direction of the wind, which can shift during application, but is unlikely to result in movement off-field in all directions during each spray event. While the wind direction cannot be predicted, increasing the number of potential applications at a use site increases the likelihood that spray drift exposure reflects the omni-directional assumption in the buffer. Likewise, habitat that is surrounded by use sites will have an increased likelihood of spray drift exposure regardless of wind direction.

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[16] AgDRIFT® (version 2.1.1; https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment), a modified version of the AGricultural DISPersal (AGDISP™) model developed by the US Forest Service. The AgDRIFT® model has the capability to assess a variety of spray drift conditions from agricultural applications and off-site deposition of liquid formulation of pesticides. This model can be used in estimating downwind deposition of spray drift from aerial, ground boom and orchard/vineyard airblast applications.

[17] AgDrift® does not have a medium to coarse droplet distribution for ground applications. The ground assessment, instead, uses a “fine to medium/coarse” distribution to approximate off-field drift for ground applications using equipment that produce medium to coarse droplets. This could result in overestimating the potential off-field exposure.

Runoff from the use sites will follow the topography of the field and surrounding area and is expected to leave the use site in the same direction unless land use changes or field management practices alter the topography. Due to limited information about use sites, the direction of runoff for every use site is uncertain and, thus, EPA assumes that runoff will occur in any direction. Runoff from treated use-sites into terrestrial, wetland, and aquatic habitats is expected to proceed as sheet flow for the first 30 meters from the treated field and then become channelized flow thereafter (NRCS, 2010). It is uncertain how far runoff in channelized flow will travel from the field and will be dependent on the topography and land use in surrounding areas. As discussed in **Section 2.3.3**, 1,500 meters is the upper-bound distance from the edge of a catchment to its main drainage network and the BE uses this distance as the initial upper-bound buffer distance to account for channelized flow runoff.

In the effects determination and predictions of the likelihood of J/AM, the exposure area buffer for runoff exposure to aquatic animal taxa and upland terrestrial plants is refined to 30 meters for all use sites. For aquatic animal taxa, this is supported by the fact that all aquatic listed species are mapped based upon their watershed and vary in scale, such that if the range or CH overlap with the UDL + a 30-meter buffer does not exceed 1% EPA can reasonably say that exposure to acetamiprid from residues in runoff connecting the UDL to the species' range or CH is unlikely. For upland terrestrial plants, the 30-meter distance is selected to assess impacts from runoff exposure to terrestrial plants that occupy areas adjacent to the use site. EPA assumes that sheet flow will be driver of exposure from runoff in terrestrial environments consistent with the Terrestrial Plant Exposure Zone (T-PEZ) model used to evaluate exposure to plants in upland habitats (described in more detail in **Section 5**). While channelized flow may impact upland terrestrial plants at distances greater than 30 meters from the field, the extent of exposure is uncertain.

For runoff exposure to semi-aquatic and aquatic plants, the exposure area buffer initially extends out to 1,500 meters to identify potential effects (*i.e.,* MA/NE determination) and is refined to 300 meters for evaluating adverse effects to individuals of a listed species, its population, and CH (*i.e.,* NLAA/LAA determination and predictions of the likelihood of J/AM). The 300-meter distance was selected to assess the proximity of the semi-aquatic plant habitat to the use site. EPA expects that pesticide exposure in wetland and aquatic habitats in proximity to the use site are likely to reflect the modeled EECs and there is an increased likelihood that impediments or geographic features (*i.e.,* topography and landcover changes), and penetration of acetamiprid into soil will attenuate runoff exposure with increasing distance from the field. Implicit in the proximity evaluation is that the habitat within 300 meters contains semi-aquatic plants whereas it may represent multiple habitat types for a species that is known to reside in and outside of wetland and aquatic habitats. The contribution of acetamiprid transported downstream from its initial entry into wetland or aquatic systems to exposure of aquatic and semi-aquatic species and the resulting impacts to listed species that rely on these aquatic taxa for PPHD is uncertain.

For many of the registered uses of acetamiprid, the label permits both ground *(e.g.,* chemigation, ground-boom, hand spray) and aerial application; however, it is likely that not all uses rely on both application methods equally. Since the application method can have a substantial impact on the off-site transport of the pesticide, EPA considered the most common application methods for the uses within each UDL to refine the exposure area. This refinement was considered in assessing adverse effects to populations and communities only as EPA could not discount the potential for less common applications methods to adversely impact individuals.

Table 6 identifies which application method was considered in defining off-site transport for each UDL. The selection of a predominant application method for agricultural UDLs is informed by survey data summarized in the Summary Use and Usage Matric (SUUM) for acetamiprid (USEPA, 2022) on the relative frequency of aerial applications for each registered use and other information collected by the Office of Pesticide Programs' Biological and Economic Analysis Division (BEAD). Based on the SUUM report, the highest percent of aerial uses occurred on crops within the Vegetable and Ground Fruit UDL. While not all uses within this UDL are likely to rely on aerial application, aerial accounted for up to 47% of applications indicating that aerial applications are as likely as ground applications for some uses. Since the Vegetable and Ground Fruit UDL exposure area represents all uses that fall within that UDL, to be protective EPA established the exposure area assuming aerial application. No data on frequency of aerial applications are reported for crops within the Alfalfa and Other Crops UDLs; however, it is likely that aerial applications are relied on occasionally for alfalfa and rarely for clover (Personal communication with BEAD; 10/19/23) and, thus, ground-boom is assumed to be the primary application method for these UDLs. Aerial accounted for 0-2% of applications to crops captured in the Soybean, Citrus, Corn, Other Orchard, and Grape UDLs and 24% for uses captured in the Cotton UDL. Since aerial accounted for less than a quarter of applications, the BE assumes ground application is more representative for these UDLs. Further, airblast is a common ground application method in orchard and vineyard settings for insecticides. Therefore, EPA based the exposure area for Other Orchard, Citrus, and Grapes assuming applications using airblast equipment, whereas the Soybean, Corn, and Cotton exposure areas are based on use of ground boom equipment. The only registered use captured by the Other Grains UDL is seed treatment for which the application method is not relevant to defining the exposure area.

Ground applications are the most common application method for the non-agricultural UDLs; however, labels permit aerial application in nurseries and for several ornamental trees that are part of SLN registrations. A majority of the residential and commercial uses that fall under the Developed and Open-spaced Developed UDLs are spot treatments with handheld equipment which have limited drift potential. For these UDLs, spray drift is assumed to be negligible, but runoff from the use sites is still likely to occur. Applications in nurseries may utilize chemigation, handspray, ground-boom or aerial application equipment. Although data are not available on the application method preferences in nurseries, it is likely that aerial applications are used rarely for nurseries (Personal communication with BEAD; 10/19/23). Consequently, ground-boom is assumed to be the primary application method for the Nursery UDL.

Table 6. Application Methods Assessed for Each Acetamiprid Use Data Layer (UDL).

UDL	% Applied by Air	Application Method Assessed
Agricultural Uses		
CONUS_Alfalfa	NR	Ground-boom
CONUS_Citrus	0%	Airblast
CONUS_Cotton	24%	Ground-boom
CONUS_Grapes	0%	Airblast
CONUS_Other Crops	NR	Ground-boom, Seed Treatment
CONUS_Other Grains	N/A	Seed Treatment
CONUS_Other Orchards	0-2%	Airblast
CONUS_Other Row Crops	0%	Ground-boom
CONUS_Soybeans	0%	Ground-boom
CONUS_Vegetable and Ground Fruit	1-47%*	Aerial, Seed Treatment

UDL	% Applied by Air	Application Method Assessed
NL48_Ag	NR	Aerial
Non-Agricultural Uses		
CONUS and NL48_Developed	NR	Handheld equipment
CONUS and NL48_Open Spaced Developed	NR	Handheld equipment
CONUS and NL48_Nurseries	NR	Ground-boom

CONUS = Contiguous United States; NL48 = Non-lower 48 states including Alaska, Hawaii, and the US territories, NR=not reported

*Vegetable and Ground Fruit uses with highest % applied by air include beans (47%), onions (37%), and spinach (35%).

Section 6 summarizes the off-site buffer distance added to the exposure areas for each UDL for each taxa. These buffers reflect the furtherest distance from the use site where adverse effects are likely to occur accounting for direct exposure at the use site and off-site transport of residues to surrounding habitat through spray drift, runoff, and/or erosion. Where off-site transport is unlikely to adversely affect the taxa, the UDL is not buffered and only the on-site overlap (*i.e.*, 0 m) is considered. The BE uses these distances to define the area in which direct effects to listed species from that taxon (where applicable) may occur and the area in which impacts to other listed species that rely on the taxon for PPHD may occur. Although EPA separately determined the off-site distances for runoff and spray drift, the exposure area captures potential exposure from both sources of off-site transport when they are both likely to contribute to adverse effects to that taxa. Notably, the off-site buffer distances are based on models that assume few barriers or mechanisms that would impede off-site transport reaching the species' habitat. Consequently, the characteristics of the receiving habitat that may influence the extent of spray drift and runoff and their relationship to the assumptions in the exposure models are considered as part of the life history characteristics in determining the likelihood of adverse effects to species individuals (**Section 3.3.1.2**) and populations (**Section 3.3.2**).

3.2.2 Identifying Species or CHs within the Action Area

The overlap analysis compares the species' range or CH locations with the representative UDLs resulting in a percent overlap (*i.e.*, the acres of the exposure area for the UDL overlapping with the range or CH divided by the total acres for the species range). For this analysis, EPA relies on spatial data representing the endangered and threatened species range and CH locations provided by the FWS and the NMFS as of February 16, 2022 (USFWS, 2022; NMFS, 2022) and UDL spatial data described in **Section 2.3.3** and further detailed in **Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)**EPA utilizes ArcGIS software (v. 10.8.1) and the python script in **Appendix J.** to calculate the percentage of overlap individually for each UDL exposure area and each species range/CH.

EPA first identifies species or CHs that occur within the action area to determine which species or CHs are most likely to be affected by this federal action. To accomplish this, EPA looks across the maximum overlap for the individual UDLs and representative exposure areas.[18] This analysis captures the full geographic footprint of the action area by considering the exposure area where effects are reasonably

[18] The Use Data Layer Overlap Tool can be found at: https://www.epa.gov/endangered-species/provisional-models-and-tools-used-epas-pesticide-endangered-species-biological.

expected to occur for each of the UDLs. A species or CH is within the action area if it is found within one or more of the UDL exposure areas identified using the maximum overlap for each UDLs and is not exclusively found in any of the use-restricted counties. **Section 3.2.3** discusses additional refinements to the UDLs and use sites considered for species or CH found within the action area when making effects determinations and the predictions of likely J/AM.

Given the categorical and temporal aggregations of UDLs described in **Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)**(*i.e*., the UDLs may contain more than one crop and are based on 5 years of data from 2013-2017), a single location (represented by a 0.22 acre or 900 m^2 area) could be accounted for in several UDLs. In the UDL method, this is referred to as "redundancy" in the UDLs. Buffering the UDLs to account for off-site exposure area further compounds the redundancy. Because of this redundancy and that it is not possible for a single site to simultaneously subject to multiple uses, the sum of the individual UDLs would overestimate the total percent overlap, and consequently, EPA does not add overlaps for a species or CH generated from multiple UDLs. EPA instead considers the maximum value of each individual UDL at the maximum off-site distance to determine if a species is within the action area. While the use of maximum overlap across exposure areas for the UDLs does not represent the total overlap across all uses, given the existing redundancy of the use site and exposure areas, EPA considers this protective. **Section 3.3** and **Section 4** describes how EPA accounts for the percent overlap of the exposure area and the species' range and CH, respectively, in the weight of evidence when making effects determinations and predictions of likely J/AM.

3.2.3 Refinements to the Exposure Area

This assessment incorporates several quantitative and qualitative refinements to the UDLs to support the weight-of-evidence evaluation of the species or CH within the action area. These refinements fall into two broad categories (*i.e.,* characterization of the use site, and consideration of available usage data). For both types of refinements, incorporation of additional non-spatial datasets with the overlap results supports either quantitative or qualitative characterization of the impacts to the species. EPA considers these refinements in the NLAA/LAA effects determination and the predictions of likely J/AM only.

3.2.1.1 Usage Refinements

The goal of the usage refinement is to determine the amount of area treated with acetamiprid based on the total area of the potential use sites (referred to as "treated acres"). EPA evaluates the impact of usage on the total exposure area using several different datasets and assumptions related to the distribution of the treated acres.

The application of usage information assumes a subset of fields are treated, therefore reducing the exposure area. The magnitude of the reduction in the exposure area is dependent on the distribution of the treated acres relative to the species range or designated CH. To address uncertainties associated with how treated acres may be distributed (relative to a species range or CH), and the magnitude of usage on any given year, EPA conducted an analysis for acetamiprid to represent both a central estimate (or uniform) for distributing treated acres, as well as an upper-bound. The central estimate assumes that the treated acres are uniformly distributed among the relevant UDL. The upper-bound assumes that the treated acres within a state are concentrated within the species range/CH (**Figure 1**). While both usage assumptions are considered for refinements, specific assumptions are applied to different datasets as discussed below.

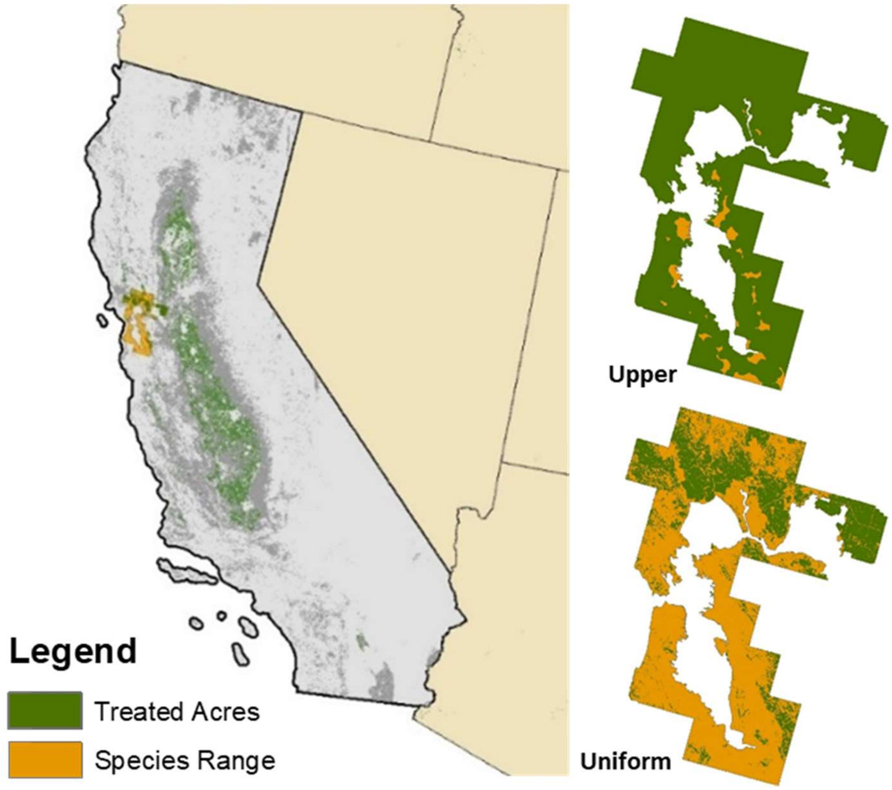

Figure 1. An example of the distribution of the treated acres. The dark gray in the map on the left is the extent of the Use Data Layer (UDL), the green area represents the treated area for a percent crop treated (PCT) of 10%. These treated acres are distributed into the species range (which is orange) using the upper and uniform distribution method (pictured on the right).

PCT Usage Refinement

EPA refined overlap with acetamiprid usage data for any species or CHs that received a MA determination. This assessment used aggregated percent crop treated (PCT) data to estimate the treated area for each UDL. Developed using crop-specific data in the acetamiprid SUUM (USEPA, 2022) provided by BEAD, the aggregated PCT represents the usage across all uses found in a given UDL. EPA applies the usage refinements to agricultural UDLs only. Reporting of non-agricultural usage is limited in the SUUM; therefore, EPA could not apply usage refinements to the non-agricultural UDLs.

Pesticide usage data are based on surveys of growers and/or other user groups. These surveys utilized by EPA are designed to be statistically robust, but by definition, sample the target populations rather than provide a complete accounting of all pesticide usage. As a result, the PCT values below 2.5% are presented as <2.5%. This method assumes the PCTs resulting in values below 2.5% are indicators of low usage. For the purposes of the spatial refinement and overlap, a PCT of 2.5% is used, recognizing this will overestimate treated area in order to conservatively account for uncertainty associated with these surveys and low usage estimates. When aggregating the PCTs, unregistered crops receive a PCT of 0; therefore, an aggregated PCT may be below 2.5% if the UDL includes crops on which acetamiprid is not registered for use. A summary of the maximum and average PCTs selected for each UDL by state are provided in **Appendix J. Appendix N. Methods for the Census of Agriculture Overlap Tool (V1.1) Information**.

The usage data are applied to the overlap analysis by assuming the maximum PCT for each UDL and that the distribution of usage is concentrated within the range or critical habitat of the species (hereafter referred to as the maximum upper distribution; **Figure 1**). EPA believes that the maximum upper distribution assumption is representative of usage for acetamiprid because application of the chemical is based on pest pressure rather than uniform applications. Furthermore, acute toxicity is a concern for multiple taxa warranting use of a more conservative assumption of usage to identify potential exposure areas.

Usage data for planting of acetamiprid-treated canola, mustard, and potato seeds are not available. Consequently, when evaluating overlap for the seed treatments, EPA assumed 100% PCT for the UDLs that cover the seed treatment uses. Although EPA considered use site refinement (**Section 3.2.1.1**) for the aggregate UDLs to quantify the acreage of crop land where acetamiprid-treated seeds could be planted, it is unlikely that acetamiprid-treated seeds are used on all canola, mustard, and potato fields resulting in an overestimate of overlap for the seed treatment analysis.

All Insecticide Census of Agriculture Data

The Census of Agriculture (CoA) data report the number of acres of agriculture that were treated for insect pests. Although these data are not pesticide-specific, they are useful in defining the proportion of agricultural areas where insecticides may be applied. The insecticide CoA data represent a uniform distribution (**Figure 1**) of all insecticide usage by acreage within a county and are buffered out to the furtherest distance likely to have an effect based on the potential for direct and PPHD effects from registered agricultural use patterns. This approach is conservative and overrepresents the usage of acetamiprid because it assumes that all applications of insecticides (which include multiple active ingredients) are represented by acetamiprid alone. For this reason, this usage estimate is treated as an upper-bound. This refinement is applied after considering the chemical specific usage data in the overlap. It does not quantitatively change the overlap value; however, it does provide historical context on the extent of insecticide applications in areas where the species range or CH are located. EPA uses this information to characterize the likelihood that insecticide applications will contribute to adverse effects to the species or CH. EPA compared the acreage of insecticide applied within the counties that overlap with the species range to the acreage of the species range within that county to determine the percent of the species range within which insecticide usage is reported. When the amount of insecticide treated acres including off-site transport does not exceed 1% of the species range or CH, EPA determined that registered agricultural uses of acetamiprid are not likely to adversely affect the species or its CH. When the amount of treated acres including off-site transport does not exceed 5%, EPA predicted that the registered agricultural uses of acetamiprid are not likely jeopardize the existence of the species or adversely modify CH. Since these data are specific to agricultural usage, this refinement does not apply to the non-agricultural UDLs.

3.2.1.2 Use Site Refinements

The UDLs considered in this assessment to define the use sites for acetamiprid represent either a single crop (*e.g.,* Soybean and Cotton), an aggregate of crops within a crop group (*e.g.,* Other Grains and Vegetable and Ground Fruit), an aggregate of all agricultural areas (*i.e.,* NL48_Ag), or an aggregate of non-agricultural uses based on application site (*e.g.*, Developed, Nurseries). While the EPA has high confidence in the overlap for single crop UDLs for the registered uses, the aggregate UDLs may include crops and non-agricultural uses and use sites that are not permitted on registered acetamiprid labels (see **Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)**for more detail on crops and non-agricultural uses included in the aggregate UDLs and how aggregation affects the confidence in UDLs). Therefore, EPA is less confident in the quantitative spatial overlap for the aggregate UDLs since the UDL area could be representing locations where acetamiprid would not be used, resulting in overestimating the extent of the use sites.

It is not possible to refine the locations of the labeled uses based solely on available GIS data, while maintaining the accuracy thresholds outlined in **Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)**The goal of the use site refinement is to determine the amount of area (by labeled use) upon which acetamiprid is reasonably expected to be used. For agricultural uses these refinements are based on the reported acres from two years the Census of Agriculture (CoA) data (when available) reported by the U.S. Department of Agriculture (USDA). EPA has developed a tool (known as the CoA tool**Appendix N. Methods for the Census of Agriculture Overlap Tool (V1.1) Information**) that compares the acreage of a given crop reported in the CoA for a county to a listed species' range or CH that includes that county. The tool provides an estimated percent area within the species range or CH that may be impacted by pesticide application to the crop of interest. EPA is utilizing this tool to better understand the scope of acetamiprid use within the aggregate UDLs in evaluating the likelihood of adverse effects to individuals of a listed species, its population, and CH (*i.e.,* NLAA/LAA determination and predictions of the likelihood of J/AM) as discussed below. This refinement is applied after considering the chemical specific usage data in the overlap. It does not quantitatively change the overlap value; however, it does provide context on the extent of crop acreage with registered uses in areas where the species range or CH are located. EPA uses this information to characterize the likelihood that the registered uses within these aggregate UDLs will contribute to adverse effects to the species or CH. When the acreage of crops with registrations within that UDL does not exceed 1% of the species range or CH including off-site transport, EPA determined that registered agricultural uses of acetamiprid within that UDL are not likely to adversely affect the species or its CH. When the amount of treated acres including off-site transport does not exceed 5%, EPA predicted that the registered agricultural uses of acetamiprid within that UDL are not likely jeopardize the existence of the species or adversely modify CH.

Non-agricultural UDLs lack a comparable data set to evaluate the number of acres treated for each use within the UDL; therefore, EPA compares the extent of the landscape and types of uses covered by the UDL to the uses on registered labels and the permitted methods of application to qualitatively refine estimates of overlap.

Citrus, Other Orchard, Vegetable and Ground Fruit

EPA uses the Citrus, Other Orchard, and Vegetable and Ground Fruit UDLs to map the foliar, and in the case of Vegetable and Ground Fruit, seed treatment use on a wide variety of crops listed in **Table 4** in **Section 2.3.3**. Although these are aggregate crop UDLs, a comparison of the crops included in the UDL (**Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)**), and the registered uses indicated that either all (*i.e*., Citrus) or a majority (*i.e.,* Other Orchards and Vegetable and Ground Fruit) of the uses captured by those UDLs are registered for use of acetamiprid. Since the UDLs are likely to accurately capture the exposure area for registered acetamiprid uses, EPA relies on the UDL overlap without refinement.

Other Crops

The Other Crops UDL is used to map the foliar use on clover and the fields where acetamiprid-treated mustard seeds are likely to be planted; however, this UDL includes crops in addition to the labeled uses (see**Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL) Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)** for a full list of crops and additional information on the Other Crops UDL). The Other Crops UDL assumes an even distribution of the cropped area between the crops making up the UDL. Furthermore, while there are geographic restrictions on the use of acetamiprid on clover, no such restrictions are in place for the use on mustard seeds. The geographic extent of the Other Crops UDL overestimates the area of the labeled crops, and therefore, overestimates where acetamiprid can be applied for this use pattern. Although the geographic restriction on clover could not be incorporated in the quantitative overlap analysis, EPA considered whether a species is known to occur in states where clover uses are permitted when foliar uses from the Other Crop UDL is contributing to adverse effects in that species.

Other Grains, Other Row Crops

The canola seed treatment use is mapped using the Other Grains UDL to identify areas where treated seeds could be planted; however, this UDL includes crops for which acetamiprid is not labeled for use (*e.g*., flaxseed, rapeseed, sorghum, rye, and oats). Likewise, the labeled use on tobacco is mapped using the Other Row Crops UDLs, but this UDL also covers agricultural areas used to grow hops, peanuts, sugarbeets, and sunflower which are not registered uses for acetamiprid (see **Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)** for a full list of crops and additional information on the Other Grains and Other Row Crops UDLs). The Other Grains and Other Row Crops UDLs assume an even distribution of the cropped area between the crops making up the

UDL. As a result, the geographic extent of the Other Grains and Other Row Crop UDLs overestimates the area of the labeled crops, and therefore, overestimates where acetamiprid can be applied for this use pattern. For these UDLs, the CoA data are considered in determining the likelihood of exposure from registered uses to species and CH that overlap these UDLs.

NL48 Ag

The NL48_Ag UDL represents all agricultural sites in the Hawaii, Puerto Rico, Alaska, Guam, the Mariana Islands, America Samoa, and the Virgin Islands, whereas acetamiprid is only registered for use on a fraction of the agricultural crops grown in those areas. Since there are no geographical restrictions on the use of acetamiprid in the NL48 states and territories, EPA assumes that acetamiprid could be used on any registered crop that is grown in the NL48. EPA relies on the CoA data in determining the likelihood of exposure from registered uses to species and CH that overlap these UDLs. Based on data provided by BEAD (Personal communication with BEAD; 10/19/23), EPA did not consider planting of acetamiprid-treated seeds for canola or mustard likely in the NL48 since those crops are unlikely to be grown in these areas.

Developed and Open Space Developed (CONUS and NL48)

There are a number of labeled uses that are geographically represented using the developed and open-spaced developed UDLs. These uses include ornamentals, non-bearing fruit trees, structural applications around buildings in occupational, manufacturing, processing, industrial, residential, recreational, institutional, or retail areas, impervious paved areas, residentially grown vegetables and legumes, and utilities/electrical/telecom/HVAC equipment. All applications are made with handheld equipment and may be foliar, soil-directed, subsurface, or tree injection. In general, the developed UDL represents non-agricultural areas with a mixture of some constructed materials and vegetation that has >20% impervious area and the open-space developed UDL represents non-agricultural areas with <20% impervious surface. Available usage data for non-agricultural uses is minimal; therefore, EPA assumed 100% usage for the UDLs. While the UDLs represent the maximum geographic extent where acetamiprid could be applied, it is not likely that every acre would be treated given that the permitted use sites for acetamiprid do not cover all possible areas represented by the UDL and the types of treatments allowed limit the size of area treated. Consequently, the overlap associated with these UDLs are likely overestimating the actual exposure area. In general, given the lack of usage information for developed and open-space developed, EPA assumes that at the population level, overlap for this use is unlikely to contribute to jeopardy given the limited geographic usage footprint, unless the species or its PPHD are known to utilize these habitats.

3.3 Species Effects Determinations and Predictions of Likely J

3.3.1 Effects Determinations

In the species-specific assessment, EPA made no effect (NE), may affect (MA) but not likely to adversely affect (NLAA), and MA and likely to adversely affect (LAA) determinations based on the potential for effects to an individual of a listed species. Distinguishing between NE and MA is a conservative approach that is based on potential direct and PPHD effects (based on EECs, toxicity endpoints, RQs and life history) and location of the species or CH. EPA also considers the degree of overlap of the species range and potential exposure areas (direct use sites and off-site exposure areas). If a MA determination is made, EPA refines assumptions related to overlap (including usage data) and considers the likelihood of effects to an individual (considering whether life history may impact this likelihood). Additional information is provided below on the overlap analysis and the determinations.

3.3.1.1 NE/MA Determination Methodology

To determine the potential for an effect, EPA uses the results of the generic taxa-based screening-level assessment to identify the listed species with direct effects concerns and the taxa on which the species depends for PPHD (**Section 2.3.2**). For any listed species that does not have direct effects or PPHD effects (*i.e.,* when all relevant RQs are less than listed species LOCs) or the species is found outside of the action area, EPA made a NE determination. For any species where the generic taxa-based screening-level assessment indicate potential direct and/or PPHD effects, EPA considers the overlap of the species range and acetamiprid potential exposure area established for the MA/NE determination. Given the known spatial relationship and correlation across the landscape, and the accuracy[19] of the available UDLs, if the resulting overlap is <1%[20] for all UDL exposure areas for a species, EPA made NE determinations for the species. For any NE determination, no additional analyses are needed.

Several species did not have GIS files available for range or CH as of February 2022. Since overlap cannot be relied on for these species, EPA made an MA determination for these species unless EPA determined those species to be outside of the action area (*i.e.*, only in states or territories where use is prohibited) or were for a taxa that is not expected to have direct effects or PPHD effects based on the generic taxa-based screening-level assessment. **Appendix K** identifies species for which range or CH GIS files are not available.

For all species with ≥1% overlap of their locations and at least one UDL exposure area, and for which EPA identified potential direct or PPHD effects, EPA made MA determinations. For all species with MA determinations, EPA completed additional analyses to determine if acetamiprid is likely or not to adversely affect (*i.e.*, LAA/NLAA determinations) at least one individual of a species.

3.3.1.2 NLAA/LAA Determination Methodology

In the LAA/NLAA determinations, refinements are made to the effects, exposure, and overlap analyses relied on for the MA/NE determination such that EPA can determine if the registered uses that may affect a listed species are likely to lead to adverse effects on an individual. As part of this determination, EPA also incorporated life history considerations. For those species presumed extinct (and recommended for delisting) by the Services,[21] EPA made NLAA determinations. EPA also made NLAA determinations for species that are not reasonably expected to be exposed because exposure is considered insignificant due to their habitats and is unlikely to adversely affect the species and its PPHD.

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[19] EPA has used this 1% overlap criteria because a known source of error within spatial datasets is positional accuracy and precision. The National Standard for Spatial Data Accuracy outlines the accepted method for calculating the horizontal accuracy of a spatial dataset (FGDC, 1998). To prevent false precision when calculating area and the percent overlap it rounded to whole number to account for significant digits, where values <0.44% are represented as 0 and values from 0.44 to 1% is represented as 1%.

[20] The overlap is rounded to whole numbers due to the precision of the remotely sensed data; therefore <1% represents <0.44% with anything over 0.44% rounding up to 1%.

[21] All of the species that are presumed extinct are under the authority of FWS. Species identified as presumed extinct are consistent with the FWS's most recent national level biological opinion (BiOp; *i.e.,* for malathion).

Table 7 lists the habitats and the rationale for why EPA expects minimal exposure and for which transport routes, when applicable. While other habitat types may have reduced exposure relative to the EPA's exposure models (*i.e.*, forest), EPA cannot discount that an individual may occupy areas within these habitats (*i.e.,* the periphery of a forest) where exposure is significant.

Table 7. Descriptions of Habitats Where Exposure is Likely Insignificant to Listed Species and Their PPHD from the Use of Acetamiprid.

Habitat with Insignificant Exposure for Registered Uses of Acetamiprid	Rationale
Remote Islands	Remote islands (*i.e.,* Laysan and Nihoa islands) are uninhabited and EPA assumes there is no agricultural or developed land on these islands. Since all registered uses are for agriculture and developed areas, there is a low likelihood of exposure to the species that live exclusively on these uninhabited islands.
Open Ocean	Runoff and spray drift from conventional pesticides applications are not reasonably expected to reach the open ocean environments at concentrations high enough to impact an individual of a species because of dilution. Since acetamiprid is not considered bioaccumulative and is not expected to accumulate in the tissue of prey, exposure from eating contaminated fish are also expected to be very low. Additionally, effects to riparian habitat along coastlines are unlikely to have a substantial impact on the water quality of the open ocean.
Interior Forests	Forest habitat with a well-established understory, midstory, and canopy are likely to limit the penetration of pesticide drift transported off-site into the forest interior. While species may be exposed on the periphery of the forest, spray drift exposure is likely to be low for species that occupy habitat only in the interior. This modifier is applicable to terrestrial species only and when spray drift is the primary route of off-site transport contributing to exposure. Offsite transport via runoff is still considered a likely transport pathway to exposure for interior forest species.
Alpine	Species that occur only in high altitude montane habitat (described as alpine) are likely to be much higher in elevation relative to use sites. Consequently, it is unlikely that species in these habitats will experience exposure either directly or from spray drift and/or runoff.

In addition, EPA identified species where direct and/or PPHD effects were possible but EPA's exposure models are unreliable for this species habitat or the spatial data available for this species are incomplete or unavailable. For these species, EPA qualitatively evaluated the likelihood of adverse effects to the individual. In many cases, these species are located in habitats described in **Table 7**. However, it should be noted that not all species evaluated qualitatively are unlikely to be adversely affected. **Appendix I. Qualitative Analysis Approach** discusses the species that were assessed qualitatively and the approach used to evaluate these listed species.

EPA made an LAA determination for species with ≥1% overlap of their locations and at least one UDL after considering the effects and refinements to account for adverse effects to individuals, and for which EPA identified likely adverse direct and/or PPHD effects. Species that did not meet these criteria received an NLAA determination.

For those species with an LAA determinations, EPA completed additional analyses to predict the likelihood of jeopardy to the species. EPA's approach to predicting the likelihood of jeopardy is described below. For any NLAA determination, no additional analyses are needed.

3.3.2 Methodology for Determining the Likelihood of Jeopardy

EPA's obligation under the Endangered Species Act (ESA) is to ensure that its actions are "not likely to jeopardize the continued existence of any endangered species or threatened species" (listed species). For those species where EPA made LAA determinations, the Agency then predicted the likelihood of jeopardy to the species. The likelihood of jeopardy predictions are included in this assessment in order to better inform any needed mitigation discussions prior to completion of a final BE and during any consultation with the Services. The Services will make the final determination as to any jeopardy to listed species and adverse modification to designated critical habitat. When EPA assesses whether there is jeopardy, the Agency considers exposures and potential effects across the population and whether life history information may modify the magnitude of effects. EPA also considers any label changes or mitigations agreed upon by the registrant. The rest of this section explains in more detail the approach to making population-level effects determinations and predictions of the likelihood of jeopardy to listed species for acetamiprid.

EPA used the FWS' draft biological opinion (BiOp) for the organophosphate insecticide malathion (USFWS, 2021) as a guide in this assessment to predict the likelihood that those species could be jeopardized by the registered uses of acetamiprid.[22] Although the FWS' BiOp for malathion was finalized (USFWS, 2022), EPA used the draft BiOp because the final BiOp contained a no jeopardy (NJ) opinion and the draft BiOp includes examples of species where FWS identified a likelihood of jeopardy. EPA used this information to inform the combination of potential exposure and species life history characteristics that would likely lead to jeopardy. Although EPA relied upon the FWS' BiOp, recent BiOps published by NMFS for malathion and two other organophosphate insecticides (*i.e.*, diazinon and chlorpyrifos; NMFS 2022) have similar considerations. In the future, EPA may revisit the approach used to predict the likelihood of jeopardy for species under the authority of NMFS with more species-specific considerations that were incorporated into NMFS' BiOp.

In this analysis for acetamiprid, EPA predicted the likelihood of jeopardy by primarily relying upon overlap[23] and magnitude of effect[24]. While the magnitude of effect and spatial overlap analyses for the predictions of the likelihood of jeopardy are similar to those conducted in the LAA/NLAA determination, EPA incorporates additional refinements and considerations to address the likelihood of adverse impacts to a species' population as described in **Sections 3.1** and **3.2**, respectively. EPA also integrated life history information[25] to account for species-specific behavior and characteristics that could modify acetamiprid exposure to and effects on a listed species' population. Although FWS incorporated species

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[22] Because 98% of the species and critical habitats for which EPA made LAA determinations are under the authority of FWS, EPA primarily relied upon FWS' approach when predicting the likelihood of jeopardy and adverse modification. During consultation, EPA will consider adjusting the approach as needed for those species and critical habitats under the authority of NMFS.
[23] Referred to by FWS as "usage"
[24] Referred to by FWS as "risk"
[25] Similar to the FWS "risk modifiers"

vulnerability directly into their determinations, EPA considered this factor as an additional line of evidence alongside the life history information to assess confidence in the predictions of the likelihood of jeopardy.

For each species, EPA assigned a high, medium or low classification to both overlap and magnitude of effect. If overlap was considered low, EPA predicted that there was not a likelihood of jeopardy. If overlap was medium or high and magnitude of effect was considered low (based on both direct and PPHD effects), EPA predicted that there was not a likelihood of jeopardy. For species that have medium to high overlap and magnitude of effect, EPA considered the weight of evidence incorporating life history characteristics and the overall vulnerability of the species (**Section 3.3.2**) in predicting the likelihood of jeopardy. If the weight of evidence did not indicate a decrease in the likelihood of effects or degree of overlap, EPA predicted that there could be a likelihood of jeopardy.

3.3.1.1 Overlap and Magnitude of Effect Classification

The classifications for overlap are based on the percentage overlap between the species range and the UDL exposure area that considers chemical-specific usage data (**Section 3.2.1.1**) and refined spray drift and runoff distances (**Section 3.2.3**) to account for the likelihood of population-level effects. For all UDLs, overlap is classified as low, medium, or high if the exposure area overlaps <5%, 5-10%, or >10% of the species range, respectively. For species that have medium to high overlap with any agricultural UDL or one or more aggregate agricultural UDLs, EPA further considers the insecticide usage and crop acreage CoA data, respectively, (as outlined in **Section 3.2.1.1**) to characterize the likelihood of exposure from registered agricultural uses. Usage based refinements could not be applied to medium and high overlap with non-agricultural UDLs; however, for developed and open spaced developed, EPA considered whether a species occupies use sites and adjacent areas alongside the likely overestimation of the overlap for these UDLs given the methods of application (*i.e.,* spot and perimeter treatments) to characterize the likelihood of exposure. EPA qualitatively assumed overlap is high for LAA species that lack a GIS range file and predictions of likely J for these species relied more on the magnitude of effect and additional lines of evidences.

Based on the results of the effect analysis for direct and PPHD effects (**Section 3.1**), EPA assigned a low, medium, or high population magnitude of effect classification to each listed species. **Table 8** summarizes the population magnitude of effects classification system used as a line of evidence in predicting the likelihood of J for listed species. The classification considers the likelihood of direct effects to the species, and generalist and obligate PPHD relationships with invertebrates, terrestrial vertebrates, and plants. The magnitude of effect classification is considered an initial assessment of the likelihood of adverse effects and does not account for many of life history modifiers described in **Section 3.3.1.2** that might alter the likelihood and extent of exposure. These modifiers are considered on a species-specific basis and factor into the weight of evidence in determining the likelihood of a population level effect to that species. The most influential modifiers are captured in summary of the predictions of the likelihood of jeopardy for each taxa (**Section 6**) and the modifiers considered for each species are discussed in more detail in **Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification**

Table 8. Population Magnitude of Effects Classification.

Population Magnitude of Effect Classification	Characteristics of Species with Classification[1]
High	• Population-level direct effects are likely • Obligate relationship with terrestrial or aquatic insects and crustaceans, birds, reptiles, or terrestrial-phase amphibians for diet, pollination, and/or dispersal • Obligate relationship with terrestrial/semi-aquatic herbaceous dicotyledon plants for habitat and/or diet. •
Medium	• Only population-level PPHD effects are likely • Obligate relationship to other listed species for which population level effects are a concern (*i.e.*, Pacific salmon are the primary prey of the Killer Whale [*Orcinus orca*]) • Generalist relationship that rely on terrestrial or aquatic insects and crustaceans, birds, reptiles, or terrestrial-phase amphibians
Low	• Population-level direct and PPHD effects are not likely • Obligate relationship with monocot or woody dicotyledon species for habitat and/or diet • Obligate or generalist relationship to taxa other than terrestrial or aquatic insects and crustaceans, birds, reptiles, or terrestrial-phase amphibians for diet, pollination, and/or dispersal

[1]Species that receive a given classification may have one or more of the characteristics described for that classification.

3.3.1.2 Additional Lines of Evidence

Life History Modifiers

Life history information was incorporated in the weight of evidence to further refine the population-level magnitude of effect and spatial overlap conclusions. EPA uses the term life history modifier to describe relevant life history information and it is analogous to the "risk modifiers" described by USFWS in the malathion BiOp. EPA considers modifications that fall broadly into three aspects of a species' life history (*i.e.*, habitat, diet, and pollinator/dispersal mechanisms). EPA expects that direct exposure at the site of application and off-site exposure to invertebrates, birds, reptiles, amphibians, and plants from spray drift and runoff will be the primary contributors to potential population-level effects in listed species for this action and dictate the modifiers considered in this assessment.

These modifiers are used to qualitatively assess the impact of life history on the likelihood of pesticide exposure for a listed species and do not account for other stressors which may impact population health and/or critical habitat integrity, which are captured in the vulnerability classification. These modifiers contextualize the magnitude of effect and spatial overlap analyses with species-specific information and provide a measure of confidence in the likelihood of a population-level impact. The extent to which each of these modifiers impacts confidence in the predictions of the likelihood of jeopardy varies by taxa and species. The modifications are discussed broadly for each aspect of the species' life history below. The life history modifiers considered for each species and how these modifiers impact predictions of the likelihood of jeopardy for that species are summarized in **Appendix K. Endangered and Threatened**

Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification

Habitat

EPA considered how the habitat requirements of a species will influence the likelihood of direct exposure at the use site, and the extent to which pesticide application will affect availability of forage and shelter within its habitat(s). EPA relied on the habitat descriptions in the EFED database and additional Services' documentation to determine the likelihood that the species will inhabit/shelter, forage, or move through the exposure area including the use site resulting in a potential exposure to the applied pesticide. EPA then considered the likelihood of a population of a species utilizing a use site, the impact of the habitat features on off-site exposure, and the number and variety of habitats a species is known to occupy including preference for certain habitat/foraging sites, and the size of the species range.

Pesticide exposure is expected to be greatest for species that inhabit or forage at the use site. As discussed in **Section 3.2.1**, the initial determination of whether a species will be at a use site were incorporated in the overlap analysis for evaluating individuals and populations. To refine these assumptions for predicting J/AM, EPA further considered life history information to qualitatively evaluate the likelihood that enough individuals would utilize the pesticide use site to result in population-level exposure. Population-level exposure on-site were considered less likely for species whose habitat requirements suggest limited reliance on agricultural fields either actively managed or fallow (*e.g.,* species habitat is primarily forest and no mention of foraging outside of forest habitat) or non-agricultural use sites. EPA made no refinements to the use-site determinations for aquatic taxa given that the ranges are based on the watershed.

Exposure of listed species in off-site habitat will depend on the features of that habitat that may increase or decrease the potential for exposure to runoff and spray drift. Off-site habitats that present few barriers to exposure (*i.e.*, few windbreaks are likely in open fields next to use sites that might limit spray drift) are expected to be of greatest concern for population-level impacts. Conversely, habitat features such as elevation, soil type, as well as the amount of precipitation are expected to limit runoff and/or spray drift from the field into montane, cliff, desert and dryland, and beach habitats. Likewise, dilution of acetamiprid in flowing and tidal-influenced waterbodies is likely to result in exposure that is lower than estimated based on EPA's exposure models for standing waterbodies. Confidence in a likely population-level effect is increased for species that inhabit or forage at the use site and/or in habitats off-site with few barriers to protect against exposure from off-site transport. Furthermore, EPA has greater confidence in population-level effects for species that occupy habitats that are similar to the models employed to estimate exposure.

EPA differentiated between habitat specialists and generalists in considering the number of habitat types available to a species and habitat preferences. EPA expects habitat generalists (*i.e*., a species that occupies a variety of habitat types) to have an equal probability of utilizing each habitat unless the Services' documentation indicates a preference or life stage requirement for a specific habitat among those they are known to occupy. The relative size of the species range was also considered alongside habitat requirements to characterize the likelihood of exposure as the species moves or disperses within and between habitats. Confidence in a likely population-level effect is increased for species when pesticide exposure is likely in most or all habitats, or in a species' preferred habitat and when the species is not expected to move or disperse over large areas.

Diet

The diet of a listed species can serve as a direct exposure route for pesticide residues and/or a decline in prey or dietary item availability following pesticide exposure can have an indirect effect on the fitness of the listed species. EPA considered the diet composition for a listed species in assessing the likelihood of direct exposure to pesticide residues in food and/or the extent to which losing one or more dietary items would impact the ability to of the species to forage. EPA relied on the diet descriptions in the EFED database and additional Services' documentation for life history information pertaining to a species' diet. Generalist consumers rely on multiple dietary items and are assumed to be equally likely to consume any of their dietary items depending on availability unless the Services' documentation indicate that a species has greater reliance on or preference for one or more dietary items over others during some or all seasons. Generalist can also be opportunistic in that their consumption habitats and will shift depending on what is available. Specialist consumers, conversely, rely on a narrow range of dietary items and would be less capable (compared to generalist consumers) to adjust their feeding habits if exposure affected their dietary items. Generalist consumers are expected to be less susceptible to loss of dietary items and less likely to be exposed given multiple dietary options; however, they may be unable to avoid exposure if the pesticide action is likely to affect a majority of their dietary items or their preferred dietary items. Confidence in a likely population-level effect is increased for species for which a majority (*i.e.,* >50%) of its dietary items or the species preferred dietary items are likely affected by the pesticide treatment. In addition to the diet, species may be exposed through other routes such as drinking water, soil ingestion, inhalation, and contact with residues; therefore, species for which there is a lower likelihood of population level adverse effects based on diet may still be adversely affected from other routes of exposure.

EPA considered generalized life history characteristics of a species' dietary items and how they might impact the likelihood of exposure to the dietary item and speed of recovery following exposure. Recovery of prey or plant species following exposure can mitigate some of the expected effects from reduced food availability depending on the speed at which the species can recover. Dietary items/prey with reproductive strategies that result in high number of offspring and short reproductive cycles (*i.e.,* arthropods) are expected to recover from exposure more quickly resulting in a transient decline in food availability. Prey/dietary items with longer reproductive cycles and lower fecundity, however, are slower to recover and may have a longer-term impact on a listed species, particularly if the listed species is a dietary specialist or prefers that food item. In addition, the pesticide use patterns and its persistence in the environment are considered in evaluating whether a species would be able to recover within a season. Confidence in a likely population-level effect is increased for species that consume dietary items with a higher likelihood of pesticide exposure and which are slower to recover.

Pollination and dispersal mechanisms

EPA relied on the pollinator/dispersal mechanism descriptions in the EFED database and additional Services' documentation for life history information pertaining to the reproductive strategies of plants and dispersal mechanisms. In evaluating confidence in the predictions of the likelihood of jeopardy, EPA considered the number of pollinator/dispersal mechanisms, whether a species had biotic (*e.g*., insect pollination) and abiotic (*e.g*., wind pollination) strategies and if one strategy results in greater reproductive or dispersal success, as well as the likelihood of exposure and the recovery potential of the biotic pollinators and dispersal agents, when applicable. These modifiers apply to listed plant species only.

In the malathion BiOP (USFWS, 2021), the FWS categorized the listed plant species into 11 assessment groups which cover lichens, ferns and allies, conifers and cycads, and four pollination strategies for monocotyledonous (monocot) and dicotyledonous (dicot) terrestrial plants (*i.e*., biotic only, abiotic only, a mixture of biotic and abiotic, or biotic and other unknown mechanisms). For listed monocots and dicots with biotic and abiotic pollinator mechanisms (Groups 6 and 10) or where a species relies on biotic mechanisms only (Groups 5 and 9) but with species from multiple taxa, EPA assumes that the species relies on all available mechanisms equally unless Services' information indicates the species is more reliant on one mechanism or it has a clear reproductive advantage (*e.g*., the mechanism increases genetic diversity and/or seed production). EPA treated species with biotic pollinators and other unknown reproductive mechanisms (Groups 7 and 11) similar to the species with biotic pollination only. Plant species with only biotic mechanisms are expected to be more susceptible, particularly when there is a defined obligate pollinator relationship or when multiple pollination options are likely to be impacted by the pesticide action. The same general considerations apply for dispersal mechanisms as well. There is increased confidence in the likelihood of a population-level effect for species that rely entirely on biotic mechanisms for pollination and/or dispersal or there is a clear reproductive advantage (*i.e.,* greater seed production) to the biotic pollination compared to abiotic, and most or all of the taxa that it relies on for its biotic pollination/dispersal strategy are impacted by the pesticide action.

The same considerations of recovery described for animal prey apply to the biotic animal pollinators (*i.e.,* terrestrial invertebrates, birds, and mammals) and dispersal agents. Accordingly, confidence in the likelihood of a population-level effect is increased for plant species that rely on biotic pollinators or dispersal agents that have a higher likelihood of pesticide exposure and are slower to recover from a pesticide exposure event.

Vulnerability

EPA considered the vulnerability of the species as an additional line of evidence in assessing confidence in its predictions of the likelihood of jeopardy. Species vulnerability is a determination made by the FWS based on multiple factors such as distribution, population size, species trends, whether pesticides were identified as a threat, and the environmental baseline. The FWS assigned a low, medium or high vulnerability to the listed species evaluated in the malathion BiOp. For NMFS and FWS species that were not classified in the malathion BiOp, EPA classified vulnerability as high unless the species narrative in recent NMFS or FWS documentation suggested otherwise. EPA's confidence in predicting the likelihood of jeopardy from pesticide exposure is increased for species with medium to high vulnerability. However, confidence was not decreased for species with low vulnerability as a pesticide application may still pose a threat to these species' existence. The overall vulnerability for each species (as determined by FWS or presumed based on NMFS or FWS documentation) is captured in **Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification**EPA may revisit the impact of species vulnerability in predicting the likelihood of jeopardy of a species as additional information becomes available.

4 Critical Habitat Effects Determination and Predictions of Likely Adverse Modification Methodology

As of February 16, 2022, there are 826 designated critical habitats (CH) and this BE evaluates only those CHs. There are many similarities between the species analysis (**Section 3**) and the CH analysis. EPA relied on the same overlap approach described earlier in this BE to determine the extent of overlap between the action area and CHs. One notable difference in the overlap analysis for CH is that there are no on/off field considerations so the CH is assumed to include use sites. EPA obtained spatial locations of CHs from FWS and NMFS. There are 34 CHs for which shapefiles are not available. As a surrogate, EPA used the species range files when determining overlap of acetamiprid exposure areas and these CHs, and as with the species, if a species range file was not available, EPA qualitatively assumed the overlap was high.

One key difference between the CH and species evaluations is that the Services define physical or biological features (PBFs) that are necessary for the CH to support the species for which it was designated. In addition, many species have special management considerations (SMC) for the critical habitat that elucidate the critical features when PBFs are not defined or provide additional context to the features of the CH. The direct and PPHD effect analyses conducted in establishing the magnitude of effect in the species determinations and predictions of likely J, inform which PBFs and SMCs are likely to be adversely affected by this action. Based on that analysis (see **Section 6**), EPA considered the following PBFs or SMCs relevant to evaluating adverse effects to CH from the registered acetamiprid uses:

1. terrestrial habitat quality (based on adverse direct effects to individuals and populations of listed species);
2. invertebrate, bird, reptile, and terrestrial-phase amphibian prey;
3. insect pollinators and dispersers.
4. terrestrial or semi-aquatic plant diet and habitat (obligate relationships with herbaceous dicots only)

The relevance of the habitat quality PBF to CH was determined based on the direct effects conclusions for listed species with different thresholds considered when evaluating adverse effects to listed species versus adverse modification to their CH. The habitat quality PBF was considered relevant for listed species in the NLAA/LAA determination when direct effects were expected to impact individuals of that listed species. However, when predicting AM, EPA considered habitat quality relevant only for listed species for which population-level direct effects are likely. While CH PBFs/SMCs for some listed species include generalist PPHD relationships with other taxa identified as having potential direct effects (*i.e.,* mammals, terrestrial plants), EPA did not consider these PPHD relationships relevant for evaluating adverse effects to CH because EPA does not expect the registered acetamiprid uses will result in community-level impacts to these taxa (**Section 6**). Where PBFs or SMCs are not defined for a CH, EPA assumed all PPHD for the listed species were relevant PBFs of the CH for the LAA/NLAA determination and predictions of the likelihood of AM. **Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification**provides more detail on the PBFs and SMCs for each CH.

For CH, EPA made NE determinations if the species and its PPHD are not likely to be impacted within the CH (*i.e.,* if all relevant taxa-based RQs are < LOCs in the generic taxa-based screening-level analysis or life history information indicate low likelihood of an effect to the species). For the same reasons described in **Section 3.3**, EPA also made NE determinations if all uses and drift areas had <1% overlap with the CH.

EPA made an LAA determination for CH with 1% or more overlap with any UDL and its off-site transport exposure area and the species' CH included one or more of the aforementioned relevant PBFs/SMCs. EPA made NLAA determinations for CH with >1% overlap but which did not include the relevant PBFs/SMCs. For all listed species with PBFs or SMCs listed above and with 1-5% overlap, EPA made LAA determinations but predicted that there was not a likelihood for adverse modification. For those CHs with relevant PBFs and >5% overlap, EPA made LAA determinations and predicted that there could be a likelihood of AM. As with the predictions of the likelihood of jeopardy, EPA considered life history modifiers relevant to the PBFs/SMCs to evaluate confidence in the predictions of the likelihood of AM. Since habitat, rather than the species, is the focus of these predictions, many of the life history modifiers considered in the predictions of the likelihood of J do not apply. The primary consideration for predicting the likelihood of AM is whether the use site is likely to occur within or adjacent to the CH. EPA also considered how overlap would change for CH when an SMC indicates that a use site would not be included as part of the CH (*i.e.*, where man-made structures are described as not part of the species' CH).

5 Environmental Fate and Exposure Estimation

5.1 Environmental Fate Characterization

5.1.1 Summary of Fate Data

Table 9 summarizes the physical-chemical properties of acetamiprid. Acetamiprid is classified as moderately mobile using the Food and Agriculture Organization (FAO) classification system (K_{OC} = 157-298 L/kg-organic carbon) and may be transported to surface water and/or groundwater via runoff, leaching, and spray drift. Aerobic soil metabolism is the primary route of degradation of acetamiprid with degradation half-life (DT_{50}) values on the order of days in aerobic soil studies (DT_{50} range: 1.85 to 3.20 days) and months in aerobic aquatic metabolism studies (DT_{50} range: 87 to 96 days). Acetamiprid is stable to hydrolysis at 25°C at pH 5, 7, and 9 at 25 °C but undergoes some hydrolysis at pH 9 under higher temperatures (≥35°C). Acetamiprid may undergo aqueous photolysis (half-life = 34 days) if present for sufficient periods in clear and shallow surface water. Anaerobic aquatic metabolism is slower than aerobic aquatic metabolism, with DT_{50} values ranging from 477 to 585 days in two sediment/water systems (MRID 49734004). Based on its low log octanol-water partition coefficient (log K_{ow} = 0.8 at 25 °C), acetamiprid is not expected to bioconcentrate significantly; data on bioaccumulation in fish are not required based on 40 CFR, Part 158.630 and were not submitted.

Table 9. Summary of Physical-Chemical, Sorption, and Bioconcentration Properties of Acetamiprid.

Parameter	Value[1]	Source/Study/Comment
Molecular Weight (g/mol)	222.68	Chemical structure
Water Solubility Limit at 25°C (mg/L)	4250	MRID 44651803
Vapor Pressure at 25°C (torr)	<1 x 10^{-8} Torr	MRID 46235701
	7.5 x 10^{-10} Torr	Footprint Database[2] Nonvolatile from dry non-absorbing surfaces
Henry's Law Constant at 25°C (atm-m^3/mole)	5.2 x 10^{-14}	Estimated[1] from vapor pressure and water solubility at 25 °C.
Log Dissociation Constant at 25°C (pKa)	0.7	USEPA, 2002 Protonation of the pyridine ring. Negligible ionization expected at pH 5-9

Parameter	Value[1]			Source/Study/Comment
Octanol-water Partition Coefficient (K_{ow}) at 25°C (unitless)	6.31 (log K_{OW}=0.8)			MRID 44651883 Not likely to bioconcentrate significantly.
Soil-Water Distribution Coefficients (K_d in L/kg-soil or sediment) Organic Carbon-Normalized Distribution Coefficients (K_{oc} in L/kg-organic carbon)	**Soil/Sediment**	**K_d**	**K_{OC}**	MRID 44651883. Moderately mobile based on FAO classification scheme
	loamy sand, pH 4.4	0.39	157	
	loamy sand II, pH 6.2	3.9	266	
	silt loam, pH 6.6	1.1	251	
	clay, pH 7.5	3.5	298	
	Sandy loam sediment, pH 5.6	4.1	164	
	Mean	2.60	227.2	
	CV	66%	28%	
Fish Bioconcentration Factor (BCF)	No data			Data requirement not triggered, no data submitted[3]

CV=Coefficient of Variation; FAO= Food and Agriculture Organization of the United Nations; MRID=master record identification number

[1] All estimated values were calculated according to "*Guidance for Reporting on the Environmental Fate and Transport of the Stressors of Concern in Problem Formulations for Registration Review, Registration Review Risk Assessments, Listed Species Litigation Assessments, New Chemical Risk Assessments, and Other Relevant Risk Assessments*" (USEPA, 2010a).

AERU. 2009. The FOOTPRINT Pesticide Properties Database. Agriculture & Environment Research Unit (AERU). Available at http://sitem.herts.ac.uk/aeru/footprint/ (Accessed November 3, 2017) (AERU, 2009).

[3] Bioconcentration studies (OCSPP guideline numbers 850.1710 and 850.1730) are not required when the log K_{OW} of the compound is <3 (40 CFR, Part 158.630)

Table 10 summarizes representative degradation half-life values from laboratory-based degradation studies of acetamiprid and acetamiprid plus degradate IM-4. These values often are different from the actual time to 50 percent decline of the residues as degradation kinetics were often biphasic with the rate of degradation slowing over time. The representative DT_{50} is designed to provide an estimate of degradation for biphasic degradation curves that will not overestimate degradation when assuming a single first-order decline curve in modeling. Since the 2017 risk assessment, parent + IM-4 degradation kinetics for the North Dakota (ND) sandy loam soil were recalculated based on public comments that identified an error in the calculated model input half-life, and the updated values were used in all aquatic modeling (USEPA, 2019). The calculated DT_{50} and DT_{90} values for each study are provided in **Appendix D. Aquatic Exposure Modeling Input Files and Results Summary**

Transformation products resulting from the environmental degradation of acetamiprid are:

- N-methyl(6-chloro-3-pyridyl)methylamine (IM 1-4)
- I-N1-[(6-chloro-3-pyridyl)-methyl]-N2-cyano-N1-methylacetamidine (IM 1-5)
- 6-chloronicotinic acid (IC-0)
- N2-carbamoyl-N1-((6-chloro-3-pyridyl)-methyl)-N1-methylacetamidine (IM 1-2)
- 6-chloro-3-pyridylmethano (IM-0)
- N-((6-chloro-3-pyridyl)methyl)-N-methylacetamide (IM 1-3)
- N-[(6-chloro-3-pyridyl)methyl]acetamide (IM 2-3)
- N1-[(6-chloro-3-pyridyl)methyl]-N2-cyanoacetamidine (IM 2-1)
- Carbon dioxide

Table 10. Summary of Environmental Degradation Data for Acetamiprid and Acetamiprid plus the Degradate IM-4.

Study	System Details	Representative Half-life (days)[1]		Source/Study Classification/Comment
		Parent	Parent+IM-4	
Abiotic Hydrolysis	pH 5, 7, 9	Stable	--	MRID 44651876. Acceptable
Atmospheric Degradation	Hydroxyl Radical	0.14 (SFO)	--	Estimated value EPI Suite™ (Version 4.1)
Aqueous Photolysis	pH 7, 25°C 40°N sunlight	34 (SFO)	--	MRID 44988509. Acceptable
Soil Photolysis	-	No half-lives calculated		MRID 48563501. Supplemental. Study provides evidence of degradation products
Aerobic Soil Metabolism	IL Loam, 20°C	14.9 (IORE)	69 (DFOP)	MRID 49734002. Supplemental ND Sandy loam parent + IM-4 degradation kinetics recalculated to correct an error identified in registrant comments on the PID
	GA Sand, 20°C	7.04 (IORE)	337 (DFOP)	
	IA Sandy loam, 20°C	4.92 (IORE)	383 (DFOP)	
	ND Sandy loam, 20°C	1.85 (SFO)	35.1 (DFOP)	
Aerobic Aquatic Metabolism	NC sand, 20°C	96.2 (SFO)	398 (DFOP)	MRID 49734003 Supplemental
	PA silty clay loam, 20°C	86.4 (SFO-LN)	318 (SFO-LN)	
Anaerobic Aquatic Metabolism	PA Loam, 20°C	585 (SFO)	--	MRID 49734004 Acceptable
	NC sandy loam, 20°C	477 (SFO)	--	

OC=organic carbon; SFO=single first order; DFOP=double first order in parallel; IM-4 = N-methyl(6-chloro-3-pyridyl)methylamine; IORE=indeterminate order (IORE); MRID=master record identification number; PID=preliminary interim decision; SFO DT_{50}=single first order half-life; TIORE=the half-life of a SFO model that passes through a hypothetical DT_{90} of the IORE fit; DFOP slow DT_{50}=slow rate half-life of the DFOP fit, --=not available or applicable

[1] The value used to estimate a model input value is the calculated SFO DT_{50}, TIORE, or the DFOP slow DT_{50} from the DFOP equation. The model chosen is consistent with that recommended using the, *Guidance for Evaluating and Calculating Degradation Kinetics in Environmental Media (NAFTA, 2012)*. The same kinetic equation used to determine the representative model input value was used to describe the DT_{50} and DT_{90} results based on standard kinetic equations. For the aerobic aquatic silty clay loam and terrestrial field dissipation studies, the natural log transformed single first order model was used to describe the data (SFO-LN).

The terrestrial field dissipation half-lives for acetamiprid applied to domestic food, fiber and ornamental crops ranged from 3 to 14 days for residues in 0 to 15 cm soil depth (MRIDs 44988514, 44988515). The terrestrial field dissipation half-lives for acetamiprid applied to bare ground plots (determined in Canadian soils) ranged from 5 to 18 days (MRID 44988625). While terrestrial field dissipation half-lives reflect a number of loss processes and are not expected to be the same as the laboratory-based fate results that are intended to reflect one loss process, some useful information can be gained in comparing the field dissipation values with the laboratory degradation study results. Leaching to the lowest depth sampled was observed in some but not all of the terrestrial field dissipation studies. Terrestrial field dissipation half-lives are longer than some of the aerobic soil metabolism half-lives and shorter than others (**Table 11**).

Table 11. Summary of Terrestrial Field Dissipation Data for Acetamiprid.

Study	System Details	Dissipation Half-life	MRID[1] or Reference/ Comment
Terrestrial Field Dissipation	CA, Gilman loamy fine, Vinca rosea	2.8	MRID 44988514
	FL, Astatula fine, tree ferns	14.1	
	NJ, Penn silt loam, garden mums	4.2	
	WA, Timerman coarse sandy loam, apples	3	MRID 44988515
	FL, Candler sand soil, oranges	6	
	NY, Oakville loamy fine sand, cabbage	13	
	CA, Romona loam soil, cotton	6	
	Prince Edward Island, Alberry sandy loam (bare ground)	10.1	MRID 44988625
	Ontario, London loam (bare ground)	5.2	
	Manitoba, Ryerson clay loam (bare ground)	17.8	

[1]MRID = master record identification number

5.1.2 Residues of Concern

Based on an analysis of empirical fate and toxicity data and estimated toxicity values for acetamiprid and its major degradates, the EPA concluded that the Residues of Concern (ROC) for aquatic exposure consist of the parent compound and degradate IM 1-4. Degradate IM 1-4 is a major degradate (*i.e.*, formed in greater than 10% applied radioactivity), structurally similar to the parent, and of similar toxicity to some aquatic taxa (**Table 12**). Several other major degradates were identified in fate studies including IM 1-2, IM 1-3, IM 1-5, and IC-0; however, aquatic toxicity data for these degradates indicate lower toxicity compared to parent. These other major degradates are, therefore, excluded from the aquatic ROCs. A total residue approach was used for the exposure assessment and estimated environmental concentrations are compared to toxicity endpoints of parent acetamiprid. A detailed discussion of the ROC selection is included in **Section 2.5** and **Appendix A** of the most recent Registration Review ecological risk assessment (USEPA, 2017).

Table 12. Ecological Structure Activity Relationship (ECOSAR; v 1.0) Toxicity Estimates for Acetamiprid and its Degradates.

Compound (compounds class used by ECOSAR)	Estimated Toxicity Endpoint (mg/L)				
	96-hr FW Fish LC_{50}	48-hr Daphnid LC_{50}	96-hr EC_{50} Green Algae	Fish Chronic Value	Daphnid Chronic Value
ECOSAR TOXICITY PREDICTIONS					
Acetamiprid (Parent)					
Empirical (*Measured*)	>100	50	>1.3	19.2	5.0
Halopyridines	0.21	0.73	--	0.30	0.97
Neutral SAR	59	36	19	5.5	3.7
IM 1-4					
Empirical (*Measured*)	>98.1	43.9	--	--	--
Aliphatic Amines	182	14	3.8	2.8	0.025
Halopyridines	0.15	0.80	--	3.3	--

Compound (compounds class used by ECOSAR)	Estimated Toxicity Endpoint (mg/L)				
	96-hr FW Fish LC_{50}	48-hr Daphnid LC_{50}	96-hr EC_{50} Green Algae	Fish Chronic Value	Daphnid Chronic Value
Neutral SAR	1724	843	208	169	61

IC-0 = 6-chloronicotinic acid ; IM-0 = 6-chloro-3-pyridylmethano; IM 1-2 = N2-carbamoyl-N1-((6-chloro-3-pyridyl)-methyl)-N1-methylacetamidine; IM 1-3 = N-((6-chloro-3-pyridyl)methyl)-N-methylacetamide; IM 1-4 = N-methyl(6-chloro-3-pyridyl)methylamine; IM 1-5 = (E)-N1-[(6-chloro-3-pyridyl)-methyl]-N2-cyano-N1-methylacetamidine; SAR=structure-activity relationship.

5.2 Plant and Aquatic Animal Exposure Estimates

Available terrestrial toxicity data on acetamiprid degradates indicated similar or reduced toxicity in birds and mammals relative to parent in the same test species. Acute and chronic toxicity to several non-bee terrestrial invertebrate species is also reported for one the acetamiprid degradate IM 1-5; however, acceptable studies on the same species are not available for the parent precluding comparison of relative toxicity. No data are available for plants or other taxa leaving it uncertain as to the relative toxicity of degradates to parent in these taxa. For terrestrial animal exposure, parent is the only identified ROC; however, EPA accounts for uncertainty in the degradate toxicity data through the use of a 35-day foliar dissipation half-life which likely incorporates exposure to degradates in terrestrial habitats. For terrestrial and semi-aquatic plants, EPA relies on the TTR approach to estimate exposure given that there are no plant data to evaluate relative toxicity.

EPA used environmental fate models to generate estimated environmental concentrations (EECs) for pesticide concentrations in surface water and terrestrial and semi-aquatic habitat. The primary model used in for aquatic exposure are the Pesticide Root Zone Model (PRZM5) and the Variable Volume Water Model (VVWM)[26] contained within the Pesticide in Water Calculator (PWC; version 2.001). The PWC is used to estimate pesticide concentrations for terrestrially applied pesticides in agricultural and non-agricultural environments. The other aquatic models used in this assessment are the Plant Assessment Tool (PAT; version 2.8) and Pesticides in Flooded Application Model (PFAM; version 2.0). The PAT uses output from the PWC to estimate pesticide concentrations in terrestrial, wetland, and aquatic plant habitats (referred to as exposure zones where T-PEZ is the terrestrial plant exposure zone; W-PEZ is the wetland plant exposure zone; and, A-PEZ is the aquatic plant exposure zone). The aquatic models simulate the extent to which spray drift, runoff, and erosion from use of the pesticide cause exposure to listed aquatic animals and plants in surface water. Exposure estimates represent acute (daily average) concentrations at different areas of the country (*i.e.*, by Hydrologic Unit Code (HUC)-2 regions[27]).

5.2.1 Aquatic Bins

Aquatic exposures are quantitatively estimated for ten generic habitat types (*i.e.*, aquatic bins 1-10) nine of which are aquatic, and one is a semi-aquatic habitat (or aquatic-associated terrestrial habitat).

[26] The exposure models can be found at: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment
[27] More information on Hydrologic Unit Codes can be found at: https://water.usgs.gov/GIS/huc.html

Aquatic bins have been defined by the Services to facilitate the estimation of pesticides in surface water for comparison to relevant toxicity endpoints for listed species assigned to the appropriate bin, based on habitat requirements. Each bin varies in depth, volume, and flow; **Table 13** summarizes the characteristics of each bin. It should be noted that the same waterbody used in PWC may be used as a surrogate to represent multiple bins defined by the Services. As such, the PWC bin number (*i.e.*, specified in the model input file) may differ from the aquatic bin number that the modeling represents.

Aquatic Bin 1 is intended to represent riparian habitats or other land-based habitats adjacent to waterbodies that may occasionally be inundated with surface water (such as wetlands) and provide habitat or influence the water quality for aquatic and semi aquatic organisms.

Aquatic bins 2, 3, and 4 are used to simulate flowing waterbodies for which Bin 2 represents low flow, bin 3 represents moderate flow, and bin 4 represents high flow. Bins 5, 6, and 7 are used to simulate static waterbodies with low, medium and high volumes. Bin 5 represents low volume, bin 6 represents moderate volume, and bin 7 represents high volume.

EPA relies on two standard conceptual model waterbodies which have been traditionally used to estimate pesticide concentrations in water using PWC. The standard farm pond[28] is used to develop EECs for the medium and large static bins (*e.g.*, bins 6 and 7) and the medium and large flowing bins (*e.g.*, bins 3 and 4). For the smallest flowing and static bins (aquatic bins 2 and 5), EPA derived edge-of-field estimates from the PRZM5 daily runoff file (*e.g.*, ZTS file) to be protective of concentrations in a headwater stream or a standing puddle that receives runoff at the edge of a treated field.

Bins 8, 9, and 10 represent estuarine/marine habitats, but EFED does not currently have standard conceptual models to estimate EECs for these environments. EPA and the Services[29] have assigned surrogate freshwater flowing or static systems to evaluate exposure for these estuary and marine bins. Aquatic bin 5 is used as surrogate for pesticide exposure to species in tidal pools (bin 8); aquatic bins 2 and 3 are used for exposure to species at low and high tide (bin 8 and 9), and aquatic bins 4 and 7 are used to assess exposure to marine species that occasionally inhabit offshore areas (bin 10).

Table 13. Aquatic Bin, Modeled Waterbody Crosswalk.

Aquatic Bin	Description	Width (m)	Length (m)	Depth (m)	Flow (m^3/s)	Waterbody Used for Modeling
1	Wetland	64	157	0.15	Variable[1]	Custom
2	Low-flowing waterbody	2	Field[2]	0.1	0.001	Edge-of-field
3	Medium-flowing waterbody	8	Field[2]	1	1	Farm pond
4	High-flowing waterbody	40	Field[2]	2	100	Farm pond
5	Low-volume, static waterbody	1	1	0.1	N/A	Edge-of-field
6	Medium-volume, static waterbody	10	10	1	N/A	Farm pond
7	High-volume, static waterbody	100	100	2	N/A	Farm pond
8	Intertidal nearshore	50	Field[2]	0.5	N/A	Edge-of-field
9	Subtidal nearshore	200	Field[2]	5	N/A	Farm pond
10	Offshore marine	300	Field[2]	200	N/A	N/A

[28] This "standard farm pond" scenario assumes that rainfall onto a treated 10-hectare agricultural field causes pesticide-laden runoff into a one hectare water body which is 2-meters deep (total volume: 20,000 cubic meters).
[29] NAS, 2013. Assessing Risks to Endangered and Threatened Species from Pesticides. The National Academies Press. 2013. (https://www.nass.usda.gov/AgCensus/).

[1]The depth and flowrate in this waterbody is variable, depending on rainfall.
[2]The habitat being evaluated is the reach or segment that abuts or is immediately adjacent to the treated field. This habitat is assumed to run the entire length of the treated area.

5.2.2 Aquatic Models

EPA simulates surface water aquatic modeling using the PWC (version 2.001) for use patterns to terrestrial areas. **Table 14** presents chemical input parameters used in modeling parent and ROC based on information described in **Section 5.1.2. Appendix D. Aquatic Exposure Modeling Input Files and Results Summary** specifies input parameters specific to the application scenario based on the use information described in **Section 2.2.** EPA selected input parameters in accordance with Office of Pesticide Programs' guidance documents (USEPA, 2009b; USEPA, 2010b; USEPA, 2012c; USEPA, 2013a; USEPA, 2013b; USEPA, 2014a; USEPA, 2014b; USEPA and Health Canada, 2012).

Pesticides in Flooded Applications Model (PFAM; version 2.0) was used to estimate pesticide concentrations for wet-harvested cranberries. Use on dry-harvested cranberries is modeled with PWC. The PFAM model simulates application of the pesticide to a wet or dry field and degradation in soil and water. If the pesticide is applied to dry soil, water may be introduced into the field and movement of the pesticide may occur from the soil into the water. After flooding, water may be held in a holding system, recirculated to other areas, or released to adjacent waterbodies external to cranberry.

Edge of Field (EoF) EECs are derived for treated areas using daily runoff concentrations obtained from the PRZM daily runoff file (e.g., ZTS file). The PWC EoF calculator tool is used to derive these estimates. EoF EECs represent exposures in low volume, low to no-flow systems, e.g., vernal pools.

EPA relied upon PAT (v 2.8 run with Python version 3.9.7 (64-bit)) for estimating environmental exposure to plants. PAT is a mechanistic model that incorporates pesticide fate (*e.g.*, degradation) and transport (*e.g.*, sorption) data that are typically available for conventional pesticides to estimate concentrations in terrestrial, wetland, and aquatic plant habitats. EPA developed PAT to make runoff exposures consistent with the approaches and assumptions considered for estimating aquatic EECs in EPA's standard 2 m deep 1-ha farm pond. EPA modeled wetlands using outputs from the Pesticide Root Zone Model (PRZM) and the Variable Volume Water Model (VVWM), which are then processed in PAT to estimate aquatic (mass per volume of water; mg ai/L) and terrestrial (mass per area; lbs ae/A) concentrations. PAT simulates exposure in three different zones: terrestrial, semi-aquatic (wetland) and aquatic. PAT (version 2.2.1.1) is designed to be compatible with Python (version 2.7 or greater), and with weather files that have more or less than 30 years of data.[30]

The terrestrial plant exposure zone (TPEZ) is intended to represent a non-target terrestrial (non-inundated) plant community immediately adjacent to the treated field that is exposed to pesticides via sheet flow[31] and spray drift from the treated field. The TPEZ is defined as an area adjacent to the treated field with a length of 316 m (equal to the length of the edge of the treated field in PWC) and a width of 30 m. The width of the TPEZ represents the distance that EPA assumes the modeled overland surface flow travels before sheet flow transitions into concentrated (channelized) flow. The TPEZ assumes that

[30] The most recent version of PAT is available at https://www.epa.gov/endangered-species/provisional-models-and-tools-used-epas-pesticide-endangered-species-biological.
[31] A continuous film of water flowing over the soil surface that is not concentrated into channels.

runoff to an area immediately adjacent to the treated field is in the form of sheet flow that carries pesticides dissolved in water and/or sorbed to eroded sediment. The model uses a mixing cell approach to represent water within the active root zone area of soil, and accounts for flow through the TPEZ caused by both treated field runoff and direct deposition onto the TPEZ through spray drift. Pesticide loss through the TPEZ occurs from transport (*i.e.*, washout and infiltration below the active root zone) and degradation.

Beyond 30 meters, EPA assumes the runoff becomes concentrated (channelized) into rivulets, gullies, *etc*., which are represented by the wetland plant exposure zone (WPEZ). The WPEZ is intended to represent a non-target wetland plant community that is exposed to pesticide via overland flow[32] and spray drift. The wetland can be immediately adjacent to the treated field or some unspecified distance away. The WPEZ is intended to represent any plant community that can exist in a saturated to flooded environment (*e.g*., a depression or shallow wetland that would collect and hold runoff from an upland area). This wetland system is considered protective of other surface-fed wetland systems (*e.g.*, permanently flooded; riparian) such that it is allowed to dry-down (concentrating contaminants), has a finite volume (considers standing water exposure), and would receive all of the runoff from an adjacent treated field. The WPEZ is defined as a one-hectare (ha) wetland receiving inputs from the adjacent 10-ha field. Within the WPEZ, two depth zones are defined: a standing water zone and a saturated soil pore-water (benthic) zone. The maximum depth of the standing water is set to 15 cm, but the water is allowed to dry down to a minimum depth of 0.5 cm using algorithms from the VVWM. The saturated soil pore-water zone is fixed 15 cm depth. This model excludes comparisons of standing water concentrations to aquatic taxa (*e.g.*, vascular and non-vascular aquatic plants) when water depth is less than 0.5 cm. Pesticide concentrations are presented as total mass in the water and benthic zones, expressed on an area-normalized basis (lbs ai/A) for comparison to terrestrial plant toxicity endpoints.

In addition to the TPEZ and WPEZ analyses that are specific to PAT, PWC calculates exposure estimates in the aquatic plant exposure zone (APEZ) using the standard farm pond assumptions (*i.e.,* runoff and spray drift from a 10-ha field into a 2 m deep 1-ha pond) to represent exposure concentrations in aquatic environments that could receive runoff and spray drift from the treated field.

PWC Scenarios

The PWC uses soil, hydrology, land cover/land use, weather, and waterbody properties to simulate environmental conditions. To develop new scenarios that would be consistent across the landscape, the Office of Pesticide Programs developed a new method to generate PWC scenarios[33]. These scenarios include the use of more recent weather data (1961-2014) (Fry *et al.*, 2016). In addition, EPA developed a process to compare and rank the new scenarios (combinations of soil, land cover, and weather) in order to evaluate relative vulnerability. EPA generated combinations of soil, land cover, and weather parameters using GIS data following the guidance entitled *Estimating Field and Watershed Parameters Used in USEPA's Office of Pesticide Programs Aquatic Exposure Models*. Scenario parameters were obtained from the following datasets:

- Soil map units from USDA's Soil Survey Geographic (SSURGO) database (USDA NRCS SSS, 2018);

[32] Water flow that moves in swales, small rills, and gullies

[33] For aquatic exposure assessments, input scenarios are used to represent a finite set of combinations of soil, weather, hydrology, and management/crop use conditions that are expected to conservatively estimate the potential for pesticides to move into surface water.

- The latest five years of land cover/crop groups from the USDA's Cropland Data Layer (CDL) (USDA NASS, 2014-2018);
- Meteorological data generated from the National Oceanic and Atmospheric Administration (NOAA) data for the years 1961 to 2014 (Fry *et al*., 2016);

The scenarios were developed, analyzed, and ranked using an automated methodology to identify the 90th percentile vulnerability scenario within each National Hydrography Dataset Hydroregion (NHDPlus HR)[34] (**Figure 2)** (USEPA, 2019b).

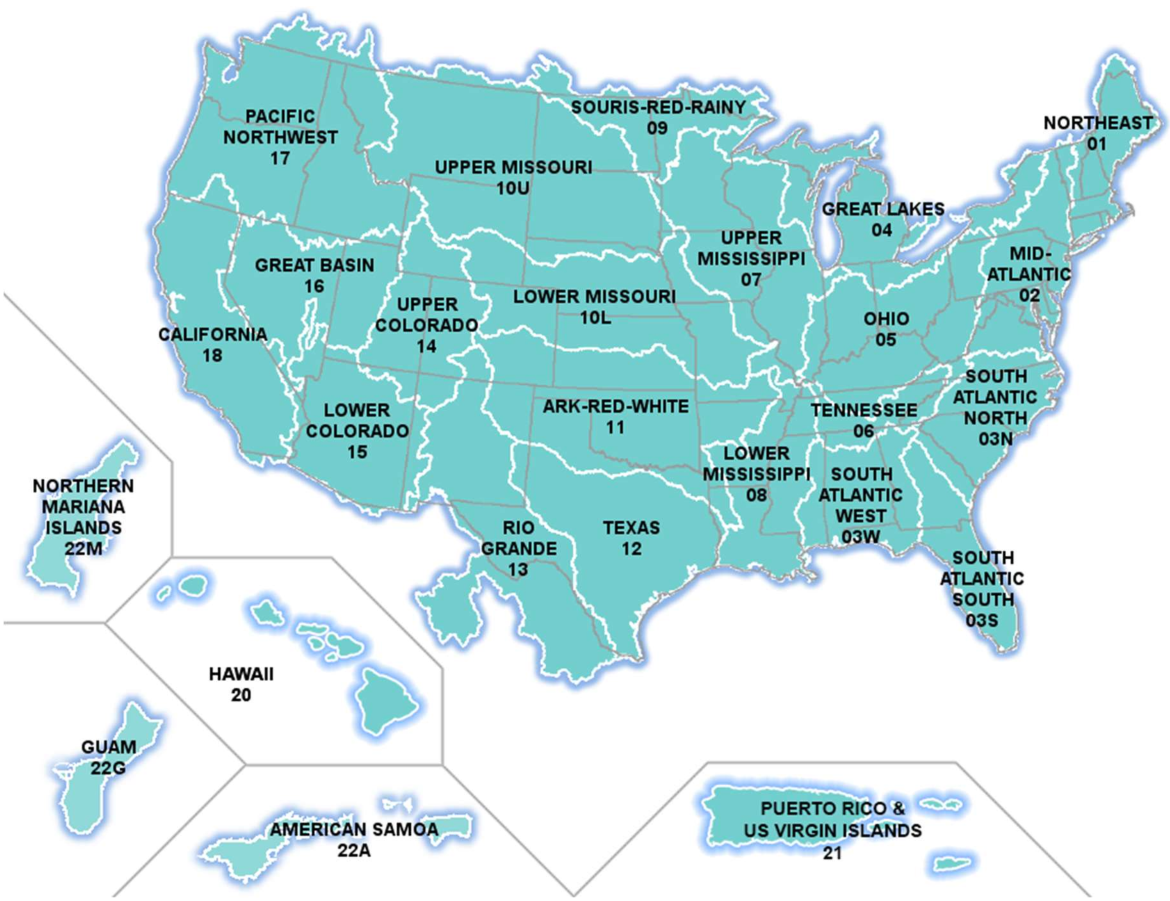

Figure 2. Map of the National Hydrography Dataset (NHDPlus Hydroregions; USGS, 2020)[39]

The U.S. Geological Survey (USGS) delineated watersheds in the United States based on surface hydrologic features classified by hydrologic unit. Each hydrologic unit is identified by a unique hydrologic unit code (HUC) consisting of two to twelve digits based on the level of classification in the hydrologic unit system (these levels range from region to subwatershed). The HUC-02 is the first level of classification and represents specific hydrologic regions distributed across 21 HUC-02 regions of the

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[34] The NHDPlus HR is a national, geospatial model of the flow of water across the landscape and through the stream network. The NHDPlus HR is built using the National Hydrography Dataset High Resolution data at 1:24,000 scale or better, the $^1/_3$ arc-second (10 meter ground spacing) 3D Elevation Program data, and the nationally complete Watershed Boundary Dataset (https://www.usgs.gov/core-science-systems/ngp/national-hydrography/nhdplus-high-resolution#WhatIsIt).

United States, eighteen of which are within the conterminous 48 states (CONUS). The NHDPlus hydro regions generally align with the HUC-02 regions, except for regions 3 and 10, which are subdivided into multiple smaller subregions.

EPA grouped non-commodity (*i.e.*, crops other than corn, wheat, soybeans, sugarcane, and cotton) crops based on agronomic practices to reduce the level of uncertainty in the spatial footprint for individual minor crops. EPA selected a single 90th percentile scenario for each crop/group of crops within each hydroregion or subregion where the crop is present, based on CDL data, for a total of up to 21 scenarios to represent each group of crops on a national scale. Since pesticides with different soil organic carbon normalized sorption coefficient (K_{OC}) values will behave differently in the different scenarios and what is vulnerable for one set of chemicals may be different for another, EPA selected separate sets of 90th percentile scenarios to represent chemicals based on three ranges of K_{OC} values. EPA uses these different sets of scenarios to assess chemicals that have K_{OC} values that fall into different ranges in terms of liters per kilogram organic carbon (L/Kg_{oc}): K_{OC}<100 L/Kg_{oc}, K_{OC} from 100 to 3,000 L/Kg_{oc}, and K_{OC}>3,000 L/Kg_{oc}. EPA approved these scenarios for use in ecological risk assessments in April 2023 and all the aquatic modeling for agricultural uses of acetamiprid utilized these scenarios.

Non-agricultural uses for acetamiprid include ornamental and residential applications. EPA modeled applications to ornamental crops using the standard PWC nursery scenarios. EPA modeled the residential uses of acetamiprid using the residential Red-Legged Frog (*Rana aurora draytonii*) (RLF) and Barton Springs Salamander (*Eurycea sosorum*) (BSS) scenarios with the runoff curve number[35] of 83, representing quarter acre lots with approximately ⅓ impervious surface area based on the USDA National Resources Conservation Services (NRCS) TR-55 methodology.[36] EPA developed the BSS and RLF scenarios in support of risk assessments conducted to evaluate potential risk to the Federally endangered BSS and RLF in Texas and California, respectively. As a result, they may not be representative of vulnerable areas across the United States. Exposure was also characterized using the standard Pennsylvania and Florida turf scenarios, which have lower curve numbers but capture the weather of a wider range of locations than the residential scenarios.

PWC and PFAM Model Inputs

EPA simulated surface water aquatic modeling using the Pesticide in Water Calculator (PWC version 2.001) for use patterns to terrestrial areas (including applications to cranberries that are dry harvested). **Table 14** presents chemical input parameters used in the modeling**.** EPA selected input parameters in accordance with Office of Pesticide Programs' guidance documents (USEPA, 2009, 2010b, 2012d, 2013a, 2013b, 2014a, 2014b; USEPA and Health Canada, 2013). Based on comments received on the 2017 ecological risk assessment, the EPA recalculated the aerobic soil model input half-life due to an error identified in the calculations. The previous and updated aerobic soil metabolism model input half-lives are given in **Table 15**.

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[35] The runoff curve number is the major soil/landscape input affecting runoff (Jones and Russell, 2001; Jones and Mangels, 2002). It is dependent upon the hydrologic soil group associated with the major soil map unit, general land cover types, crop production system, predominant agricultural practice, and hydrologic condition
[36] USDA NRCS, 1986. Urban Hydrology for Small Watersheds, Technical Release 55 (TR-55) https://www.nrc.gov/docs/ML1421/ML14219A437.pdf

Table 14. Aquatic Modeling Input Parameters for Residues of Acetamiprid Alone and Acetamiprid Plus IM-4.

Parameter (units)	Value		Source	Comments
	Parent	Parent +IM-4		
K_{OC} (mL/g)	227.2		MRID	Average of 5 values for parent. The coefficient of variation was 27% for K_{OC} and 66% for K_d. EPIweb 4.1 estimated K_{OC} values for IM 1-4 that are within the range of measured parent K_{OC} values for parent.
Water Column Metabolism Half-life (days) at 20°C	106	481	MRID 49734003	Represents the 90 percent upper confidence bound on the mean of 2 representative half-life values.
Benthic Metabolism Half-life (days) at 20°C	697		MRID 49734004	Represents the 90 percent upper confidence bound on the mean (531) of 2 representative half-life values. As parent was stable, a separate value was not calculated for parent plus IM 1-4.
Aqueous Photolysis Half-life @ pH 7 (days)	34 at 40°N		MRID 44988509	One measured value for parent.
Hydrolysis Half-life (days)	0		MRID 44651876	No significant degradation observed at 25°C.
Soil Half-life (days) at 20°C	12	352.9	MRID 49734002	Represents the 90 percent upper confidence bound on the mean of 4 representative half-life values.
Foliar Half-life	--			No Data
Molecular Weight (g/mol)	222.68		--	--
Vapor Pressure (Torr) at 25°C	7.5×10^{-10}		--	Vapor pressure for parent
Solubility in Water (mg/L)	4250		--	20°C and pH 7, measured value for parent
Heat of Henry (J/mol)	45061		--	Calculated from EPIWEB 4.1
Henry Reference Temperature °C	22.5			The vapor pressure was measured at 20°C and the water solubility was measured at 25°C.
Application Efficiency (decimal)	0.99 (ground) 0.95 (aerial) 1 (seed treatment)		--	–
Spray Drift Fraction (decimal)	0.125 (aerial) 0.062 (ground) 0.042 (airblast) 0.0 (hand held equipment, seed treatment)		(USEPA, 2013b)	Default spray drift assumptions

Table 15. Summary of Changes in Aquatic Model Inputs Between the 2017 Assessment and the Current Preliminary Risk Assessment (PRA).

Aquatic Modeling Input Parameter	Half-Life Input for Different Residues (days)	
	Parent	Parent + IM 1-4
Aerobic Soil (2017)	12	397
Aerobic Soil (2023)	12	352.9

For the use on flooded cranberries, since there were no substantial changes to the application patterns, model input values, or modeling scenarios used to model cranberries in PFAM since the previous assessment, the EPA relied on the model inputs and results of the previous ecological risk assessment for cranberries (USEPA, 2017). While the Total Residues (TR) aerobic soil metabolism model input half-life decreased from 397 to 352.9 days based on the corrected model input half-life, EPA expects this change to have a negligible effect on EECs as the previously calculated values do not substantially overestimate the potential exposure.

The uses of acetamiprid on agricultural crops allow for ground, aerial, and airblast applications of a flowable material. For the agricultural crop uses, EPA generated EECs for broadcast aerial, airblast (for tree and orchard crops), and ground spray applications using a batch processing input file. The highest EEC for each UDL are shown in the results table in the following section. **Appendix D. Aquatic Exposure Modeling Input Files and Results Summary** provides the full set of modeled use patterns.

Acetamiprid labels specify of the number of crop cycles per year for uses on berries. EPA completed modeling using standard scenarios, which only simulate crop parameters for one crop cycle per year. EPA selected application dates to be consistent with the season where the crop is produced for the area; however, applications may have occurred outside of the dates that the PWC simulates for the crop on the field.

For the new agricultural scenarios, since the emergence, maturity, and harvest dates for the crop can vary based on the geographic location the scenario represents, EPA relied on a standard set of application date application method assumptions dates (listed below) to determine the PWC application.

Application assumptions

- Seed treatment application:
  - Seed treatment applications were made 7 (for canola and mustard) or 14 (for potatoes) days before the PWC scenario emergence date. Assumed a planting depth of 4 inches for potatoes and 0.5 inches for canola and mustard.
- For post-emergence applications:
  - Unless otherwise specified, applications were made on 1st day of the month with the high average precipitation when the crop is on field for at least 20 days (*i.e.*, between the emergence and harvest dates of the PWC scenario). If the first of the month was before the PWC scenario emergence date, then the application was made on the 15th of the month. If the last application would be made after the harvest date or the minimum pre-harvest interval, then the first application date was set to the date closest to the 1st or 15th that would result in the last application falling before the PHI or scenario harvest date.
- For uses with multiple crop cycles per year:

- The application dates for the first crop cycle were set based on the method for post-emergence applications, and applications for subsequent two crop cycles were set 120 and 240 days from the initial application dates.

Simulations for applications in residential areas and structural treatments assumed that only a portion of a lot would be treated, that only a portion of the watershed contained residential lots, and that between 1 and 58 houses in the watershed were treated. The methodology used in this assessment is consistent with the methodology used by EPA for residential applications of pyrethroids (USEPA, 2016d) and was updated to incorporate public comments from the carbaryl draft biological evaluation (USEPA, 2020f).

EFED modeled the residential applications of acetamiprid using the Residential ESA scenarios with the curve number of 83, as these scenarios were readily available, as acetamiprid is expected to be applied to pervious and impervious surfaces, the curve number is in the range of curve numbers reflected for developed open spaces (**Table 16**), and this simplifies the modeling for residential uses. EPA also characterized exposure using the standard turf scenarios, which have lower curve numbers but capture the weather of a wider range of locations than the residential scenarios. EPA completed calculations specific to acetamiprid label recommendations, where label recommendations could be used to estimate a per area rate. There are some recommended use patterns on labels that could not easily be translated into a per area rate and these were not considered in the calculations (*e.g.*, rates were provided in lb/linear ft or lb per gallon). Consistent with the 2017 PRA (USEPA, 2017), EFED assumed that 17% of each residential lot would receive perimeter treatments at the 0.189 lb ai/acre application rate and 11% of each lot would be concurrently treated at the 0.0375 lb ai/acre application rate 5 times with a minimum retreatment interval of 7 days.

Table 16. Curve Number Guidelines Based on NRCS TR-55 Methodology.

Cover Type	Treatment of practice	Hydrologic Condition (HC) or Percent Impervious surface	Hydrologic Soil Group			
			A	B	C	D
Developed Open Space	<50% grass cover	Poor HC	68	79	86	89
	50 – 75% grass cover	Fair HC	49	69	79	84
	>75% grass cover	Good HC	39	61	74	80
Residential	1/8 ac lots or less	65% impervious	77	85	90	92
	¼ acre lots	38% impervious	61	75	**83**	87
	1/3 acre lots	30% impervious	57	72	81	86
	½ acre lots	25% impervious	54	70	80	85
	1 acre lots	20% impervious	51	68	79	84
	2 acre lots	12% impervious	46	65	77	82

Table produced from page 42 Appendix D on instructions for determining curve number for developing PWC scenarios (USEPA, 2019a). The bold value is the value chosen to parameterize the curve number for the CAresidentialRLF scenario.

An estimate of the number of residential lots in a 10-ha watershed has been previously evaluated for California Red Legged Frog (CRLF) and other endangered species assessments [*i.e.*, Appendix G of "Potential Risks of Alachlor Use to Federally Threatened California Red-legged Frog (*Rana aurora draytonii*) and Delta Smelt (*Hypomesus transpacificus*)", USEPA 2009]. The assumption previously made was 58 lots arranged in 10 lot blocks (USEPA, 2009c). There are 10,890 ft^2/lot x 58 lots in 10 ha = 631,620 ft^2 out of a total of 1,076,391 ft^2/ watershed (*i.e.*, 10 ha), resulting in an adjustment factor of

0.587. To model both the different rates on the different treated areas and the residential lot adjustment factor, EPA modeled residential applications as 1 application at 0.021 lb ai/acre plus 4 applications at 0.0024 lb ai/acre.[37] Initial applications were made on June 1st, based on the previous assessment.

5.2.3 PWC Modeling Results

Table 17 and **Table 18** present a summary of the range of PWC-calculated EECs across HUC-02 watersheds for acetamiprid and acetamiprid ROC in surface water for aerial, ground, chemigation, and seed treatment applications to agricultural crops and residential use sites. The results were summarized according to the UDL associated with the use sites. EPA used these EECs to calculate the magnitude of effects to aquatic animals and plants. The range of EECs presented for each UDL demonstrate the variation in exposure for that UDL across uses and HUC-02 watersheds. EPA considers this variation in assessing the likelihood of direct effects to terrestrial, semi-aquatic, and aquatic taxa. The full list of modeled use patterns and associated HUC-02 level EECs can be found in **Appendix D. Aquatic Exposure Modeling Input Files and Results Summary**

For acetamiprid parent, the 1-in-10 year 1-, 21-, and 60-day average surface water EECs range from 0.0063-13.74, 0.0062-13.36, and 0.006-12.56 µg/L, respectively. For the TPEZ, 1-in-10 year EECs range from 0.00021-0.172 lb ai/acre. For the WPEZ, 1-in-10 year EECs range from 0.11-240 µg/L and from 0.00010-0.17 lb ai/acre. The 1-day average EoF concentrations range from 0.67 to 98 µg/L.

For acetamiprid ROC, the 1-in-10 year 1-, 21-, and 60-day average surface water EECs range from 0.033-63, 0.032-63, and 0.03-62 µg/L, respectively. For the TPEZ, 1-in-10 year EECs range from 0.00048-0.32 lb ai/acre. For the WPEZ, 1-in-year EECs range from 0.17-240 µg/L and from 0.00025-0.24 lb ai/acre. The 1-day average EoF concentrations range from 0.92 to 223 µg/L.

Table 17. Summary of Acetamiprid Parent Estimated Environmental Concentrations (EECs) Calculated Using the Pesticide in Water Calculator (PWC; version 2.001), the Plant Assessment Tool (PAT; version 2.8), and the Edge-of-Field Calculator.

Model Waterbody or Habitat→	EPA Farm Pond			T-PEZ	W-PEZ		Edge of Field
Use Pattern↓	1-Day (µg/L)	21-Day (µg/L)	60-Day (µg/L)	Runoff+spray drift at 15 m EEC (lb ai/A)Peak EEC (lb ai/A)	Peak EEC (ug/L)	Peak EEC (lb ai/A)	1-day (µg/L)
Citrus	1.5-9.7	1.3-9.4	1.1-8.8	0.032-0.11	16-230	0.021-0.084	23-79
Cotton	2-5.8	1.8-5.3	1.5-4.5	0.031-0.073	14-110	0.021-0.066	17-62
Developed	0.033-0.23	0.032-0.21	0.03-0.18	0.00021-	0.22-	0.00029-	0.67-2.2

[37] Application rates calculated as maximum application rate x treated area x Residental lot adjustment factor. The first application consists of a perimeter treatment at 0.189 lb ai/acre to 17% of the lot and an ornamental/garden application at 0.0375 lb ai/acre to 11% of the lot for an application rate of (0.189 lb ai/acre x 0.17 + 0.0375 lb ai/acre x 0.11) x 0.587 = 0.021 lb ai/acre. Subsequent applications consist of the garden/ornamental application at 0.0375 lb ai/acre to 11% of the lot for an application rate of (0.0375 lb ai/acre x 0.11) x 0.587 = 0.0024 lb ai/acre.

				0.00096	1.4	0.0018	
Nurseries	3.8-11	3.6-10	3.2-8.4	0.065-0.12	27-240	0.04-0.1	24-98
Other Grains	0.056-0.74	0.053-0.73	0.049-0.69	0.0012-0.0048	0.85-3.1	0.00095-0.0042	2.8-9.3
Other Orchards	1.6-9.4	1.5-8.8	1.4-8.2	0.024-0.12	14-220	0.016-0.15	14-59
Other Row Crops	1.1-6	1.1-5.7	0.97-5	0.022-0.072	12-97	0.014-0.088	8.9-47
Soybean	2.5-13	2.2-13	1.8-11	0.033-0.096	18-220	0.023-0.11	15-49
Vegetables and Ground Fruit	0.0063-14	0.0062-13	0.0061-13	0.0046-0.17	0.11-210	0.0001-0.17	0.86-94
Open Space Developed	0.033-11	0.032-10	0.03-8.4	0.00021-0.12	0.22-240	0.00029-0.1	0.67-98
Grapes	0.79-2.6	0.71-2.4	0.61-2.2	0.015-0.035	8.3-100	0.009-0.048	3.2-15

TPEZ = Terrestrial Plant Exposure Zone, WPEZ = Wetland Plant Exposure Zone; CC = crop cycle

Table 18. Summary of Acetamiprid Residue of Concern (ROC) Estimated Environmental Concentrations (EECs) Calculated Using the Pesticide in Water Calculator (PWC; version 2.001), the PLant Assessment Tool (PAT; version 2.8), and the Edge-of-Field Calculator.

Model Waterbody or Habitat→	EPA Farm Pond			T-PEZ	W-PEZ		Edge of Field
Use Pattern↓	1-Day (µg/L)	21-Day (µg/L)	60-Day (µg/L)	Peak EEC (lb ai/A)[1]	Peak EEC (µg/L)	Peak EEC (lb ai/A)	1-day (µg/L)
Citrus	3.2-21	3.1-21	2.9-20	0.042-0.21	18-230	0.023-0.089	24-84
Cotton	4.3-12	4.1-12	3.9-11	0.051-0.13	16-120	0.024-0.086	23-73
Developed	0.19-0.41	0.19-0.4	0.18-0.39	0.00047-0.0012	0.44-1.6	0.00061-0.0021	0.99-2.6
Nurseries	7.1-22	7-22	6.7-22	0.082-0.16	29-240	0.044-0.1	26-110
Open Space Developed	0.19-22	0.19-22	0.18-22	0.00047-0.16	0.44-240	0.00061-0.1	0.99-110
Other Grains	0.15-1.3	0.15-1.3	0.15-1.3	0.0021-0.0072	1.3-3.8	0.0015-0.0053	3-10
Other Orchards	3.6-26	3.5-26	3.3-25	0.044-0.23	15-230	0.018-0.16	22-75
Other Row Crops	2.2-13	2.1-13	2-14	0.032-0.13	13-100	0.016-0.095	13-96
Soybean	4.7-25	4.5-24	4.1-23	0.049-0.13	19-220	0.026-0.12	18-56
Vegetables and Ground Fruit	0.033-63	0.032-63	0.031-62	0.0072-0.32	0.17-210	0.00025-0.24	0.92-220
Grapes	1.7-7.7	1.7-7.5	1.6-7.4	0.02-0.066	8.9-110	0.0098-0.052	4.7-20

TPEZ = Terrestrial Plant Exposure Zone, WPEZ = Wetland Plant Exposure Zone; CC = crop cycle
Residue of concern (ROC) include parent acetamiprid plus its degradate IM 1-4
[1]EECs reported for the T-PEZ account for runoff from the treated site to an adjacent terrestrial habitat 30 meters and spray drift up to 15 meters in that habitat.

5.2.4 Water Quality Monitoring Summary

For the 2017 PRA (UESEPA, 2017), EFED searched for monitoring information in the Water Quality Portal and the California Environmental Data Exchange Network (CEDEN). The results of those searches is summarized below. An additional search of the water quality portal and CEDEN was not conducted for this BE.

As of September 2017, there were 17 reported detections (0.74%) in the Water Qualtiy Portal of acetamiprid out of 2,286 surface water samples analyzed for acetamiprid with the maximum detection of 0.227 µg/L. There were 1,834 groundwater samples analyzed for acetamiprid, and acetamiprid was not detected in any of the samples. The limit of quantitation (LOQ) ranged from 0.003 to 0.025 µg/L. It is unknown whether samples were collected in areas where acetamiprid is used; however, acetamiprid is used heavily in the central valley of California and there were no detections reported in CEDEN a database of monitoring data collected in California.

Hladick *et al.* (2014) collected 79 surface water samples from nine streams in a high corn and soybean producing area during the growing season in 2013. Acetamiprid had lower usage as compared with other neonicotinoids evaluated in the study, and only had one detection at 11.1 ng/L in Little Sioux River. Method detection limits ranged from 0.004 to 0.006 µg/L.

Anderson *et al.* (2013) evaluated water quality of the playas[38] and monitored pesticides applied to cotton in the Southern High Plains of Texas. Water samples (n=109) were collected from twelve playas that contained water at the beginning of the growing season in 2005. Sediment samples were collected in April and December. Acetamiprid was detected in 17% of samples at a mean concentration of 2.2 µg/L (maximum concentration detected was 44.1 µg/L in the crop playas). In the grassland playas, acetamiprid was detected in 4% of samples at a maximum concentration 26.7 µg/L. The exact limit of detection (LOD) was not reported for each individual analyte examined in the study; however, the LOD concentrations assumed for calculations was 0.1 µg/L. Monitoring results are summarized in **Table 19**.

Table 19. Summary of Monitoring Results for Acetamiprid.

Source	Type of Study	Frequency of Detections (detections/# of samples)	Maximum detection (µg/L)	Mean in µg/L (SD)	Limit of Detection (µg/L)
Surface Water					
Water Quality Portal[1]	Non-targeted	<1% (17/2,286)	0.227	--	0.003-0.025
Anderson et al. 2013	Cotton use area in Texas	17% (19/108)	44.1	2.2 (7.3)	0.1
Hladik et al. 2014	Low use area	1% (1/79)	0.0111	--	0.004-0.006
Groundwater					
Water Quality Portal[1]	Non-targeted	0% (0/1834)	Not detected	--	0.003-0.025

[1]Data accessed 9/18/2017

[38] Playas are undrained dry lake beds at the bottom of a desert basin, which periodically fill with water to form a temporary lake.

Except for the Anderson *et al.* (2013) study, most monitoring studies were not specifically targeted at acetamiprid and the frequency of sample collection in all studies was not adequate to ensure the capture of peak concentrations. Monitoring data are useful in that they provide some information on the occurrence of acetamiprid in the environment under existing usage conditions. However, the measured concentrations should not be interpreted as reflecting the upper end of potential exposures. Absence of detections from non-targeted monitoring cannot be used as a line of evidence to indicate exposure is not likely to occur because data are often collected in areas where the pesticide is not used. Additionally, monitoring results cannot be directly compared to modeling results, as the monitoring does not reflect the modeled conceptual model and the sampling frequency and duration do not reflect what are simulated in modeling. However, the monitoring data provide a useful line of evidence to explore whether exposure in the environment is occurring at the levels of the modeled EECs and whether monitoring shows that exposure is occurring at levels that are higher than toxicity endpoints. If exceedances are not occurring this is not evidence that exceedances will not occur with usage; however, if there are exceedances, it confirms that exposure has been confirmed in the environment at levels where effects are expected to occur. It also provides a line of evidence on whether the EECs estimated with modeling are occurring in the environment.

5.2.5 Spray Drift for Plants and Aquatic Animal Species

Acetamiprid exposure in aquatic environments from use sites may be from direct application to the waterbody, or off-site transport via spray drift and/or runoff. The PWC modeling incorporates spray drift exposure in the EEC; however, the EoF EECs do not account for spray drift. EPA used the AgDRIFT® spray drift model (v2.1.1) and the spray drift mitigations on currently registered labels (see **Section 3.2**) to estimate acetamiprid exposures of organisms as a result of spray deposition in terrestrial, semi-aquatic, and aquatic habitats and to characterize the contribution of spray drift exposure to direct effects in aquatic wildlife and plants. EPA calculates the footprint of off-field spray drift from the agricultural field following the Environmental Fate and Effects Division Offsite Transport Guidance (USEPA, 2013b). EPA determined off-field distances to thresholds of concern (*e.g.,* LOCs) by comparing estimated exposure in terrestrial or aquatic environments based on the highest single maximum application rate (see **Table 20** in **Section 5.3.1.1**) for each UDL to the threshold of concern for individuals, populations, and communities. EPA estimated drift distances for aquatic animals for the representative waterbodies of each aquatic bin (*i.e.,* see **Section 5.2.1** for a description of the bins and representative size). These estimates reflect exposure at the point of deposition and do not account for flow in the waterbody. Based on the spray drift analysis, adverse effects to aquatic animals from spray drift alone are likely to occur between 0 and 792 meters from the edge of the treated field with the largest distances accounting for effects to aquatic invertebrate individuals in low-volume, low to no-flow waterbodies (*i.e.*, Bins 2 and 5) following aerial application. For terrestrial and semi-aquatic plants, adverse effects from spray drift are likely to occur between 0 and 305 meters from the edge of the field with the largest distances accounting for effects to terrestrial dicot plant individuals following aerial application. Since adverse effects are not likely for aquatic plants (**Section 6.7**), spray drift is not a concern for that taxa. Details on spray drift exposure for terrestrial and semi-aquatic plant habitat and aquatic animal habitat for each UDL at the different levels of biological organization are discussed in the aquatic animal and plant taxa direct effects analyses in **Section 6** and the distances estimated for all applications methods for each UDL are presented in **Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)**

5.3 Terrestrial Animal Exposure Estimates

5.3.1 Terrestrial Vertebrates

Terrestrial vertebrate species may be exposed to acetamiprid residues as a result of direct spray during application, consumption of residues in prey, dietary items, and drinking water, contact with residues on foliar and soil surfaces, or from incidental ingestion of residues in soil. Terrestrial wildlife exposure estimates for birds, reptiles, amphibians, and mammals typically focus on the dietary exposure pathway (USEPA, 2004), which EPA expects to be the primary route of exposure to acetamiprid residues. Potential dietary exposure for terrestrial vertebrates is based on consumption of acetamiprid residues on food items following spray (foliar) applications and consumption of seeds treated with acetamiprid. EPA conducted separate analyses for these two routes of dietary exposure.

5.3.1.1 Exposure from Foliar Uses

EPA calculated EECs for terrestrial wildlife from consumption of dietary items on the treated field following foliar application using Terrestrial Residue EXposure (T-REX) model (version 1.5.2)[39]. EPA derives dietary exposure estimates for terrestrial animals assumed to be consuming plants and arthropods in an area exposed to spray. The T-REX model incorporates the Kenaga nomograph, as modified by Fletcher *et al.* (1994), which is based on a large set of actual field residue data. The upper-bound and mean exposure values from the nomograph represent an approximation of the highest and average initial residue level observed in the data set for each plant dietary item (Hoerger and Kenaga, 1972). The upper-bound and mean initial residue value for arthropods is based on a Monte Carlo simulation of 100 treatment fields using random sampling of empirical residue data from field and laboratory studies. The upper-bound initial arthropod residue value represents the 90th percentile initial residue value from the 90th percentile simulated treated field. The mean initial arthropod residue values represents the 90th percentile initial arthropod residue from the 50th percentile simulated treatment field. Although mean initial Kenaga values provide a characterization of the central tendency of the distribution of initial pesticide residues, they should not be interpreted as a "typical" (*e.g.*, the most common) initial residue values.

EPA modeled both upper-bound and mean exposure estimates which the Agency considers representative of exposure for different levels of biological organization. Consideration is given to different types of feeding strategies for mammals and birds, reptiles, and terrestrial-phase amphibians, including herbivores, insectivores and granivores. For dose-based exposures, EPA considers the weight of the listed species for species-specific evaluations of adverse effects and EPA considers three generic weight classes of birds (*i.e.,* 20, 100, and 1,000 g) and mammals (*i.e.,* 15, 35, and 1,000 g) in assessing effects to terrestrial vertebrates that serve as PPHD for listed species. Since no other half-life data are available and there is uncertainty in the toxicity of acetamiprid degradates to terrestrial animals, EPA used the default foliar dissipation half-life of 35 days. EPA modeled both single and multiple foliar spray applications of acetamiprid for the registered use within each UDL that would result in the highest exposure as summarized in **Table 20**.

[39] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#t-rex

Table 20. Summary of Use Patterns Selected to Model Terrestrial Estimated Environmental Concentrations (EECs) for Listed Birds, Reptiles, Terrestrial-phase Amphibians, Terrestrial Invertebrates, and Mammals.[1]

UDL	Use Pattern with Highest Exposure		Range of Maximum Single App Rates (lbs ai/A)
	Use Pattern (lbs ai/A)	Use	
Alfalfa	2 x 0.15 + 1 x 0.1, 7-day RI		0.075-0.15
Citrus	2 x 0.249 + 1 x 0.052, 7-day RI	10-10 Citrus Fruit	0.249
Cotton	4 x 0.1, 7-day RI	Cotton	0.1
Developed/ Open Spaced Developed	1 x 0.189, 5 x 0.0375, 7-day RI	Buildings/Structural	0.189
Grapes	2 x 0.101, 14-day RI	13-07F. Small fruiting vine climbing subgroup	0.101
Other Crops	1 x 0.075	Clover	0.075
Other Orchards	4 x 0.18, 14-day RI	Tree nuts	0.15-0.18
Other Row Crops	4 x 0.075, 7-day RI	Tobacco	0.075
Soybean	2 x 0.041, 7-day RI	Soybeans	0.041
Vegetable and Ground Fruit	4 x 0.15, 7-day RI	3-07. Bulb Vegetables and 1C. Tuberous and corm vegetables	0.075-0.15
Nurseries	0.52 x1 + 0.03 x1, 7-day RI	Ornamental	0.15-0.52

RI = retreatment interval; N/A = not applicable because there is only one use pattern for this UDL

[1]Use patterns selected for highest exposure from national registrations. Several special local needs (SLN) registrations permit higher application rates and other applications methods not on the national label in certain states. Terrestrial EECs are separately calculated for these SLNs and EPA considered how these uses would change our effects determinations and predictions of J/AM when a species and CH are located in those states.

Dietary exposure values ranges from 1.1 to 125 mg ai/kg diet and 0.5 to 44 mg ai/kg diet across all potential dietary items for upper-bound and mean residue levels, respectively. Dose-based exposure ranges from 0.04 to 119 and 0.02 to 42.1 mg ai/kg bw for upper-bound and mean residue levels, respectively, in small (15 g), medium (35 g), and large (1000 g) mammals. Dose-based exposure values range from 0.1 to 142 and 0.03 to 50.3 mg ai/kg bw for upper-bound and mean residue levels, respectively, in small (20 g), medium (100 g), and large (1000 g) birds. **Appendix E. Supplemental Tables for Direct Effects Analysis** summarizes estimated dose-based residue levels in plant and insect dietary items for each listed species and the six generic body weight classes as well as estimated dietary residues levels for each UDL.

5.3.1.2 Dietary Exposure from Consumption of Treated Seeds

In addition to foliar spray, acetamiprid is applied as a seed treatment for potatoes, canola, and mustard seeds. Therefore, potential dietary exposure for terrestrial vertebrates in this assessment is also based on possible dietary ingestion of acetamiprid residues on treated seeds. No off-site (drift) is expected from seed treatment applications; however, depending on multiple factors (*e.g.,* seed type, seeding equipment, sticking agents, fluency agents, weather), treated seed coatings may be abraded and may result in drift (dust-off/fugitive dust). However, given the number of factors influencing such events it is not possible to reliably/consistently quantity this route of exposure. EPA modeled seed treatment uses in T-REX based on the default maximum seeding rate values. For the canola and spring mustard seed scenarios, EPA used a maximum application rate of 15.4 fluid ounces of product per 100 weight (fl oz product/cwt). For the seed piece potatoes scenario, EPA used a maximum application rate of 0.3 fl oz product/cwt. Calculation of EECs for treated seeds relied on equations presented in the Interim Guidance for Refinements of Risk Assessment of Pesticide Treated Seeds (USEPA, 2016a) and reproduced below:

- Acute dietary exposure (mg ai/kg bw) = [(seed application rate (mg ai/kg-seed)*daily food intake (g/day)*0.001 kg/g]/body weight of animal (kg)

- Acute exposure ($LD_{50}ft^2$)= [(Application Rate (lbs ai/A)*100,000 mg/kg)/43,560 ft^2*2.2 lb/kg)]

- Chronic dietary exposure =mg/kg-seed

5.3.2 Non-Bee Terrestrial Invertebrates

Non-bee terrestrial invertebrate species may be exposed to acetamiprid residues as a result of direct spray during application, consumption of residues in prey, dietary items, and contact with residues on foliar and soil surfaces. EPA expects dietary and contact exposure from foliar applications to be the primary route of exposure to acetamiprid residues. Dietary exposure is estimated using T-REX based on the same methodology described for terrestrial vertebrates in **Section 5.3.1**. EPA estimates contact exposure based on the T-REX modeled arthropod body burden. For both contact and dietary exposure, EPA uses upper-bound residues to assess exposure to individuals, whereas mean residues are used to reflect exposure in populations and communities. Terrestrial invertebrate species that are granivores may also be exposed to acetamiprid from treated seeds. EPA does not have a model to quantify this route of exposure for terrestrial invertebrates; therefore, there is an uncertainty in assessing effects to invertebrate granivores.

Contact exposure ranges from 7.1 to 49 mg ai/kg bw and 4.9 to 34 mg ai/kg bw based on upper-bound and mean residue levels, respectively. Dietary exposure ranges from 1.1 to 125 mg ai/kg diet and 0.5 to 44 mg ai/kg diet across all potential dietary items for upper-bound and mean residue levels, respectively. **Appendix E. Supplemental Tables for Direct Effects Analysis** summarizes of the dietary and contact EECs for each UDL.

5.3.3 Bees

EPA estimated contact and dietary exposure to listed bee species separately using different approaches specific to different plant exposure assumptions (*e.g.*, direct spray or systemic transport from soil). The Bee-REX model (Version 1.0)[40] calculates default (*i.e.*, high-end, yet reasonably conservative) EECs for contact and dietary routes of exposure for foliar, soil, and seed treatment applications. EPA used the highest single maximum application rate for each UDL reported in **Table 21** to estimate contact and dietary exposure for those UDLs. Additional information on bee-related exposure estimates, and the

[40] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment

calculation of risk estimates in Bee-REX, can be found in the *Guidance for Assessing Pesticide Risks to Bees* (USEPA *et al.*, 2014). Although measured residue data in pollen and nectar are available, EPA relied on the default residue levels for assessing exposure in all levels of biological organization given uncertainty in the available data due to a lack of variability indices (*e.g.,* standard deviation) in the measured values. Notably, the default residues values fall within the range of empirically measured values. For foliar uses, dietary exposure across UDLs range from 0.56 to 7.1 µg ai/bee and 1.3 to 17 µg ai/bee for adults and larvae, respectively; contact exposure estimates range from 0.11 to 1.4 µg ai/bee. Soil-applied treatments are only an application method for uses within the Open Spaced Developed and Developed UDL. Contact exposure is assumed to be similar to that estimated for the foliar uses in this UDL and dietary exposure estimates for adults and larvae ranges from 0.0034 to 0.0074 µg ai/bee. Exposure from seed treatments are likely to occur primarily through the diet. Dietary exposure estimates from residues in treated seeds translocating to pollen/nectar for adults and larvae range from 0.13 to 0.29 µg ai/bee and is assumed to be independent of application rate. **Appendix E. Supplemental Tables for Direct Effects Analysis** summarizes the dietary EECs for adult and larvae bees and contact EECs for adults for each UDL and application method.

5.3.4 Spray Drift for Terrestrial Animal Species

EPA used the AgDRIFT® model (v. 2.1.1) and contact and dietary exposure estimates for foliar applications generated with T-REX and Bee-Rex to estimate the potential distances to the level of concern for taxa in which direct on-field adverse effects were identified. The footprint of off-field spray drift from the agricultural field was calculated by following the Environmental Fate and Effects Division Offsite Transport Guidance (USEPA, 2013b). EPA calculated the fraction of applied acetamiprid for terrestrial animals using the exposure to effects ratios from T-REX that reflect exposure and the likelihood of effects at the use site. EPA determined spray drift distances for the highest exposure use pattern and the highest single application use patterns for each UDL identified in **Table 49**. When considering spray drift exposure to an individual, EPA relied on the distance to adverse effects from the highest exposure use pattern to identify all possible locations where maximum exposure from spray drift could occur. For populations and communities, EPA considers the off-site exposure area from the highest single application use pattern more representative of likely exposure given the low likelihood of multiple applications leaving the field in the same direction. Although drift may occur from dust resulting from abraded treated seed coatings during planting, those residue levels cannot be quantified reliably; therefore, EPA did not consider spray drift in its analysis of seed treatments. The distance at which spray drift exposure is estimated to exceed the threshold of concern for terrestrial animals ranges from 0 to 305 meters from the field depending on the level of biological organization and taxa. **Section 6** contains details on spray drift exposure in terrestrial environments for each UDL at the different levels of biological organization captured in the terrestrial animal taxa direct effects analysis. The spray drift distances estimated for all applications methods for each UDL are presented in **Appendix F. Spray Drift Analysis**

6 Listed Species Draft Effects Determinations and Predictions of the Likelihood of Jeopardy

This section presents the rationale supporting the acetamiprid draft effects determinations and predictions of the likelihood of jeopardy made for the 1,715 listed species as of February 16, 2022.[41] This section is split into eight subsections, each covering a taxon with one or more listed species. Each subsection is further split into three parts. The first part covers the direct effects analysis for individuals, populations, and communities of species from that taxon and how the results inform the likelihood of direct effects to listed species within that taxon and PPHD effects to listed species that rely on that taxon. The second part discusses the PPHD effects that are likely for listed species from that taxon. The final part summarizes the effects determinations/predictions of the likelihood of jeopardy conclusions along with a list of the justifications for each determination/prediction based on the synthesis of the magnitude of effect, spatial overlap, and additional lines of evidence. A list of species with predicted likelihood of jeopardy is provided along with additional details on the effects and routes of exposure driving these predictions. **Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification**includes more detailed information on the species' diet and habitat, its overlap with UDLs, the direct and PPHD effect concerns, magnitude of effect classification, life history modifiers, vulnerability, and the species-specific rationale for effects determination and predictions of the likelihood of jeopardy for each listed species within a taxon.

6.1 Aquatic Invertebrates

6.1.1 Direct Effects

6.1.1.1 Summary of Ecotoxicity Data

Ecotoxicity data are available for 25 different aquatic invertebrate species spanning three phyla: Arthropoda (*i.e.,* aquatic insects and crustaceans), Mollusca (*i.e.,* mussels and aquatic snail), and Annelida (*i.e.,* aquatic worms). For the purposes of this evaluation the estuarine/marine and freshwater species are considered together. There are clear differences in sensitivity between the different phyla represented in the aquatic invertebrate data and generally a wide range of sensitivities are observed within the phyla. **Table 21** presents the most sensitive endpoints for aquatic insects, crustaceans, worms, and mollusks from studies that are acceptable for quantitative use. Among the aquatic invertebrate species tested, acetamiprid ranges from being very highly toxic to slightly toxic on an acute exposure basis.

Aquatic arthropods are the most sensitive phyla tested in both acute and chronic studies with aquatic insects exhibiting the greatest sensitivity overall, consistent with the mode of action for the neonicotinoids which targets the insect nicotinic acetylcholine receptor. The acute lethal concentration causing 50% mortality (LC_{50}) in aquatic insects ranged from 1.99 to 26,600 µg ai/L with a nymph from a species of Mayfly (*Neoclean triangulifer*) exhibiting the greatest sensitivity. In chronic exposure studies, mortality and sublethal effects on growth and development are observed at similar exposure

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[41] This count of endangered and threatened species reflects separate species in addition to listed distinct population segments (DPS) or evolutionarily significant units (ESUs) as of 2023.

concentrations in aquatic insects. Repeated exposure to 0.71 µg ai/L in the water column over 56 days lead to a 47 and 15% reduction in adult emergence and the average number of days to emergence, respectively, in the freshwater midge *Chironomus dilutus*. Chronic exposure for 32 days at same water column concentration resulted in an 83% decrease in adult *N. triangulifer* survival. Crustacean species exhibited a similarly wide range of sensitivity to acute exposure with LC_{50} values ranging from 5.13 to 68,700 µg ai/L. The lowest reported LC_{50} of the crustacean species is in the scud (*Hyalella azteca*) and is comparable in sensitivity to the most sensitive aquatic insect species. Although chronic data are not available for the scud, exposure to 4.7 µg ai/L in the water column for 35 days resulted in an 11% decrease in dry weight in estuarine/marine mysid shrimp (*Americamysis bahia*). Growth and reproductive effects in another crustacean species (*i.e.*, the freshwater waterflea *Daphnia magna*) occurred at concentrations that are orders of magnitude higher (*i.e.,* LOAEC = 9,000 ug ai/L). This disparity in crustacean sensitivity to chronic exposure is consistent with observations in the acute response for these species (mysid LC_{50} = 66 µg ai/L; *D. magna* LC_{50} = 50,000 µg ai/L).

Toxicity data for annelids is limited to acute mortality in a single species, the freshwater blackworm (*Lumbriculus variegatus*). The LC_{50} for this species is 29.9 µg ai/L which is an order of magnitude higher than the most sensitive aquatic insects.

Aquatic mollusk species are the least sensitive of the aquatic phyla represented. Acute toxicity for mollusks are limited to a single species, the estuarine/marine Eastern oyster (*Crasseotrea virginica*), with an EC_{50} of 41,000 µg ai/L for shell deposition, which is comparable to the LC_{50} reported in the least sensitive crustacean species. Chronic toxicity on aquatic mollusks from two open literature studies focused on development and survival effects in two snail species, the freshwater ramshorn snail (*Biomphalaria straminea*) and the freshwater snail *Chilina gibbosa*. In both studies, the study authors established the no observed adverse effects concentration (NOAEC) as the highest concentration tested, which ranged from 1,500 (Cossi *et al.,* 2020; E186703) to 10,000 µg ai/L (Herbert *et al.,* 2021; E186766). The studies were considered reliable for qualitative use only; however, their findings support the conclusion of low sensitivity in aquatic mollusk species relative aquatic insects and crustaceans. Furthermore, these findings and the low acute toxicity are consistent with low toxicity to mollusks reported for the nitroguanidine-substituted neonicotinoids (USEPA, 2023).

Table 21. Most Sensitive Acetamiprid Toxicity Data for Aquatic Invertebrates.

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value	MRID Classification
Arthropoda – Aquatic Insect				
Acute	TGAI (99.9%)	Mayfly (*Neocloeon triangulifer*)	96-h LC_{50} = 1.99 µg ai/L	50776201 Quantitative
Chronic	TGAI (99.9%)	Mayfly (*N. triangulifer*)	NOAEC = 0.50 µg ai/L LOAEC = 1.0 µg ai/L	50776201 Quantitative
Chronic	TGAI (99.9%)	Midge (*Chironomus dilutus*)	NOAEC = 0.50 µg ai/L LOAEC = 1.0 µg ai/L	50776201 Quantitative
Arthropoda - Crustaceans				
Acute	TGAI (99.9%)	Scud (*Hyalella azteca*)	96-h LC_{50} = 5.13 µg ai/L	50776201 Quantitative

Study Type	Test Substance (% a.i.)	Test Species	Toxicity Value	MRID Classification
Chronic	TGAI (99.9%)	Mysid shrimp (*Americamysis bahia*)	NOAEC = 2.5 ug ai/L LOAEC = 4.7 µg ai/L	44651873 Acceptable
Annelida				
Acute	TGAI (99.9%)	Aquatic worm (*Lumbriculus variegatus*)	96-h LC_{50} = 29.9 µg ai/L	50776201 Quantitative
Chronic	Not data available			
Mollusca				
Acute	TGAI	Eastern oyster (*Crassostrea virginica*)	96-h EC_{50} = 41,000 µg ai/L	44988410 Acceptable
Chronic	Available data considered acceptable for qualitative use only. No effects on development or survival observed from 1,500 to 10,000 ug ai/L			

Note: LOQ=limit of quantification; TGAI=Technical Grade Active Ingredient; ai=active ingredient; NOAEC=No-Observed-Adverse-Effect-Concentration; LC_{50}=lethal concentration to 50% of the organisms tested; LOAEC=Lowest-Observed-Adverse-Effect-Concentration; (USEPA, 2011).

Acute toxicity to the degradate included as a residue of concern (*i.e*., IM 1-4) was evaluated in several aquatic invertebrate species. Acute exposure to the freshwater species *D. magna* (MRID 44651868) resulted in 48-hr LC_{50} values of 43,900 µg ai/L. These data indicate that IM 1-4 has similar toxicity to the parent for some freshwater aquatic invertebrates (*i.e.,* both parent and IM 1-4 are classified as slightly toxic on an acute exposure basis). For estuarine/marine invertebrates, an acute toxicity study of IM 1-4 with mysid shrimp (MRID 44651870) resulted in an LC_{50} of 19,000 µg ai/L which is several orders of magnitude less toxic on an acute exposure basis than is the parent compound.

6.1.1.2 Species Sensitivity Distribution

Given the diversity of species represented in the acute data, EPA developed a species sensitivity distribution (SSD) for all aquatic (*i.e*., freshwater and estuarine/marine) invertebrates to visualize differences in sensitivity among the aquatic invertebrates. EPA developed the SSD from LC_{50} values of 20 aquatic invertebrate species using data on the typical end-use product (TEP) and technical grade active ingredient (TGAI). EPA only considered definitive endpoints, and all LC_{50} values are based on 96-hour exposure except for the endpoints in *D. magn*a, *C. riparius*, and *Trichocorixa spp* which reflect mortality after a 48-hour exposure. It is likely that a 96-hour exposure to *D. magn*a, *C. riparius*, and *Trichocorixa spp* would result in an equivalent or more sensitive LC_{50} and inclusion of the 48-hour endpoints in the SSD may result in an underestimation of the HCx. However, were 96-hour data available, it is unlikely to substantially alter the sensitivity distribution given that this would only affect 15% of the species included in the current SSD (3 out of 20). From this SSD of LC_{50} values, EPA derived concentrations of acetamiprid that would be expected to be hazardous (hazard concentration; HC) to 5%, 25%, and 50% (HC_{05}, HC_{25}, HC_{50}, respectively) of all aquatic invertebrates for which data were available. Given the differences in sensitives in the various phyla to acetamiprid, EPA considered developing SSDs separately for aquatic insects and non-insects; however, the HC_x values estimated for aquatic insect and non-insect SSDs were similar to the all aquatic invertebrate SSD. Since there were no clear differences in estimates between the SSDs, EPA relied on the all aquatic invertebrate SSD for the direct effects analysis. **Appendix H. Aquatic Invertebrate Species Sensitivity Distribution** includes more detail on the development of the aquatic invertebrate SSDs.

The LC_{50} values used in the SSD range from 1.99 µg ai/L to 68,700 µg ai/L. The most sensitive species is an aquatic insect, *N. triangulifer* exposed to TGAI, and the least sensitive species is a crustacean, *D. magna*, exposed to the a TEP. **Figure 3** illustrates the highest EEC (*i.e*., LowBerry3CC, 2 aerial applications to berry crops over 3 crop cycles) and lowest aquatic EEC (*i.e*., potato seed treatment) for low volume and medium to large volume waterbodies as they relate to the SSD. These results suggest that approximately 44% and 28% of aquatic invertebrate LC_{50} values would be exceeded in the low volume and medium to large volume waterbodies, respectively, for the highest exposure scenarios. Although not represented in **Figure 3**, the scenario resulting in the lowest EECs will not exceed any of the aquatic invertebrate LC_{50} in any waterbody. These results illustrate the broad-spectrum of potential acetamiprid toxicity to aquatic invertebrate species in aquatic environments that receive runoff and spray drift from treated areas.

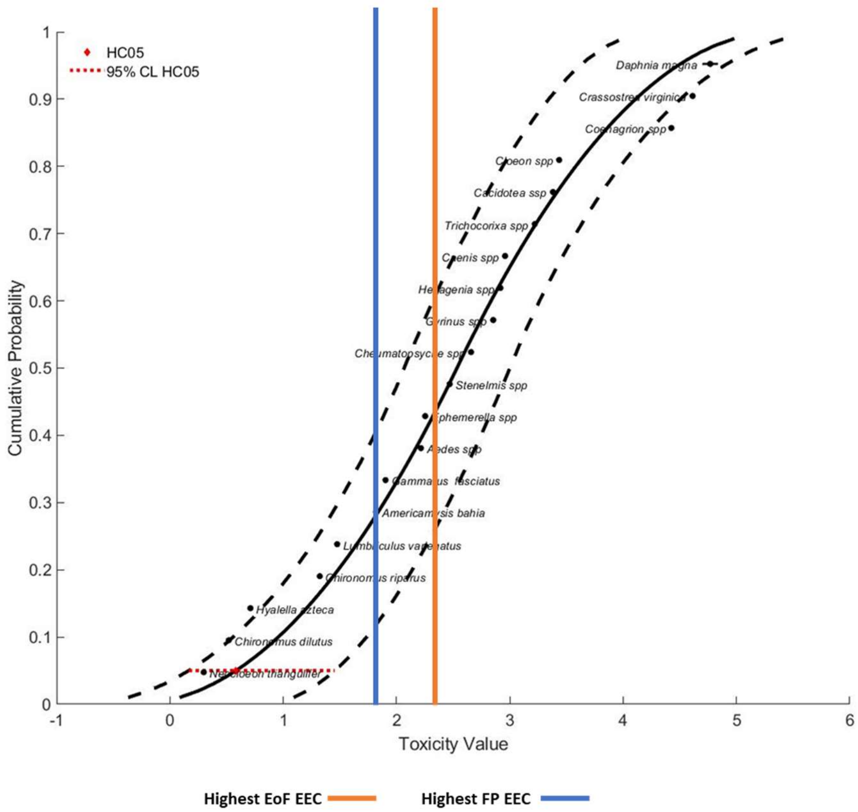

Figure 3. Acetamiprid aquatic invertebrate species sensitivity distribution of 96-hour lethal concentrations to 50% of the organism tested (LC_{50} values). Orange vertical line represents the highest estimated environmental concentration (EEC) based on Edge-of-Field while the vertical blue line represents the highest EEC from EPA standard farm pond. The horizontal red line represents the lower fifth percentile hazard concentration (HC_{05}) 95% confidence interval.

6.1.1.3 Endpoint Selection and Exposure Models

Table 22 summarize the exposure models and endpoints used to evaluate mortality and sublethal effects in aquatic invertebrates from acute and chronic exposure at each level of biological organization. These endpoints are used to estimate an initial exposure/effects ratio for direct effects to aquatic invertebrates. Subsequent characterization including differences in phyla sensitivity is then considered in the final direct effects conclusion. EPA used different aquatic exposure models depending on the aquatic bins as described in **Section 5.2.1**.

Table 22. Description of Toxicity Endpoints and Exposure Models Used in Direct Effects Analysis for Aquatic Invertebrates.

Level of Biological Organization	Exposure Models	Direct Effects	
		Mortality	Growth/Reproduction
Individual	Pesticide in Water Calculator (PWC) v. 2.001 Low-Volume (Bins 2 and 5): Peak 1-in-10 year Peak Edge of Field EECs from PWC Medium/Large-Volume (Bins 3, 4, 6, and 7): 1-in-10 year 1-day (acute) and 21-day (chronic) average in standard farm pond from PWC	Acute: LC_{50} = 1.99 µg ai/L (LOC=0.05) Chronic: NOAEC = 0.5 µg ai/L (LOC = 1.0)	Acute: 96-h EC_{50} = 41,000 µg ai/L (Mollusks only) Chronic: NOAEC = 0.5 µg ai/L (LOC =1.0)
Population		Acute: HC_{05} = 3.83 µg ai/L (LOC = 1.0) Chronic: MATC = 0.71 µg ai/L (LOC = 1.0)	Acute: No endpoint selected Chronic: MATC = 0.71 µg ai/L (LOC = 1.0)
Community		Acute and Chronic: Lower 95% CI of HC_{25} = 13 µg ai/L (LOC = 1.0)	

MATC=maximum acceptable toxic concentration representing the geometric mean of the no-observed adverse effect concentration (NOAEC) and the lowest observed adverse effect concentration (LOAEC). LOC=level of concern.
HC_{05}=hazard concentration representing the lower 5th percentile of the species sensitivity distribution of lethal concentrations to 50% of the organisms tested (LC_{50} values)
CI = confidence interval.

EPA evaluated individual-level effects utilizing the same endpoints and listed species' level of concern employed in the generic taxa screening-level assessment. Acute (LC_{50} = 1.99 µg ai/L) and chronic (NOAEC = 0.5 µg ai/L) toxicity endpoints reflect the response in the most sensitive species evaluated, the aquatic insect *N. triangulifer*. With the exception of the Eastern Oyster, acute data for aquatic invertebrates only reported endpoints based on mortality. Since mollusk species exhibit a unique lack of sensitivity to acetamiprid, the acute growth endpoint reported in the Eastern Oyster is only considered in evaluating sublethal acute direct effects to mollusk species. Acute effects on aquatic insect and crustacean growth and reproduction are not evaluated in this BE. The chronic endpoint for growth/reproduction (NOAEL = 0.5 µg ai/L) is based on a decrease in emergence and time to emergence in another aquatic insect, the chironomid *C. riparius*.

EPA selected the HC_{05} of 3.83 µg ai/L [95% confidence interval (CI): 0.74 – 20 µg ai/L] from the aquatic invertebrate SSD as the endpoint to assess acute effects to aquatic invertebrate populations. EPA developed the SSD from all available data and assumes the SSD reflects all aquatic invertebrate species; therefore, the HC_{05} indicates an effect level where 95% of aquatic invertebrates species exposed will not experience 50% or greater mortality. Since the HC_{05} reflects an exposure concentration that is not likely to elicit mortality that will have a population-level effect in most aquatic invertebrate species and the confidence interval of the HC_{05} encompass the most sensitive acute endpoint for aquatic invertebrates (*i.e.,* LC_{50} = 1.99 µg ai/L), it is considered protective of acute population-level effects that occur in a listed species and a single species or small number of species that form obligate relationships. For chronic exposure in populations, EPA estimated the maximum acceptable toxicant concentration (MATC), which is the geometric mean of the NOAEC and LOAEC, based on most sensitive chronic toxicity endpoints for mortality and growth/reproduction (MATC for all effects = 0.71 µg ai/L). As the most sensitive endpoints, the chronic thresholds are protective of potential population-level effects in all aquatic invertebrate species.

EPA also relied on the aquatic invertebrate SSD to assess effects to aquatic invertebrate communities. EPA first considered the HC_{25} of 50 µg ai/L (95% CI: 13 – 188 µg ai/L) which indicates an effect level where 75% of aquatic invertebrates species exposed will not experience 50% or greater mortality. Since EPA developed the SSD from all available data, it reflects the likely acute response in a diverse aquatic invertebrate community. Few chronic studies are available to quantitatively evaluate sensitivity from repeated exposure; however, the distribution of species sensitivity aligns with the distribution of acute responses: aquatic insects are the most sensitive species tested, mollusks are the least sensitive species, and crustaceans exhibit a range of sensitivities. Based on the SSD, it is likely that the aquatic insects represented in the chronic data are some of the most sensitive species to acetamiprid and that a community of aquatic insects would exhibit a similar range of chronic sensitivities as crustaceans had more species been tested. Given the variation in sensitivity across species, relying on endpoints for the most sensitive species from the chronic studies overestimates adverse chronic effects to aquatic invertebrate communities that consist of species from multiple phyla.

Rather than evaluate acute and chronic responses separately, EPA selected the lower 95% CI of the HC_{25} (*i.e.*, 13 µg ai/L) as the threshold to assess community-level effects for both durations. This threshold is equivalent to HC_{13} where 87% of aquatic invertebrates species exposed will not experience 50% or greater mortality. While chronic mortality and sublethal effects in the most sensitive species are observed at concentrations approximately an order of magnitude below this threshold, the selection of lower 95% CI accounts for the likely variability in chronic response similar to that observed in the acute data. Consequently, EPA believes that for exposures less than this threshold, losses within aquatic invertebrate communities would not likely result in significant adverse species-level effects to listed species that have a generalist relationship with aquatic invertebrate communities for PPHD. As part of characterization for generalist relationships, EPA also considered whether exposure scenarios for each UDL exceeded the HC_{25} (50 µg ai/L) and the HC_{50} (341 µg ai/L), which increases confidence that a community-level effect is likely.

6.1.1.4 Direct Effects Analysis

Listed aquatic invertebrate species include crustaceans, insects, mollusks (*i.e.,* freshwater mussels, nautilus, and snails), and corals. Listed species of aquatic invertebrates and other taxa also rely on aquatic invertebrates for prey. Direct effects to aquatic invertebrate species may result from off-site transport of acetamiprid residues in runoff and spray drift. Since direct application to waterbodies is not permitted for registered uses, with the exception of cranberry bogs which may be treated prior to flooding , direct application to the species aquatic habitat is not a source of exposure.

Table 23 and **Table 24** provide summaries of the initial exposure to effects ratio estimates in low volume and medium to large volume waterbodies, respectively, at different levels of biological organization**.** **Appendix E. Supplemental Tables for Direct Effects Analysis** presents**Appendix D. Aquatic Exposure**

Modeling Input Files and Results Summary includes the acute and chronic aquatic EECs and exposure to effects ratios for all waterbodies for each aquatic modeling scenario.

The representative EECs for all UDLs exceed the individual, population-, and community-level thresholds in low volume to low flow waterbodies (**Table 23**). While most UDLs exceed for both acute and chronic exposure, peak EECs for the Open Spaced Developed and Developed UDLs exceed chronic but not the acute population-level threshold and do not exceed the community-level threshold. With respect to community-level effects, EECs for at least one scenario for all UDLs except Other Grains, Other Crops, Developed and Open Spaced Developed exceed the HC_{25}. Aquatic exposure is, however, not likely to exceed the HC_{50} for any UDL. The EoF EECs used to represent exposure in low volume waterbodies reflect estimated concentrations without dilution or aqueous phase degradation of the acetamiprid in the runoff. Dilution, degradation and other environmental fate processes are likely to reduce the resulting concentrations in low volume/low flow waterbodies over time, rendering EoF ECCs as overestimates of exposure. The EoF EECs, however, do not account for the contribution of spray drift to the aquatic EECs, which are considered in the spray drift analysis (**Appendix F. Spray Drift Analysis**) and in establishing the off-site buffer distance (**Section 6.1.1.5**). There is further uncertainty in estimating chronic exposure to effects ratios in aquatic invertebrates based on a one-day peak aquatic EEC rather than a 21-day average. The EoF values are likely more conservative estimates of the 21-day average concentration than would be predicted based on the standard farm pond. Despite the likely overestimates of exposure in low volume waterbodies based on EoF modeling, direct adverse effects to aquatic invertebrate individuals, populations, and communities are likely for most UDLs given the high magnitude of the exposure relative to the effects thresholds. One exception is the Open Spaced Developed and Developed UDLs. Individual level effects from acute and chronic exposure from uses in these UDLs cannot be discounted in low volume waterbodies; however, the likelihood of adverse population level effects from chronic only exposure will depend on the species' habitat. Low volume aquatic habitat that are not well represented by the EoF model (*i.e.,* subterranean waterbodies), for example, are likely to experience lower exposure compared to modeled concentrations for chronic durations, rendering a population level effect adverse effect less likely to occur in species that occupy these habitats.

Table 23. Direct Effects Analysis Summary for Aquatic Invertebrates Exposed to Acetamiprid in Low Volume Waterbodies (Aquatic bins 2 and 5).

Level of Biological Organization	Acute			Chronic		
	1-in-10-year Peak Edge-of-Field EECs (µg/L)	Exposure-to-Effect Ratio (EEC/Toxicity Endpoint)[1]	UDL Exceedances	1-in-10-year Peak Edge-of-Field EECs (µg/L)	Exposure-to-Effect Ratio (EEC/Toxicity Endpoint)[1]	UDL Exceedances
Individual	0.67 – 223	0.34 – 112	All UDLs	0.67 – 223	1.33 – 446	All UDLs
Population		0.17 – 58.2	All Agricultural UDLs and Nursery UDL		0.94 – 314	All UDLs
Community		0.05 – 17.2	All Agricultural UDLs and Nursery UDL	Based on results of the acute analysis.		

EEC=estimated environmental concentrations; UDL=use data layer

[1] Acute and chronic effects thresholds for each level of biological organization are reported in **Table 22**. For acute effects to aquatic invertebrate individuals, the level of concern (LOC) is 0.05. For all other exposure to effects ratios, the LOC is 1.0.

Exceedances of effects thresholds in medium to large waterbodies vary based on the level of biological organization (**Table 24**). At the individual level, adverse effects from acute exposure are likely for all UDLs whereas chronic adverse effects are likely from all UDLs except Open Spaced Developed and Developed. Aquatic EECs for Open Spaced Developed and Developed UDLs likewise do not exceed the population or community-level thresholds regardless of exposure duration. Adverse acute population effects and community effects are also unlikely for the Other Grains and Other Crop UDLs, but EECs exceed at least one scenario for all other agricultural UDLs and the Nursery UDL. The aquatic bins represented by the farm pond EECs include static medium to large volume waterbodies and lotic waterbodies with moderate to high flow (**Section 5.2.1**). The dimensions of the farm pond are consistent with the representative large volume static waterbodies and, therefore, the modeled EECs and exposure to effects ratios reflect likely adverse effects to aquatic invertebrate individuals, populations, communities that occupy the static medium to large volume waterbodies (*i.e.,* Bins 6 and 7). The farm pond EECs do not, however, account for the impact of flow on exposure within the lotic (flowing) waterbodies (*i.e.,* Bins 3 and 4) and the movement of the pesticide inputs downstream. While EPA expects that flow would reduce (dilute) exposure relative to a static waterbody, it is unlikely that the EECs would decrease such that all UDLs are below the thresholds of concern, even in high-flow waterbodies.

Table 24. Direct Effects Analysis Summary for Aquatic Invertebrates Exposed to Acetamiprid in Medium to Large Volume Waterbodies (Aquatic bins 3, 4, 6, and 7).

Level of Biological Organization	Acute			Chronic		
	1-in-10-year 1-day mean Farm Pond EECs (µg/L)	**Exposure-to-Effect Ratio (EEC/Toxicity Endpoint)[1]**	**UDL Exceedances**	**1-in-10-year 21-day mean Farm Pond EECs (µg/L)**	**Exposure-to-Effect Ratio (EEC/Toxicity Endpoint)[1]**	**UDL Exceedances**
Individual	0.03-63.1	0.02-**31.7**	All UDLs	0.03 – 62.7	0.06 – **125**	All Agricultural UDLs and Nursery UDL
Population		0.01 – **16.7**	Citrus, Other Orchard, Vegetable and Ground Fruit, Cotton, Soybean, Other Row Crops, Nursery		0.05 – **88.3**	All Agricultural UDLs and Nursery UDL
Community		<0.01 – **4.85**	Citrus, Other Orchard, Vegetable and Ground Fruit, Soybean, Other Row Crops, Nursery	Based on results of the acute analysis.		

EEC=estimated environmental concentrations; UDL=use data layer

[1]Acute and chronic effects thresholds for each level of biological organization are reported in **Table 22**. For acute effects to aquatic invertebrate individuals, the level of concern (LOC) is 0.05. For all other exposure to effects ratios, the LOC is 1.0.

Detections of acetamiprid in targeted and non-targeted water quality monitoring studies (**Section 5.2.4**) reached concentrations that exceed the individual level threshold for aquatic invertebrates except in the study (Hladik *et al.* 2014) conducted in areas where acetamiprid has low usage. Notably, in the targeted study (Anderson *et al.* 2013), the mean detected concentration exceeded approached the population level threshold and the maximum detection in both crop and grassland playas in cotton fields exceeded the population and community level threshold.

Although direct effects analysis indicates aquatic invertebrate individual, population-, and community-level effects are likely for all UDLs, there are ranges in sensitivities across phyla represented in the database that alter the expectation of adverse effects. Mollusk species, in particular, exhibit low sensitivity to acetamiprid relative to the other aquatic species tested. The exposure to effects ratios based on all aquatic invertebrate data and skewed by effects in the more sensitive phyla overestimate direct effects to mollusk species. The highest EECs for all waterbodies is 223 µg ai/L which is approximately an order of magnitude below the lowest NOAEC reported in aquatic mollusks (NOAEC = 1,500 µg ai/L for the aquatic snail *B. straminea*). Furthermore, the highest EEC reflects peak exposure in low volume waterbodies whereas the lowest endpoint for aquatic mollusks is based on a lack of effects after 6-30 days for which the average exposure in the low volume waterbody over that duration would likely be lower than the peak estimate. Given that estimated exposure does not exceed the toxicity thresholds for mollusks, there is a low likelihood of direct effects to aquatic mollusk species individuals and populations.

Aquatic insects and non-mollusk non-insects (*e.g.,* worms and crustaceans) exhibited similar ranges of sensitivities and are most prominently represented in the SSD. Consequently, the individual and population-level effects for aquatic invertebrates identified in the direct effects analysis are likely representative of adverse effects in these species.

The relative sensitivity of insects, mollusks, crustaceans, and worms also affect the likelihood of community-level impacts. Listed species may rely on specific aquatic invertebrate phyla or a diverse aquatic invertebrate communities which may increase or decrease their likelihood of adverse effects. The community-level effects reported in **Table 23 and Table 24** above represent potential adverse effects to listed species that either rely on a diverse aquatic invertebrate community or are more narrowly restricted community of aquatic insects and non-mollusk non-insects. Conversely, adverse effects are not likely to aquatic mollusk communities given low toxicity relative to estimate exposure, and therefore, adverse effects to listed species that rely exclusively on mollusk communities are unlikely. Some listed aquatic species (*e.g*., freshwater mussels) also consume zooplankton communities (*e.g.,* ciliates, rotifers, microcrustaceans) as part of their diet. No data are available for ciliates or rotifer; therefore, effects to zooplankton are evaluated based on the sensitivity of the planktonic crustacean *D. magna*. Given the low sensitivity of daphnids to acetamiprid, it is unlikely that the registered uses of acetamiprid will adversely affect zooplankton communities.

6.1.1.5 Off-Site Transport Distances for Aquatic Invertebrates

Given that adverse effects to aquatic invertebrates are likely, EPA determined the extent to which off-site transport will contribute these adverse effects at each level of biological organization to define the exposure area for each UDL. Spray drift and runoff are considered off-site transport routes that may lead to direct effects to aquatic invertebrates. Spray drift distances are established for low volume, low to no-flow waterbodies and moderate to high flow velocity and static medium to large volume waterbodies separately using the dimensions of the aquatic bins and estimated direct depositions of acetamiprid from a single spray application at the single maximum application rate permitted for each UDL (see **Appendix F. Spray Drift Analysis** for spray drift distance calculations). For runoff exposure at the individual, population, and community level, exposure to sheet flow is most likely to occur within 30 m of the field (**Section 3.2**). **Table 25** provides the furthest off-field distances within which spray drift and/or runoff may lead to direct effects to aquatic invertebrate individuals, populations, and communities based on the toxicity thresholds for each level of biological organization. The UDLs are then buffered out by these distances to establish the exposure area when assessing the potential for adverse direct to listed aquatic invertebrate species and listed species that rely on aquatic invertebrates for PPHD.

Table 25. Off-site Transport Distances (meters, m) Used for Estimating Spatial Overlap for Aquatic Invertebrates in Effects Determinations and Predictions of Likelihood of Jeopardy for Acetamiprid[1].

UDL	Common Application Method[2]	Potential for Effects to an Individual[3]		Potential for Effects to a Population[4]		Potential for Effects to a Community[5]	
		Bins 2 & 5	Bins 3, 4, 6, & 7	Bins 2 & 5	Bins 3, 4, 6, & 7	Bins 2 & 5	Bins 3, 4, 6, & 7
Alfalfa	Ground-boom	792 m	90 m	30 m	30 m	30 m	30 m
Citrus	Airblast	792 m	180 m	30 m	30 m	30 m	30 m
Cotton	Ground-boom	792 m	90 m	30 m	30 m	30 m*	30 m
Nursery	Ground-boom	792 m	305 m	30 m	30 m	30 m	30 m
Other Crops	Ground-boom, Seed treatment	792 m	60 m	30 m	30 m	30m*	Adverse effects not likely
Other Grains	Seed treatment	30 m*	30 m*	30 m*	30 m*	30 m*	Adverse effects not likely
Other Orchards	Airblast	792 m	120 m	30 m	30 m	30 m	30 m
Other Row Crops	Ground-boom	792 m	60 m	30 m*	30 m	30 m*	30 m
Soybean	Ground-boom	792 m	30 m	30 m*	30 m	30 m*	30 m
Vegetable and Ground Fruit, NL48 Ag	Aerial	792 m	90 m	90 m	30 m	30 m	30 m
CONUS and NL48 Developed, Open Spaced Developed	Handheld equipment	30 m*	30 m*	30 m*	Adverse effects not likely		

*Runoff is only route of off-site transport likely to contribute to adverse effects because adverse effects are not likely for this UDL at this level of biological organization from residues deposited by spray drift.

[1] These distances reflect exposure at the use site and off-site exposure to spray drift and runoff. If adverse effects are likely for a given UDL, the distance will be at least 30 meters to account for runoff and may be further if spray drift alone is likely to adversely affect aquatic invertebrate. Distances account for acute and chronic effects; however, both acute and chronic effects may not be likely within the entire exposure area based on differences in sensitivity.

UDL	Common Application Method[2]	Potential for Effects to an Individual[3]		Potential for Effects to a Population[4]		Potential for Effects to a Community[5]	
		Bins 2 & 5	Bins 3, 4, 6, & 7	Bins 2 & 5	Bins 3, 4, 6, & 7	Bins 2 & 5	Bins 3, 4, 6, & 7

[2]The common application method for each UDL is considered in establishing the buffer distances for potential effects to populations and communities only (**Section 3.2.1**). The application method among those permitted on the label for a given UDL that results in the largest exposure area (generally aerial) is used to establish the buffer distance for individuals.

[3]Distances are used to establish the exposure area for each UDL for the May Affect/No Effect (MA/NE) and to evaluate direct effects in the Not Likely to Adversely Affect/Likely to Adversely Affect (NLAA/LAA) Determination.

[4]Distances are used to establish the exposure area for each UDL to evaluate direct effects in the predictions of Likely Jeopardy (J) and to evaluate PPHD effects to obligate relationships for the NLAA/LAA Determination and predictions of Likely J.

[5]Distances are used to establish the exposure area for each UDL to evaluate PPHD effects to generalist relationships for the NLAA/LAA Determination and predictions of Likely J.

CONUS=contiguous United States; NL48=non-lower 48 states (includes Alaska, Hawaii, Puerto Rico, U.S. Virgen Islands, U.S. Samoa)

6.1.2 PPHD Effects

Aquatic invertebrates have generalist diet/prey relationships with plants, fish and other aquatic invertebrates and obligate relationships with fish and aquatic non-vascular plants. Based on the generic-taxa based screening-level assessment, registered uses of acetamiprid are likely to have an effect on listed aquatic invertebrate species that have PPHD relationships with upland and semi-aquatic plants and other aquatic invertebrates. The registered uses are further likely to adversely affect aquatic invertebrate populations and communities; therefore, listed aquatic invertebrate species with a generalist or obligate relationship with other aquatic invertebrates for prey are the most likely to experience adverse effects at both the individual and population level. However, the diversity of a species aquatic invertebrate prey will dictate the extent to which a loss of aquatic invertebrate prey will affect the listed species. Based on the direct effects analysis for aquatic invertebrate communities, species that consume a variety of prey items or primarily aquatic insects and/or non-mollusk non-insects are likely to experience a population-level impact. Conversely, listed species whose aquatic invertebrate prey are primarily mollusks or zooplankton are unlikely to experience adverse individual or population-level effects from loss of those prey items. Community-level effects are not likely for upland or semi-aquatic plants (**Section 6.7.4**); therefore, adverse effects related to a decline in shelter availability and integrity and/or water quality as a result of effects to plant communities in riparian areas or in the waterbody are not likely.

Aquatic invertebrate obligate relationships include the Unionidae freshwater mussels which require certain species of freshwater fish to complete their life cycle and coral species which rely on single-celled dinoflagellates referred to as Zooxanthellae. Since adverse population-level effects are not likely for fish (**Section 6.2.3**) or for non-vascular aquatic plants (**Section 6.7.5**), the registered uses are not likely to adversely affect these obligate relationships.

6.1.3 Effects Determinations and Predictions of Likely Jeopardy

Species determinations were made for 174 listed aquatic invertebrate species as of February 16, 2022. A NE determination was made for one of the aquatic invertebrate species. There are NLAA determinations for 140 aquatic invertebrate species and LAA determination for 33 aquatic invertebrate species. Of the 33 aquatic invertebrate species with LAA determinations, EPA predicts that the registered uses of acetamiprid have no potential likelihood to jeopardize (*i.e.,* LAA-Not Likely J) 24 species and there is a likelihood of jeopardy (*i.e*., LAA-Likely J) for 9 species. **Table 26** summarizes the effect determinations for aquatic invertebrates and **Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification**discusses the factors and life history characteristics contributing to each determination and J prediction .

Table 26. Number of Listed Species Effects Determinations and Predictions of Likelihood of Jeopardy for Aquatic Invertebrates from Registered Uses of Acetamiprid.

Taxon	Number of Species[1]	NE	NLAA	LAA-Not Likely J	LAA-Likely J
Aquatic Invertebrates	174	1	140	24	9

J = jeopardy; NE = no effect; LAA = likely to adversely affect; NLAA = not likely to adversely affect.
[1]Reflects the species listed as of February 16, 2022.

Listed Species with NE Determinations

EPA makes NE determinations for species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects (*i.e.*, the species is outside of the action area or has <1% overlap) and for species where direct and PPHD effects are unlikely. All of the aquatic invertebrate species had ≥ 1% overlap and were likely to experience direct or PPHD effects except for the chambered nautilus (*Nautilus pompilius*). Because of dilution, the potential exposure of listed nautilus to acetamiprid is not reasonably expected to reach concentrations high enough to directly affect the species nor are effects to its PPHD likely to result in an impact to the species. EPA, therefore, makes an NE determination for this species.

Listed Species with MA Determinations

For the remaining listed aquatic invertebrates, EPA made MA determinations because of the potential for direct and PPHD effects. For all species designated as MA, EPA further evaluated the listed species for adverse effects to individuals and classified those species as Not Likely to Adversely Affect (NLAA) or Likely to Adversely Affect (LAA).

Not Likely to Adversely Affect (NLAA) Determinations

NLAA determinations are driven by an assessment of the likelihood of direct effects and exposure occurring based on overlap and different habitat characteristics. EPA made NLAA determinations for species that are unlikely to experience adverse direct and PPHD effects, that have a range with <1% overlap with any individual UDL after refining the exposure area to account for likely adverse effects to individuals and with consideration of insecticide usage and crop acreage data from the CoA, and for species where life history indicate the likelihood of exposure and adverse effects is low. The main life history considerations for NLAA determinations included:

- The species is presumed extinct and proposed for delisting by the Services.
- species is found in remote habitats, where exposure is highly unlikely,
- the species is a listed corals and mollusks for which no adverse direct effects or PPHD effects are likely (see detailed section below), or
- the species range is entirely on federal lands where exposure is likely to be low

Corals

Corals are aquatic invertebrates that have a symbiotic relationship with single-celled dinoflagellates. Tidal reversal (fluxes) in freshwater streams and vertical stratification of the freshwater inflow due to differences in salinity and temperature can enhance or reduce the mixing process at the freshwater/marine interface and disperse potential pesticide concentrations that may occur in freshwater streams and rivers that discharge into marine environments, limiting the potential for a pesticide to reach individuals of the listed species. Therefore, because of dilution, the potential exposure of listed corals to acetamiprid is not reasonably expected to reach concentrations high enough to impact an individual. Direct effects to the phytoplankton that are necessary for the survival of coral are also unlikely given low toxicity to non-vascular plants. Based on the information above, EPA makes NLAA determinations for all listed coral species.

Mollusks

Listed mollusks consist of a combination of bivalves (freshwater mussels), gastropods (mostly freshwater snails) and the cephalopod chambered nautilus, which received an NE determination. The majority of the freshwater mussels have an obligate relationship to certain species of fish in which mussel larvae (glochidia) attach to their gills during early development. The unionid mussels are sessile filter feeders, consuming plankton (bacteria, algae, zooplankton) and detritus. The freshwater snails are herbivores, consuming algae, bacteria and fungi from submerged surfaces.

Direct effects to mollusk species are unlikely given their low sensitivity to acetamiprid relative to the estimated exposure in all sized waterbodies. PPHD effects related to dietary items are unlikely given that adverse effects to mollusk species aquatic plant and zooplankton food sources are unlikely. Likewise, the acetamiprid uses are unlikely to have adverse direct effects on fish that freshwater mussels rely on for their reproductive cycle. In terms of habitat, effects are likely for upland and semi-aquatic plants which make up riparian communities surrounding the aquatic habitat of these species. Consequently, an effect on the species as a result of impacts to plants in riparian habitat cannot be discounted. Adverse effects are, however, unlikely for upland and semi-aquatic plant communities indicating a low likelihood that effects to the riparian plants will have an adverse effect on the aquatic habitat of the mollusk species. Based on the information above, EPA makes an NLAA determination for all listed aquatic mollusks.

Likely to Adversely Affect (LAA) Determination

EPA made LAA determinations for species that inhabit areas where exposure is expected to reasonably occur at levels that could cause effects. Based on the weight of evidence, EPA determined listed aquatic insects and crustacean species as LAA either through direct effects and/or from the consumption of aquatic invertebrate prey.

Predictions of Likely Jeopardy

Predictions of likely jeopardy for listed aquatic invertebrates consider the magnitude of effect designations described previously, the extent of spatial overlap between the species range and UDL after refinements, and additional information on life history and vulnerability that can influence the likelihood of a species level effect that could jeopardize its existence. All LAA aquatic invertebrate species have high magnitude of effect due to the likelihood of adverse direct effects. A potential likelihood of future jeopardy is not predicted for species that have low overlap (<5%) with the refined exposure area for any individual UDL or where the CoA data can be used to discount the likelihood of exposure based on low usage of insecticides or low acreage of registered crops for aggregate agricultural UDLs. In addition, no prediction of a likelihood of future jeopardy are made for species where Open Spaced Developed and Developed UDLs are the only use sites with >5% overlap and the species occupies habitat where adverse population level direct effects are unlikely for these UDLs (*i.e.*, subterranean, medium to larger waterbody)

Table 27 summarizes the listed aquatic invertebrate species for which EPA predicts a likelihood of jeopardy from registered uses of acetamiprid. A potential likelihood of future jeopardy is predicted for these species based on the following overlap and life history information:

1) At least one UDL overlaps with >5% of the watershed(s) contributing to their aquatic habitat and CoA data indicate high acreage of insecticide usage and/or crop acreage for aggregate UDLs;
2) The species is a crustacean or aquatic insect
3) The species occupies low volume waterbodies only or in addition to larger volume waterbodies

In addition, all species that are predicted to have potential likelihood of future jeopardy have high vulnerability.

Nine listed aquatic invertebrates are predicted to have potential likelihood of future jeopardy from the currently registered uses of acetamiprid. Spray drift and runoff from the use sites will contribute to direct effects and, for some species, PPHD effects resulting from a decline in aquatic invertebrate prey in the species' aquatic habitat, which are likely to adversely affect the populations of these species.

Table 27. Listed Aquatic Invertebrate Species with Predicted Likelihood of Jeopardy from Use of Acetamiprid.

Entity ID	Common Name (Scientific Name)
475	Hay's Spring amphipod (*Stygobromus hayi*)
480	Alabama cave shrimp (*Palaemonias alabamae*)
481	California freshwater shrimp (*Syncaris pacifica*)
482	Kentucky cave shrimp (*Palaemonias gunteri*)
484	Illinois cave amphipod (*Gammarus acherondytes*)
490	Conservancy fairy shrimp (*Branchinecta conservatio*)
491	Longhorn fairy shrimp (*Branchinecta longiantenna*)
493	Vernal pool fairy shrimp (*Branchinecta lynchi*)
494	Vernal pool tadpole shrimp (*Lepidurus packardi*)

6.2 Fish

6.2.1 Direct Effects

The available data indicate that technical grade acetamiprid and its residue of concern (IM 1-4 are practically non-toxic to freshwater fish on an acute exposure basis, with no significant mortality observed in available acute toxicity tests. In a 96-hr flow-through toxicity test with Rainbow Trout (*Oncorhynchus mykiss*; MRID 44651864), mortality did not exceed 20% after exposure to acetamiprid treatments up to 100,000 µg ai/L (nominal). The resulting 96-hr LC_{50} value is, therefore, non-definitive (*i.e.*, >100,000 µg ai/L). Similar results are observed in the Bluegill Sunfish (*Lepomis macrochirus*; MRID 44651863), although no mortality was observed in this species up to 100,000 µg ai/L. Acute toxicity for IM 1-4 in Rainbow Trout (LC_{50} is >98,100 µg ai/L) is comparable to that of parent. A significant ($p<0.05$) decrease in growth (5.3% decrease in length; 17.6% decrease in wet weight) was detected at 38,400 µg ai/L in a 35-day early life stage toxicity study (MRID 44651872) with Fathead Minnow (*Pimephales promelas*), resulting in a NOAEC value of 19,200 µg ai/L.

Available data suggest that technical grade acetamiprid is slightly toxic to estuarine/marine fish on an acute exposure basis, based on a 96-hr flow-through toxicity test with Sheepshead Minnows (*Cyprinodon variegatus*; MRID 44988711). Mortality was 10 and 90% at the highest two test concentrations (90,000 and 150,000 µg ai/L, respectively), resulting in an LC_{50} value of 100,000 µg ai/L. No chronic toxicity data were submitted for estuarine/marine fish. Although a freshwater acute-to-chronic ratio (ACR) can sometimes be used to estimate the chronic toxicity value for estuarine/marine organisms in the absence of data, the non-definitive acute toxicity value (LC_{50} >100,000 µg ai/L) for freshwater fish, precludes the use of an ACR.

Table 28. Most Sensitive Acetamiprid Toxicity Data for Fish.

Study Type	Test Substance (% ai)	Test Species	Toxicity Value	MRID Classification
Freshwater Fish				
Acute	TGAI (>99%)	Rainbow Trout (*Oncorhynchus mykiss*)	96-h LC_{50} > 100,000 µg ai/L	44651864 Acceptable
	TGAI (100%)	Bluegill sunfish (*Lepomis macrochirus*)	96-h LC_{50} > 100,000 µg ai/L	44651863 Acceptable
	TGAI (>99%)	Rainbow Trout (*O. mykiss*)	96-h LC_{50} > 91,800 µg ai/L	44651864 Acceptable
Chronic	TGAI (100%)	Fathead Minnow (*Pimephales promelas*)	NOAEC = 19,200 µg ai/L LOAEC = 38,400 µg ai/L	44651972 Supplemental
Estuarine/Marine Fish				
Acute	TGAI (100%)	Sheepshead minnow *(Cyprinodon variegatus)*	96-h LC_{50} = 100,000 µg ai/L	44988411 Acceptable
Chronic	No study is available and an acute to chronic ratio could not be calculated from the freshwater data due to the non-definitive acute endpoint.			

TGAI=Technical Grade Active Ingredient; ai=active ingredient; LC_{50}=lethal concentration to 50% of the organisms tested; NOAEC=No-Observed-Adverse-Effect-Concentration; LOAEC=Lowest-Observed-Adverse-Effect-Concentration; > Greater than values designate non-definitive endpoints where no effects were observed at the highest concentration tested, or effects did not reach 50% at the highest concentration tested (USEPA, 2011).

Adverse direct effects are not likely to fish individuals, populations, or communities that occupy medium to large volume waterbodies from the registered uses of acetamiprid based on the conclusions of the generic taxa-based screening-level assessment (**Section 2.3.2**). Although the screening level analysis did not assess risk to fish in low-volume waterbodies, the most sensitive acute (96-h LC_{50} = 100,000 µg ai/L) and chronic (NOAEC =19,200 µg ai/L) endpoints for fish are two or more orders of magnitude above the highest peak EoF value (*i.e.*, 223 µg/L) which indicates there is low likelihood of adverse direct effects to fish in low volume waterbodies as well. Consequently, direct effects are not likely for listed fish species in any waterbody nor are the currently registered uses likely to affect listed species through their obligate or generalist relationships with fish.

6.2.2 PPHD Effects

Listed fish species have generalist diet/prey relationships with aquatic plants, invertebrates, and other fish. In the absence of data to the contrary,, EPA assumed all listed fish species have a generalist relationship with upland, semi-aquatic, and/or aquatic plants for habitat if not explicitly stated in the habitat description. EPA searched through Services documentation to further define the plant relationships for each listed fish species. Semi-aquatic or aquatic plants are explicitly identified for some listed fish species as an important component of their habitat. EPA also assumed that all fish species are rely on riparian plant communities to maintain high water quality whether or not it is explicitly stated. None of the listed fish species have reported obligate relationships. Based on the generic-taxa based screening-level assessment, effects are likely for listed fish species with relationships to upland and semi-aquatic plants and invertebrates.

For the potential effect to translate to an individual or population-level effect to listed fish via a reduction in the food availability or habitat, EPA believes that aquatic and terrestrial invertebrates and plants would need to experience community-level impacts. Since the registered uses are likely to adversely affect aquatic and terrestrial invertebrate communities (**Section 6.1** and **Section 6.3**), listed fish species with a generalist relationship with aquatic and terrestrial invertebrates for prey are the most likely to experience adverse effects at both the individual and population level. However, the diversity of a species aquatic invertebrate prey will dictate the extent to which a loss of aquatic invertebrate prey will affect the listed species. Based on the direct effects analysis for aquatic invertebrate communities, species that consume a variety of prey items or primarily aquatic insects and/or non-mollusk non-insects are likely to experience a population-level impact. Conversely, listed species whose aquatic invertebrate prey are primarily mollusks or zooplankton are not likely to experience adverse individual or population-level effects from loss of those prey items. For species that consume terrestrial prey, a decline in that prey base is most likely to result in adverse effects to listed fish if it consumes terrestrial invertebrate species that have an aquatic-phase, where effects in the species habitat are likely, and/or acetamiprid use sites are in proximity to the fish species' aquatic habitat which increase the likelihood that terrestrial-phase invertebrates are exposed. Community-level effects are not likely for aquatic plants (**Section 6.7**) or fish; therefore, species that have a generalist relationship with these taxa are unlikely to experience adverse effects related to a decline in these prey/dietary items or loss of aquatic plant habitat in all waterbodies. Species whose diet includes consuming fish or phytoplankton in addition to invertebrates are also less likely to experience population-level adverse effects unless invertebrates are its primary prey item.

6.2.3 Effects Determinations and Predictions of Likely Jeopardy

EPA made determinations for 170 fish species listed as of February 16, 2022. One species, the Snail darter, has been delisted due to recovery since February 2022. No NE determinations are made for listed fish species. There are NLAA determinations for 47 fish species and LAA determination for 122 fish species. Of the 122 fish species with LAA determinations, EPA predicts that the registered uses of acetamiprid have no potential likelihood to jeopardize 112 species and predicts a potential likelihood of future jeopardy for 10 species. **Table 29** summarizes the determinations for listed fish and **Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification**discusses factors and life history characteristics contributing to each determination and J prediction.

Table 29. Number of Listed Species Effects Determinations and Predictions of Likelihood of Jeopardy for Fish from Registered Uses of Acetamiprid.

Taxon	Number of Species	NE	NLAA	LAA-Not Likely J	LAA-Likely J
Fish	170*	0	47	112	10

J = jeopardy; NE = no effect; LAA = likely to adversely affect; NLAA = not likely to adversely affect.
* Total does not equal the sum of the determinations/predictions of jeopardy because one species has been delisted due to recovery.
[1]Reflects the species listed as of February 16, 2022.

Listed Species with No Effect (NE) Determinations

No NE determinations were made since all species are likely to experience PPHD effects based on relationships with invertebrates and had either >1% overlap with at least one UDL or the species did not have a range GIS file.

Listed Species with May Affect (MA) Determinations

EPA made a MA determination due to the potential for PPHD effects from consumption of terrestrial or aquatic non-mollusk invertebrate prey. For all species designated as MA, EPA considered the overlap applied life history modifiers, and species and were then classified as either NLAA or LAA.

Not Likely to *Adversely Affect (NLAA)*

NLAA determinations are driven by an assessment of the likelihood of adverse effects and exposure occurring based on different habitat characteristics. Since there are no direct effects identified for listed aquatic vertebrates regardless of waterbody type, the NLAA determinations were driven by the likelihood of PPHD effects via reductions in terrestrial or aquatic non-mollusk invertebrate prey as well as the likelihood of exposure based on habitat type. EPA made NLAA determinations for species that are unlikely to experience adverse direct and PPHD effects, that have a range with <1% overlap with any individual UDL after refining the exposure area to account for likely adverse effects to individuals and with consideration of insecticide usage and crop acreage data from the CoA, and for species where life history indicate the likelihood of exposure and adverse effects is low. The main life history considerations for NLAA determinations included:

- habitat is primarily the open ocean where exposure is likely to be insignificant (**Appendix I. Qualitative Analysis Approach**);
- the species is likely extinct and proposed for delisting (*e.g.,* the Scioto madtom; *Noturus trautmai*)

Likely to *Adversely Affect (LAA)*

Of the MA species, LAA determinations were driven by an assessment of the likelihood of PPHD effects from the diet and exposure occurring based on different habitat characteristics. Species designated as LAA had both the potential for PPHD effects from the consumption of non-mollusk aquatic invertebrate prey and inhabit areas where exposure is reasonable expected to occur at levels that could cause effects.

Listed Species with Potential Jeopardy Determinations

The predictions of likely jeopardy for listed fish consider the magnitude of effect designations described previously, the extent of spatial overlap between the species range and UDL after refinements, and additional information on life history and vulnerability that can influence the likelihood of a species level effect that could jeopardize its existence. All LAA listed fish species have medium magnitude of effect based on their generalist relationships with terrestrial and/or aquatic invertebrates. A potential likelihood of future jeopardy is not predicted for species that have low overlap (<5%) with the refined exposure area for any individual UDL or where the CoA data can be used to discount the likelihood of exposure based on low usage of insecticides or low acreage of registered crops for aggregate agricultural UDLs. In addition, no prediction of a likelihood of future jeopardy are made for species where Open Spaced Developed and Developed UDLs are the only use sites with >5% overlap and the species occupies habitat where adverse population level direct effects are unlikely for these UDLs (*i.e.*, subterranean, medium to larger waterbody). Additional reasons for predicting no likelihood of future jeopardy include:

- The species' habitat is medium to high flowing waterbodies only and modeled concentrations are within 2x of the community level threshold for aquatic invertebrates. Dilution in these habitats is not accounted for in modeling but is likely to result in concentrations at levels that will not adversely affect the aquatic invertebrate prey base.
- The species is an opportunistic or generalist consumer and its dietary items include invertebrates in addition other dietary items that are not likely to be adversely affected by the registered uses

Table 30 summarizes the listed fish species for which EPA predicts a potential likelihood of future jeopardy from registered uses of acetamiprid. A potential likelihood of future jeopardy is predicted for these species based on the following overlap and life history information:

- At least one UDL overlaps with >5% of the watershed(s) contributing to their aquatic habitat and, when available, CoA data indicate high acreage of insecticide usage and/or crop acreage for aggregate UDLs;
- Species spends some or all of its life cycle in low to slow-flowing water bodies and/or shallow waterbodies; and,
- Terrestrial insects and/or aquatic insects and crustaceans are the species preferred or only source of prey for some or all of the species life cycle.

In addition, all listed species that are predicted to have a potential likelihood of future jeopardy are medium to high vulnerability (or not specified which is assumed to be high).

Ten listed fish species are predicted to have a potential likelihood of future jeopardy from the currently registered uses of acetamiprid. Runoff from the use site are likely to adversely affect aquatic invertebrate communities, particularly aquatic insect and non-mollusk non-insect species, in waterbodies where these listed fish species reside. Depending on the UDL, spray drift is also likely to contribute to adverse effects in aquatic invertebrate communities. The resulting decline in prey availability is likely to affect the fish species survival, growth, and reproduction leading EPA to predict that there is a likelihood of jeopardy for these species resulting from the pesticide action.

Table 30. Listed Fish Species with Predicted Likelihood of Jeopardy as a Result of Registered Uses of Acetamiprid.

Entity ID	Common Name (Scientific Name)
239	Slackwater darter (*Ethestoma boschungi*)
2514	Chinook salmon (*Oncorhynchus* (=Salmo) *tshawytscha*)
2528	Steelhead (*Oncorhynchus* (=Salmo) *mykiss*)
4093	Green sturgeon (*Acipenser medirostris*)
4274	Steelhead (*Oncorhynchus* (=Salmo) *mykiss*)
4248	Grotto Sculpin (*Cottus specus*)
4300	Chinook salmon (*Oncorhynchus* (=Salmo) *tshawytscha*)
5288	Carolina madtom (*Noturus furiosus*)
7332	Spring pygmy sunfish (*Elassoma alabamae*)
7855	Chinook salmon (*Oncorhynchus* (=Salmo) *tshawytscha*)

6.3 Terrestrial Invertebrates

6.3.1 Direct Effects

6.3.1.1 Summary of Ecotoxicity Data

Ecotoxicity data are available for 7 different terrestrial invertebrate species spanning two phyla: Arthropoda (*i.e.,* terrestrial insects, beetles, arachnids) and Annelida (*i.e.,* terrestrial worms). Within the phylum Arthropoda, a majority of the studies are on insect species (Class: Insecta) and primarily *Apis* and non-*Apis* bees. Additional semi-field and field studies on *Apis* bees are also available for characterization. **Table 29** presents the most sensitive endpoints for terrestrial invertebrates for contact and dietary toxicity from studies that EPA classified as acceptable for quantitative use. Among the terrestrial invertebrate species tested, acute toxicity classifications for acetamiprid range from highly toxic to practically non-toxic on an acute oral and contact exposure basis.

Acute contact toxicity data are available for insect species from the Order Hymenoptera, annelid species from the Order Lumbriculida, and arachnid species from the Orders Parasitiformes and Trombidiformes. Exposure in these studies was the result of contact with a surface containing acetamiprid residues or from direct application to the organism. Mortality or survival were the only apical endpoints reported in the contact studies. Toxicity endpoints are reported in terms of dose (mg ai/kg bw or mg ai/organism) and application rate (lbs ai/A) and exposure durations ranged from 1 to 4 days. EPA made an effort to normalize all dose-based endpoints to mg ai/kg bw or mg ai/bee to compare sensitivity across species and Orders; however, the lack of body weight information for the test species precluded normalization of several endpoints identified in the open literature.

Contact dose-based endpoints are available for Hymenopteran species including several species of honey bee (*i.e*., *Apis mellifera* and *Apis cerana japonica*) and one species of bumble bee (*Bombus terrestris*) with reported acute contact LD_{50} values ranging from 3.71 to >500 mg ai/kg bw and 0.000278 to >0.100 mg ai/bee The most sensitive species tested is the Asian honey bee (*A. cerana japonica*). The least sensitive species tested is *B. terrestris*; however, it should be noted that its acute contact endpoint is based on exposure to a TEP and it is uncertain how the toxicity of this TEP relates to the TGAI.

Contact application rate-based endpoints are reported in the open literature for terrestrial insect (Cheng *et al.*, 2018), annelid (Saggioro *et al.*, 2019), and arachnid (Cheng *et al.*, 2021) species based on mortality only. Acute LC_{50} values range from 0.00029 to 0.13 lbs ai/A. The most sensitive species tested was the Parasitic wasp (*Trichogramma dendrolimi*) and, in general, terrestrial insects and annelids exhibited greater sensitivity to acetamiprid compared to the arachnids species [Predatory mite (*Neoseiulus cucumeris*) and Carmen spider mite (*Tetranychus cinnabarinus*)]. Notably, the concentration of the spray solutions were not analytically confirmed in these studies; therefore, the reported endpoints are only reliable for qualitative characterization. No reliable data are available to assess repeated contact exposure to the TGAI.

Dietary

Acute and chronic dietary toxicity data are available for insect species from the Order Hymenoptera only. In acute studies, species were exposed to acetamiprid in the diet for 48 hours and mortality was the primary endpoint assessed. In chronic toxicity studies, exposure duration ranged from 4 to 10 days and endpoints assessed include mortality in adults and larvae, and development in larvae. Endpoints are reported in terms of dose (mg ai/bee) and dietary concentration (mg ai/kg diet).

Dose and dietary-based acute endpoints for dietary exposure are reported for the Western honey bee (*A. mellifera*) adults and larvae and adults for a species of bumble bee (*B. terrestris*). Acute contact LD_{50} values in adults range from >0.0102 to 0.0223 mg ai/bee (studies did not report endpoints in mg ai/kg diet). The acute contact LD_{50} for larvae is 0.000116 mg ai/bee and the LC_{50} is 35.12 mg ai/kg-diet. The most sensitive species tested in adults and larvae is *A. mellifera*.

Chronic dietary toxicity data are available for the Western honey bee only. Chronic exposure adult honey bees to acetamiprid in their diet for 10 days resulted in 20-100% mortality at dietary doses equal to or greater than 0.00741 mg ai/bee (158 mg ai/kg-diet). In larval bees, exposure for 4 days to 0.00035 mg ai/larva in the diet resulted in cumulative mortality of 29% and a 33% reduction in adult emergence. The acute and chronic dietary data indicate enhanced sensitivity of bee larvae relative to adult bees to acetamiprid exposure.

EPA did not include other contact and dietary toxicity studies identified in the open literature in this analysis because the studies involved non-traditional exposure methods for contact (*i.e.*, dipping eggs in exposure solution), use of a formulation that is not registered in the United States, study did not include a negative control or report on purity of the test substance, or the endpoints could not be converted to dose or application rate-based units. No acceptable quantitative data are available for soil-dwelling organisms reported in units of mg ai/kg soil nor are data available to evaluate toxicity in terrestrial mollusk species (*e.g.*, tree or ground-dwelling snails).

Table 31. Most Sensitive Acetamiprid Toxicity Data for Terrestrial Invertebrates.

Study Type	Test Substance (% ai)	Test Species	Toxicity Value	MRID Classification
Contact				
Acute - Adult	TGAI (98%)	Asian honey bee (*Apis cerana japonica*)	48-h LD_{50} = 0.000278 mg ai/bee (3.7 mg ai/kg bw)	E183780 Quantitative
Dietary				

Study Type	Test Substance (% ai)	Test Species	Toxicity Value	MRID Classification
Acute - Adult	TGAI (99.8%)	Western honey bee (*Apis mellifera*)	LD_{50} = 0.011 mg ai/bee LC_{50} = 165 mg ai/kg diet	50015702 Supplemental
Acute – Larval	TGAI (99.9%)	Western honey bee (*A. mellifera*)	72-hr LD_{50} = 0.00116 mg ai/bee 72-hr LC_{50} = 35.12 mg ai/kg diet	50581901 Acceptable
Chronic – Adult	TGAI (99.8%)	Western honey bee (*A. mellifera*)	NOAED = 0.00242 mg ai/bee LOAED = 0.00741 mg ai/bee NOAEC = 73.6 mg ai/kg diet LOAEC = 158 mg ai/kg diet	50015702 Supplemental
Chronic - Larval	TGAI (99.9%)	Western honey bee (*A. mellifera*)	NOAED = 0.00012 mg ai/bee LOAED = 0.00035 mg ai/bee NOAEC = 3.06 mg ai/kg diet LOAEC = 9.03 mg ai/kg diet	50581902 Acceptable

TGAI=Technical Grade Active Ingredient;; NOAEC=No-Observed-Adverse-Effect-Concentration; LD_{50}/LC_{50}=lethal dose/concentration to 50% of the organisms tested; LOAELLOAEC=Lowest-Observed-Adverse-Effect-Concentration; > Greater than values designate non-definitive endpoints where no effects were observed at the highest concentration tested, or effects did not reach 50% at the highest concentration tested (USEPA, 2011).

Several semi-field studies and one full-field study assessed the impacts of acetamiprid applications in more environmentally relevant settings and provided measurements of residues in pollen in nectar. The study results are summarized briefly here and discussed in more detail in the 2017 PRA (USEPA, 2017).

In one semi-field tunnel study (MRID 49342201), two applications of an acetamiprid TEP (Mospilan™ 20 SG; 20.4% ai) to phacelia (*Phacelia tanacetifolia*) at a rate of 0.089 lbs ai/A with an 8-day retreatment interval resulted in a transitory decline in the number of foraging Western honey bees after the second application but no statistically significant effects on overall colony performance or other endpoints assessed the study. Colonies were not monitored beyond 21 days (*i.e.*, a single brood[42] cycle) after the exposure phase of the study; therefore, there is uncertainty regarding any potential long-term effects over multiple brood cycles. No statistically significant effects on mortality, flight frequency, or foraging behavior were observed in two other tunnel studies (MRIDs 45932504 and 45932505) which exposed Western honey bees via both contact and dietary exposure from a single application of 0.09 and 0.15 lbs ai/A.

In the full-field study (MRID 50091901), another acetamiprid TEP (Acetamiprid™ 20 SG; 20.44% ai) was applied to full bloom phacelia at a rate of 0.089 lbs ai/A during Western honey bee foraging, and twice at rates of 0.089 and 0.067 lbs ai/A after honey bee foraging activities. No effects on colony health were observed in the acetamiprid treatment group relative to controls; however, only a single replicate was tested which limits the studies ability to detect treatment related effects. Acetamiprid residues measured in pollen and nectar peaked on the day of application, ranging from 2.05-16.96 mg ai/kg and 1.17-5.60 mg ai/kg, respectively, across the three treatments, and declined to below the limit of detection (LOD=0.003 mg/kg) by 14 days after application. Residues were also measured in bees on the

[42] The brood cycle is the time required for the bee to transition from an egg to an adult; this period includes larval and pupal develop and end at adult eclosion.

day of application and ranged from 0.02-0.15 mg/kg across the three treatment groups. Notably, this study did not provide sufficient data to estimate the amount of variability that was associated with these estimates.

In a separate tunnel study (MRID 50015701), canola at full bloom was treated with a single foliar application of an acetamiprid TEP (Acetamiprid™ 20 SG; 19.9% ai) at rate of 0.045 lbs ai/A and residues were measured in honey-bee collected pollen and nectar at 3 and 6 days after application, and comb honey and canola plants at 20 days after application. Residues in bee-collected pollen and nectar ranged from 0.104 to 0.178 mg ai/kg and <0.01 mg ai/kg (limit of quantification; LOQ) to 0.128 mg ai/kg, respectively, with levels declining in both pollen and nectar from day 3 to day 6. At 20 days after application, residues in comb honey were below the LOD or LOQ and maximum residues in the canola plant were 0.013 mg/kg. There is uncertainty however regarding the extent to which the formulation of acetamiprid used in the study is representative of products registered in the U.S. and their maximum application rates. Also, rain events during the study may have affected exposure (*i.e.*, the extent to which bees may have been foraging as well as the extent to which acetamiprid was available for uptake/distribution by the plants).

An additional study was also conducted to investigate the residual contact toxicity of acetamiprid on foliar surfaces. Application of acetamiprid TEP at a rate of 0.18 lbs ai/A to alfalfa resulted in no observed lethality to introduced honey bees. Consequently, the residual time to 25% or lower mortality (*i.e.*, the RT25) is less than 3 hours. These data suggest bees are likely to experience low toxicity from contact with treated foliar surfaces; however, it should be noted that the species tested is not the most sensitive to contact exposure based on available data and that the application rate evaluated is lower than the maximum permitted single rate across all registered uses.

6.3.1.2 Species Sensitivity Distribution

EPA did not develop terrestrial invertebrate SSDs for acetamiprid. While data on multiple species are available for dietary and contact toxicity, inconsistencies in the units reported and exposure methodology limited the number of studies and species that could be grouped together into an SSD. Reporting deficiencies further rendered many of the studies identified in the open literature unreliable for quantitative use; therefore, these studies could not be incorporated into an SSD.

EPA developed dietary and contact SSDs for the nitroguanidine-subsitituted neonicotinoids based on data for imidacloprid (USEPA, 2023). EPA elected not to use these SSDs quantitatively in the acetamiprid BE based of the lower sensitivity of terrestrial insects to cyano-substituted neonicotinoids compared to the nitroguanidine-subsituted neonicotinoids. **Table 32** below provides a comparison of species where toxicity data are available for both acetamiprid and imidacloprid. The comparison is limited to *Apis* bees since quantitative data for acetamiprid are not available for other non-bee terrestrial invertebrate species. For studies where a comparison could be made, *Apis* species are several orders of magnitude more sensitive to acute contact and dietary exposure of imidacloprid compared to acetamiprid. These findings are consistent with research by Iwasa *et al.* (2004) summarized in the 2017 PRA (USEPA, 2017). The study authors observed lower sensitivity in honey bees to acetamiprid compared to the nitro-subsituted neonicotinoids and concluded that cytochrome P450 enzymes were an important mechanism for detoxification of acetamiprid in bees based on evidence of enhanced toxicity when acetamiprid was co-exposed with the P450 inhibitor, piperonyl butoxide.

Table 32. Comparison of Acetamiprid and Imidicloprid Toxicity Endpoints for Honey bees (*Apis spp.*).

Exposure Route and Duration	Test Species	Acetamiprid Endpoint	Imidacloprid Endpoint
Contact			
Acute Contact - Adult	Asian honey bee (*Apis cerana*)	LD_{50} = 0.000278 mg ai/bee	LD_{50} = 0.0000036 mg ai/bee
	Western honey bee (*Apis mellifera*)	LD_{50} < 0.0125 mg ai/bee (<97.7 mg/kg-bw[1])	LD_{50} = 0.000043 mg ai/bee (range from BE: 0.021-0.52 mg/kg-bw[1])
Dietary			
Acute Dietary – Adult	Western honey bee (*A. mellifera*)	LD_{50} = 0.011 mg ai/bee	LD_{50} = 0.0000039 mg ai/bee
Acute Dietary – Larval	Western honey bee (*A. mellifera*)	LD_{50} = 0.00116 mg ai/bee	No endpoint reported

ai=active ingredient; LD_{50}=lethal dose to 50% of the organisms tested
[1]Honey bee endpoints are reported in terms of mg ai/bee and are converted to mg/kg-bw using the default Western honey bee weight of 0.128 g.

6.3.1.3 Endpoint Selection and Exposure Models

Table 33 and Table 34 below summarize the exposure models and endpoints used to evaluate mortality and sublethal effects in terrestrial invertebrates from acute and chronic contact and dietary exposure, respectively, at each level of biological organization. Larval and adult endpoints are reported for dietary exposure; however, only adult toxicity data were available to establish contact toxicity thresholds. These endpoints are used to estimate an initial exposure/effects ratio for direct effects to terrestrial invertebrates. Subsequent characterization including differences in phyla sensitivity and exposure potential is then considered in the final direct effects conclusion.

Table 33. Description of Acetamiprid Contact Toxicity Endpoints and Exposure Models Used in Direct Effects Analysis for Terrestrial Invertebrates.

Level of Biological Organization	Exposure Models	Terrestrial Invertebrate Taxa	
		Bees	Non-Bee Invertebrates
Individual	On-Site: BeeREX v. 1.0 (bees) and T-REX v. 1.5.2 (non-bees) Off-Site: AgDrift® v. 2.1.1 Bees: Contact exposure estimated in accordance with 2016 guidance Non-Bees: Upper-bound residues for arthropods	Acute: LD_{50} = 0.000278 mg ai/bee (LOC=0.05) Chronic: No data available	Acute: LD_{50} = 3.7 mg ai/kg bw (LOC=0.05) Chronic: No data available

Level of Biological Organization	Exposure Models	Terrestrial Invertebrate Taxa	
		Bees	Non-Bee Invertebrates
Population	On-Site: BeeREX v. 1.0 (bees) and T-REX v. 1.5.2 (non-bees) Off-Site: AgDrift® v. 2.1.1 Bees: Contact exposure estimated in accordance with 2016 guidance Non-Bees: Mean residues for arthropods	Acute: LD_{10} = 0.000012 mg ai/bee (LOC=1.0) Chronic: No data available	Acute: LD_{50} = 0.16 mg ai/kg bw (LOC=1.0) Chronic: No data available
Community		Acute: LD_{50} = 0.000278 mg ai/bee (LOC=1.0) Chronic: No data available	Acute: LD_{50} = 3.7 mg ai/kg bw (LOC=1.0) Chronic: No data available

LD_x = lethal dose to x% of the organisms tested (in this case, x is either 10 or 50%); LOC = level of concern

Table 34. Description of Acetamiprid Dietary Toxicity Endpoints and Exposure Models Used in Direct Effects Analysis for Terrestrial Invertebrates.

Level of Biological Organization	Exposure Models	Terrestrial Invertebrate Taxa	
		Bees	Non-Bees
Individual	On-Site: BeeREX v. 1.0 (bees) and T-REX v. 1.5.2 (non-bees) Off-Site: AgDrift v. 2.1.1 Bees: Default residues in pollen and nectar estimated in BeeREX Non-Bees: Upper-bound residues for reported dietary items	<u>Larvae</u> Acute: LD_{50} = 0.00116 mg ai/bee (LOC=0.05) Chronic: NOAEL = 0.00012 mg ai/bee (LOC =1.0) <u>Adult</u> Acute: LC_{50} = 0.0111 mg ai/bee (LOC=0.05) Chronic: NOAEC = 0.00242 mg ai/bee (LOC =1.0)	Acute: LC_{50} = 35 mg ai/kg diet (LOC=0.05) Chronic: NOAEC = 3.06 mg ai/kg diet (LOC =1.0)
Population	On-Site: BeeREX v. 1.0 (bees) and T-REX v. 1.5.2 (non-bees) Off-Site: AgDrift v. 2.1.1 Bees: Default residues in pollen and nectar estimated in BeeREX	<u>Larvae</u> Acute: LD_{10} = 0.00015 mg ai/bee (LOC=1.0) Chronic: MATL = 0.00021 mg ai/bee (LOC =1.0)	Acute: LC_{10} = 4.40 mg ai/kg diet (LOC=1.0) Chronic: MATC = 5.26 mg ai/kg diet (LOC =1.0)

Level of Biological Organization	Exposure Models	Terrestrial Invertebrate Taxa	
		Bees	Non-Bees
	Non-Bees: Mean residues for reported dietary items	Adult Acute: LC_{10} = 0.00635 mg ai/bee (LOC=0.05) Chronic: MATC = 0.00423 mg ai/bee (LOC =1.0)	
Community		Larvae Acute: LC_{50} = 0.00116 mg ai/bee (LOC=1.0) Chronic: MATL = 0.00021 mg ai/bee (LOC =1.0) Adult Acute: LC_{50} = 0.0111 mg ai/bee (LOC=1.0) Chronic: MATC = 0.00423 mg ai/bee (LOC =1.0)	Acute: LC_{50} = 35 mg ai/kg diet (LOC=1.0) Chronic: MATC = 5.26 mg ai/kg diet (LOC =1.0)

NOAEC/NOAEL= No-Observed-Adverse-Effect-Concentration/Level; LC_x/LD_x = lethal concentration or lethal dose to x% of the organisms tested (in this case x is either 10 or 50%); LOAEC/LOAEL=Lowest-Observed-Adverse-Effect-Concentration/Level; MATL/MATC=maximum acceptable toxic level/concentration representing the geometric mean of the no-observed adverse effect level/concentration (NOAEL/NOAEC) and the lowest observed adverse effect level/concentration (LOAEL/LOAEC); LOC = level of concern

Since an SSD could not be developed, thresholds for individuals, populations, and communities are based on the most sensitive terrestrial invertebrate species, which for both contact and dietary exposure are *Apis* bee species. The endpoints for bee species are reported in units of µg ai/bee which are used to evaluate contact and dietary exposure to bees using BeeREX -generated exposure levels in pollen and nectar (**Section 5**). For non-bee terrestrial invertebrates, EPA based dietary toxicity thresholds on dietary toxicity endpoints reported in the bee studies as mg ai/kg diet. EPA calculated contact thresholds by normalizing the µg ai/bee endpoints to mg ai/kg bw using the default or reported bee weight for the tested species. EPA assessed exposure for non-bee terrestrial invertebrate species based on upper-bound or mean residues in dietary items and arthropods modeled in T-REX (**Section 5**).

Contact thresholds are based on acute mortality in the Asian bee (*A. cerana japonica*). The LC_{50} is 0.278 µg ai/bee which is equivalent to 3.7 mg ai/kg bw based on an Asian honey bee weight of 0.075 grams reported in the study. This endpoint is used to evaluate acute effects in both individuals and communities; however, for individuals the LOC is 0.05 whereas for communities it is 1.0. For population-level effects, EPA used the LC_{10} of 0.012 µg ai/bee (equivalent to 0.16 mg ai/kg bw) calculated based on a probit slope of 0.94 reported in the study. Since all contact toxicity studies evaluated mortality, EPA did not select any endpoints to evaluate sublethal effects on growth and reproduction from contact exposure. EPA did not consider any of the studies that evaluated repeated (*i.e*., chronic) contact exposure in terrestrial invertebrates to be reliable for quantitative use; therefore, only acute toxicity was assessed for contact exposure.

The approach to endpoint selection for dietary toxicity differed between bee and non-bee terrestrial invertebrates, though EPA based the thresholds on effects from the same studies. EPA selected separate dietary toxicity endpoints for both adult and larval bees because BeeREX calculates exposure to effects ratios for both lifestages. Since a similar distinction is not made in calculations of exposure to effects ratios for non-bee terrestrial invertebrates, EPA relied on the most sensitive dietary endpoints available to assess direct effects in non-bee species from residues in dietary items; these endpoints were the larval endpoints for both acute and chronic exposure. Dietary toxicity in adults and larvae manifest as increased mortality and growth effects observed in the Western honey bee (*A. mellifera*). Acute dietary toxicity is evaluated based on mortality in *A. mellifera*. The most sensitive LC_{50} in adult and larval lifestages is 11.10 µg ai/bee (165.3 mg ai/kg diet) and 1.16 µg ai/bee (35.1 mg ai/kg diet), respectively. The acute adult LC_{50} is based on mortality in a chronic study because the acute dietary study in adult *A. mellifera* could not identify a definitive LC_{50} for the TGAI (*i.e.,* >10.2 µg ai/bee). While mortality from a repeat exposure study may overestimate the acute LC_{50}, it is above the non-definitive endpoint reported in that study indicating that it is at least consistent with the available acute toxicity data. Dietary LC_{10} values were estimated from the mortality curves in the adult and larval studies with the most sensitive LC_{50} values using the reported probit slopes. The dietary LC_{10} for adults is 6.53 µg ai/bee (82.7 mg ai/kg diet) and is estimated based on a reported probit slope of 5.29 and 4.16 for the bee dose based and dietary based endpoints, respectively. The dietary LC_{10} for larvae is 0.15 µg ai/bee (4.40 mg ai/kg diet) and is estimated based on the reported probit slope of 1.42.

The chronic dietary toxicity thresholds for adults (*i.e.,* the NOAEC and MATC) are based on 20% mortality in the *A. mellifera* at the LOAEC of 7.41 µg ai/bee (158 mg ai/kg bw). Based on these effects, the NOAEC and MATC are established at 2.42 µg ai/bee (73.6 mg ai/kg diet) and 4.2 µg ai/bee (108 mg ai/kg diet), respectively. The chronic dietary toxicity thresholds for larvae are the NOAEC of 0.12 µg ai/bee (3.06 mg ai/kg diet) and MATC of 0.21 µg ai/bee (5.26 mg ai/kg diet) based on 29% pupal mortality and 33% reduction in adult bee emergence in *A. mellifera* at the LOAEC of 0.35 µg ai/bee (9.03 mg ai/kg bw). The LC_{50} is used to evaluate acute effects in both individuals and communities and the LC_{10} is used to evaluate acute effects in populations. The acute LOC for individuals is 0.05 whereas for populations and communities it is 1.0. For chronic effects, EPA relies on the NOAEC for individual-level evaluations whereas the MATC is the threshold for population and community-level effects. The selected chronic toxicity endpoint represents the threshold for each level of biological organization (*i.e.,* the chronic LOC is 1.0).

No acceptable toxicity data are available to quantitatively evaluate direct effects in soil-dwelling terrestrial invertebrates; therefore, the direct effects analysis for non-soil dwelling organisms is used as a surrogate to evaluate potential effects in these species. Likewise, no data are available for terrestrial mollusks; however, EPA does not consider the thresholds used to evaluate direct effects in bees and other non-bee terrestrial invertebrates representative of mollusks given the low sensitivity observed in aquatic mollusks. Consequently, EPA relied on a weight-of-evidence approach to evaluate direct effects in terrestrial mollusks based on available data in aquatic mollusks.

6.3.2 Direct Effects Analysis

Table 33 and **Table 34** summarize upper-bound and mean exposure estimates along with effect analysis results for contact and dietary exposure, respectively, in non-bee terrestrial invertebrate individuals, populations, and communities. **Table 35 and Table 36** summarize upper-bound and mean exposure estimates along with effect analysis results for contact and dietary exposure, respectively, in bee individuals, populations, and communities. **Section 5.3** provides exposure-to-effect ratios for bees and non-bee terrestrial invertebrates for acute and chronic exposure to each level of biological organization.

Non-Bee Non-Mollusk Terrestrial Invertebrates

Contact is the more sensitive route of exposure for non-bee terrestrial invertebrates compared to dietary for most registered uses and is likely to be the driver of adverse effects across non-bee terrestrial invertebrate species. Contact exposure is likely to be greatest from foliar or soil-applied applications. Contact exposure with acetamiprid-treated seeds is likely to be low relative to dietary exposure; therefore, EPA did not evaluate contact exposure from seed treatment. The foliar contact EECs for all UDLs exceed the contact toxicity threshold for non-bee individuals, populations, and communities and bee individuals and populations (**Table 35**). For soil-applied treatment, contact exposure is likely to be similar to foliar applications for species that reside at the soil surface. Given that acetamiprid is moderately mobile, species that are primarily fossorial (*i.e.*, live underground for most or all of their lifecycle) are also likely to come into contact with residues of acetamiprid; however, it is likely to be lower contact exposure relative to species that live above ground.

Table 35. Contact Direct Effects Summary for Non-bee Terrestrial Invertebrates from Registered Uses of Acetamiprid.

Level of Biological Organization	Non-Bees		
	Contact EEC (µg ai/bee) [1]	Exposure to Effects Ratio (EEC/Toxicity Endpoint)[2]	UDL Exceedances
Individual	7.1-48.9	**1.9-13.2**	All UDLs
Population	4.9-33.8	**30.5-211**	
Community		**1.3-9.1**	

The level of concern (LOC) for effects in individuals is 0.05 and the LOC for all other exposure scenarios is 1.0. **Bold** values indicate exceedance of the LOC. No chronic toxicity endpoints are available for contact exposure; therefore, the exposure-to-effects ratios presented in this table represent acute exposure only. EEC=estimated environmental concentration; UDL = Use Data Layer;

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Adverse effects from dietary exposure vary based on dietary item and level of biological organization for non-bee terrestrial invertebrates (**Table 36**). Adverse effects to individuals are likely from acute and chronic exposure to residues on grasses, broadleaf plants, and arthropods from acetamiprid uses within all UDLs. Individuals that consume fruit, pods, or seeds are also likely to experience adverse effects from acute and chronic exposure to acetamiprid across all UDLs except for Soybeans and Other Crops. At the population level, adverse acute and chronic effects are likely for species that consume acetamiprid residues in grasses, broadleaf plants, and arthropods. In general, adverse population-level effects are likely from acute and/or chronic exposure to residues in short grass and arthropods for all UDLs. Acute and chronic effects are also likely from ingestion of acetamiprid residues in tall grasses and broadleaf plants for all UDLs except Soybean and Other Crops UDLs. At the community level, adverse effects from acute exposure are only likely for communities of species that consume acetamiprid residues in short grasses exposed as a result of spray applications to crops from the Citrus, Other Orchard, Vegetable and Ground Fruit, and Nursery UDLs. Estimated chronic exposure, however, exceeds the community-level threshold for terrestrial invertebrates foraging on grasses, broadleaf plants, and arthropods across all UDLs except the Other Crops and Soybeans UDLs. No adverse population or community-level effects are likely from consumption of acetamiprid residues in fruits, pods, and seeds.

Since terrestrial invertebrate communities are likely to have varied diets, it is unlikely that community-level effects would result solely from acute exposure in one dietary item. Chronic effects across multiple dietary items are, therefore, more likely to produce adverse effects from dietary exposure in non-bee terrestrial invertebrate communities. The chronic community-level threshold is based on the MATC for mortality and developmental effects in the most sensitive terrestrial invertebrate species tested. While it is uncertain whether the chronic community-level threshold is representative of effects across species within a community since it is based on the most sensitive species, mean EECs for grasses, broadleaf plants, and arthropods in the same UDLs also exceed exposure levels at which mortality and developmental effects are observed (*i.e.*, the LOAEL), increasing confidence that an adverse effects in some invertebrate species within the community are likely. The likelihood that a terrestrial invertebrate species will be exposed repeatedly to acetamiprid in its diet will vary among invertebrate species based on their behavior and life history. Applications are not likely to occur at all uses sites at the same time which will limit the area in which residues will be present on dietary items. Acetamiprid residues, however, are likely to remain in dietary items for days after the spray application and many of the use sites permit multiple applications in a year. Non-bee terrestrial invertebrates are also likely to forage over small areas increasing the likelihood of invertebrates communities that occupy and forage in the exposure area experiencing repeated exposure to acetamiprid residues at levels in their diet that would result in mortality and growth effects.

Overall, non-bee terrestrial invertebrates are likely to experience adverse effects at the individual, population, and community levels. Acute contact exposure will be the primary contributor to adverse effects in these species which could be further exacerbated by exposure in the diet. As stated previously, applications are not likely to occur at all use sites at the same time. Some non-bee invertebrates travel over large distances (*e.g.,* the adult Monarch butterfly), but a majority are less mobile and more likely to remain within a relatively small area when forage and shelter are available (*e.g*., Monarch butterfly caterpillar). Consequently, there is a greater likelihood that non-bee species in the exposure area will come into contact with residues on surfaces and in their diet.

Table 36. Dietary Direct Effects Summary for Non-bee Terrestrial Invertebrates Exposed to Acetamiprid.

Level of Biological Organization →	**Individual**			**Population**			**Community**		
Dietary Item↓	**Upper-bound EEC (mg ai/kg-diet)**	**Exposure to Effects Ratio (EEC/Toxicity Endpoint)[1,2]**	**UDL Exceedances**	**Mean EEC (mg ai/kg-diet)**	**Exposure to Effects Ratio (EEC/Toxicity Endpoint)[1,3]**	**UDL Exceedances**	**Mean EEC (mg ai/kg-diet)**	**Exposure to Effects Ratio (EEC/Toxicity Endpoint)[1,3]**	**UDL Exceedances**
Short grass	18-125	A: **0.5-3.6** C: **5.9-41**	All UDLs	6.4-44.2	A: **1.4-10** C: **1.2-8.4**	All UDLs	6.4-44.2	A: 0.2-**1.3** C: **1.2-8.4**	All UDLs
Tall grass	8.3-57.2	A: **0.2-1.6** C: **2.7-19**		2.7-18.7	A: 0.6-**4.3** C: 0.5-**3.6**	All UDLs except Soybean and Other Crops	2.7-18.7	A: 0.1-0.5 C: 0.5-**3.6**	All UDLs except Soybean and Other Crops
Broadleaf plants	10.1-70.2	A: **0.3-2.0** C: **3.3-23**		3.4-23.3	A: 0.8-**5.3** C: 0.6-**4.4**		3.4-23.3	A:0.1-0.7 C: 0.6-**4.4**	
Fruits, pods, seeds	1.1-7.8	A: <0.01-**0.2** C: **0.4-2.5**	All UDLs except Soybean and Other Crops	0.5-3.6	A: 0.1-0.8 C: 0.1-0.7	No exceedances	0.5-3.6	A: <0.01-0.1 C: 0.1-0.7	No exceedances
Arthropods	7.1-48.9	A: **0.2-1.4** C: **2.3-16**	All UDLs	4.9-33.8	A: 1.1-**7.7** C: 0.9-**6.4**	All UDLs	4.9-33.8	A: 0.1-1.0 C: 0.9-**6.4**	All UDLs

Bold values indicate exceedance of the level of concern (LOC).

EEC=estimated environmental concentration; A = Acute; C = Chronic; UDL = Use Data Layer;

[1]The toxicity threshold used to evaluate acute and chronic effects at each level of biological organization are provided in **Table 34.**

[2]The LOC for acute and chronic effects in individuals is 0.05 and 1.0, respectively

[3]The LOC for acute and chronic effects in populations and communities is 1.0.

Bees

Contact is the most sensitive route of exposure for bees and is likely to be the driver of adverse effects across bee species. Contact exposure is likely to be greatest from foliar or soil-applied applications. The foliar contact EECs for all UDLs exceed the contact toxicity threshold for bee individuals and populations (**Table 37**). The threshold for bee communities is also exceeded by the EECs for most UDLs except for uses that fall within the Soybeans, Other Crops, and Other Row Crops UDLs. For soil-applied treatment, contact exposure is likely to be similar to foliar applications.

Dietary exposure in bees will occur from collecting residues as they forage for pollen and nectar in and adjacent to areas where spray applications occur as well as from crops that grow from treated seeds. The source of residues in pollen and nectar may be from deposition following spray application or systemic transport of residues from plant tissues or the soil following soil-directed or subsurface applications as well as in crops that were treated as seeds. Foliar applications are likely to result in the highest exposure compared to soil-applied and seed treatments. When looking across lifestages, adverse effects to bee individuals, populations, and communities are likely from acute and/or chronic exposure across all UDLs with foliar applications (

Table 38). These conclusions are driven by the sensitivity of larval bees. Adult bees are also likely to experience acute and/or chronic effects from all UDLs with foliar applications at the individual level; however, at the population and community level, adverse effects are not likely from uses that fall within the Cotton, Other Crops, Other Row Crops, and Soybeans UDLs and acute dietary effects are only likely for the Citrus and Nursery UDLs. Fewer adverse effects are likely across the different levels of biological organization for other application methods. Despite the systemic transport of this chemical in plants, no adverse effects are likely for soil-applied or subsurface applications and seed treatment uses are only likely to result in adverse effects at the individual level in larval bees (

Table 38).

Table 37. Contact Direct Effects Summary for Bees from Registered Uses of Acetamiprid.

Level of Biological Organization	Bees		
	Contact EEC (µg ai/bee)[1]	Exposure to Effects Ratio (EEC/Toxicity Endpoint)[2]	UDL Exceedances
Individual	0.11-1.4	**0.40-5.1**	All UDLs
Population		**9.23-117**	
Community		0.40-**5.1**	All UDLs except Soybean, Other Crops, and Other Row Crops

The level of concern (LOC) for effects in individuals is 0.05 and the LOC for all other exposure scenarios is 1.0. **Bold** values indicate exceedance of the LOC. No chronic toxicity endpoints are available for contact exposure; therefore, the exposure-to-effects ratios presented in this table represent acute exposure only. EEC=estimated environmental concentration; UDL = Use Data Layer;

Table 38. Dietary Direct Effects Summary for Bees Exposed to Acetamiprid.

Level of Biological Organization	Pollen and Nectar EECs (µg ai/mg)	Adult			Larvae		
		Dose (µg ai/bee) [1]	Exposure to Effects Ratio (EEC/Toxicity Endpoint)[2]	UDL Exceedances	Dose (µg ai/bee)[3]	Exposure to Effects Ratio (EEC/Toxicity Endpoint)[2]	UDL Exceedances
Foliar Uses							
Individual			A: **0.12 – 1.50** C: 0.54 – **6.90**	All UDLs		A: **0.48 – 6.09** C: **4.65 - 59**	
Population	0.00451-0.0572	1.3-16.7	A: 0.21 – **2.63** C: 0.31 – **3.95**	All UDLs except Cotton, Other Crops, Other Row Crops, Soybean	0.56-7.1	A: **3.72 – 47** C: **2.65 - 34**	All UDLs
Community			A: 0.12 – **1.50** C: 0.31 – **3.95**			A: 0.48 – **6.09** C: **2.65 - 34**	
Soil-Direct or Subsurface Applications							
Individual[4]	0.000025	0.0074	A: <0.01 C: <0.01	No UDLs exceeded	0.0031	A: <0.01 C: 0.02	No UDLs exceeded
Seed Treatments							
Individual			A: 0.026 C: 0.12			A: **0.11** C: **1.03**	All UDLs
Population	0.001	0.29	A: 0.045 C: 0.089	No UDLs exceeded	0.13	A: 0.82 C: 0.59	No UDLs exceeded
Community			A: 0.026 C: 0.12			A: 0.11 C: 0.59	

The level of concern (LOC) for acute effects in individuals is 0.05 and the LOC for all chronic exposures and all other acute exposure scenarios is 1.0. **Bold** values indicate exceedance of the LOC. EEC=estimated environmental concentration; A = Acute; C = Chronic; UDL = Use Data Layer;

[1]Adult bee dose is based on the total dose estimated for an adult worker bee foraging for nectar in BeeREX v. 1.0. Assumes a single application at the maximum single application rate for each proposed use.

[2]The toxicity threshold used to evaluate acute and chronic effects at each level of biological organization are provided in **Table 34.**

[3] Larval bee dose is based on the total dose estimated for a 5-day old larval worker bee in BeeREX v. 1.0. Assumes a single application at the maximum single application rate for each proposed use.

[4] Only the individual exposure to effects ratios are presented for soil-applied/subsurface applications. Since there are no adverse effects to the individual, adverse effects to populations and communities from these uses are unlikely.

Contact and dietary exposure for bees is likely to be greatest from foraging for pollen and nectar at use sites. Based on the USDA publication on the *Attractiveness of Agricultural Crops to Pollinating Bees for the Collection of Nectar and/or Pollen* (USDA 2018[43]) (**Table 39**), all agricultural UDLs contain at least one crop, and often multiple crops, that are attractive to social (*i.e.*, honey and bumble bees) and solitary bees. While data are not available for the non-agricultural use sites, it is likely that ornamentals in residential areas and nurseries, and residentially grown vegetables will be attractive to pollinators. Attractive weeds and wildflowers are also likely to be present at many Open Spaced Developed and Developed use sites. Consequently, exposure to acetamiprid at uses sites across all UDLs is likely for listed bee species and non-listed bee species that serve as pollinators for listed plants.

Table 39. Summary of Information on the Attractiveness of Registered Agricultural Use Patterns Within Each UDL to Honey Bees (*Apis mellifera*) and Non-*Apis* Bees (based on USDA 2018).

UDL	Honey Bee Attractive?[1,2]	Bumble Bee Attractive?[1,2]	Solitary Bee Attractive?[1,2]	Notes
Foliar Uses				
Alfalfa	++	+	++, Alfalfa leafcutting bee, Alkali bee	Requires bee pollination for seed production only and managed pollinators are used. Only a small percentage of alfalfa is grown for seed.
Citrus	++	+	+, but only some genera for certain citrus crops	Honey bees are brought to groves for orange blossom honey. Tangerines/mandarins and tangelos use managed pollinators on small acreage (~8,300 and ~2,500, respectively) in Florida.
Cotton	+[4]	+	+, but only some genera	Used by some beekeepers for honey production
Other Crops	++	+	++, but only some genera	Requires bee pollination for seed production only and managed pollinators are used. Only a small percentage of clover is grown for seed.
Other Orchards	No, +,+[3],or ++	No, +, or ++	No, +, or ++, but only some genera	All pome fruit and some stone fruit and tree nut crops require bee pollination. Some crops from each group use managed pollinators. Several tree nuts are wind pollinated.
Other Row Crops	+[3]	+	+	Typically deflowered as standard production practice
Soybean	+	+	+	
Vegetable and Ground Fruit	+, +[4], or ++	+ or ++	+ or ++, but only some genera for certain crops	Some crops require bee pollination and use managed pollinators.
Seed Treatments				

[43] https://www.usda.gov/sites/default/files/documents/Attractiveness-of-Agriculture-Crops-to-Pollinating-Bees-Report-FINAL-Web-Version-Jan-3-2018.pdf

UDL	Honey Bee Attractive?[1,2]	Bumble Bee Attractive?[1, 2]	Solitary Bee Attractive?[1, 2]	Notes
Other Grains	++	+	++	Managed bees needed for hybrid seed production of canola
Other Crops	++	+	+	Mustard seed requires bee pollination.
Vegetable and Ground Fruit	No	+	+, *Andrena* genus only	Potatoes require bee pollination for breeding only, but only % of the acreage is grown for breeding.

[1] Attractiveness rating is a single "+", denoting a use pattern is opportunistically attractive to bees.
[2] Attractiveness rating is a double "++" denoting a use pattern is attractive in all cases
[3] Source of pollen only.
[4] Source of nectar only.
[5] A range for attractiveness ratings and acreage is presented for UDLs that contain multiple crops. The range covers all crops with registered uses within the group that have data presented in USDA 2018.

Since an SSD could not be developed, the exposure-to-effect ratios for bees are based effects observed in the most sensitive species tested in laboratory studies. Although data are only available for a small number of bee species, they exhibit a wide range of sensitivities to contact and dietary exposure (**Section 6.3.1.1**). Notably, the effects reported are all for social bee species and are used as a surrogate to evaluate solitary bees. Of the listed bees species, 2 species are social and 7 species are solitary; both social and solitary bee species serve as pollinators for listed plant species.

The exposure-to-effect ratios for bees are based on the most highly exposed caste or task within a honey bee colony. Although exposure will be lower for social bees in other castes/tasks most or all tasks for adult worker bees, larval workers that are 4-5 days in age, and drone bees are likely to experience individual adverse effects at the maximum single application rates for acetamiprid permitted for each UDL. Semi-field and field studies on the *A. mellifera*, however, indicate that while effects in the laboratory demonstrate the potential for individual effects in adults and a reduction in brood size and success, these findings did not translate to colony-level effects across multiple studies at application rates of 0.089 lbs ai/A or lower. Further, exposure to a foliar surface receiving a spray applications resulted in no toxicity within 24 hours indicting limited residual toxicity to the Western honey bee. These findings suggest that uses below a certain application rate are less likely to adversely affect social bee species at the colony level. Notably, though, no study tested above 0.15 lbs ai/A which is below the maximum single application rate permitted among uses that fall within the Citrus, Other Orchard, Open Spaced Developed, Developed, and Nursery UDLs. Furthermore, the conclusions from the semi-field and field studies inform effects on social bees and do not reflect a low likelihood of population or community level impacts for solitary bees.

While the semi-field and field data on honey bees suggest low toxicity to social bees for certain uses, there are 7 incidents reported in the Incident Data System (IDS) for acetamiprid involving the loss of bees in the U.S. Most of the incidents occurred prior to publication of the 2017 PRA, a majority of which were classified with a certainty of "possible" or "probable" and with 147 colonies affected across all U.S. incidents (See USEPA, 2017 for more detail). Since 2017, there has been one additional incident reported involving honey bees.

Overall, bees are likely to experience adverse effects at the individual, population, and community level from foliar uses. Acute contact exposure will be the primary contributor to adverse effects in these species which could be further exacerbated by exposure in the diet. Social bees may, however, not experience adverse population-level effects from uses with maximum application rates of <0.089 lbs ai/A. Communities of social bee species would also be unlikely to experience adverse effects from these UDLs. Conversely, solitary bee populations, and bee communities made of solitary bees and social bees are more likely to be adversely affected from all UDLs.

Terrestrial Mollusks

EPA considered terrestrial mollusk species separately from the other terrestrial invertebrates given that the exposure-to-effect ratios are based on observations in terrestrial insects. Although no data are available to assess toxicity in terrestrial mollusk species, the aquatic mollusk data suggest it is likely that these species will exhibit lower sensitivity to acetamiprid compared to other terrestrial invertebrates. Differences in routes of exposure introduce uncertainty in comparing the response in aquatic mollusks to terrestrial mollusks. EPA expects aquatic snails to be exposed primarily via respiration whereas terrestrial snails are expected to be exposed through dietary consumption or from direct/residual contact, though direct contact from spray droplets during application is likely to be reduced somewhat by the snail's shell. Despite this uncertainty, the low sensitivity of aquatic mollusks to acetamiprid suggest that there is a likelihood of low toxicity in terrestrial mollusk species. Furthermore, FWS recently adopted this approach of using aquatic mollusks as a surrogate for terrestrial snails in their final malathion BiOp (USFWS, 2022).

6.3.3 Off-Site Distance for Terrestrial Invertebrates

Given that adverse effects to terrestrial invertebrates are likely, EPA determined the extent to which off-site transport will contribute these adverse effects at each level of biological organization to define the exposure area for each UDL. Spray drift is likely to be the primary route of off-site exposure contributing to direct effects in terrestrial invertebrates. Spray drift may result in direct exposure to spray droplets, and deposition of residues on dietary items, and/or foliar, soil, and other surfaces that the species moves across. Runoff may contribute to residues in the soil or in plant tissues following systemic uptake; however, it is likely to be a minor route of exposure relative to spray drift. **Table 40** provides the furthest off-field distances within which spray drift may lead to direct effects to bee and non-bee terrestrial invertebrate individuals, populations, and communities based on the toxicity thresholds for each level of biological organization. EPA then buffers out the UDLs by these distances to establish the exposure area when assessing the potential for adverse direct and PPHD effects to listed species individuals and populations.

Table 40. Off-Site Transport Distances (meters, m) Used for Estimating Spatial Overlap for Terrestrial Invertebrates in Effects Determinations and Predictions of Likelihood of Jeopardy for Acetamiprid Use Data Layers (UDLs).[1]

UDL	Common Application Method[2]	Potential for Effects to an Individual[3]	Potential for Effects to a Population[4]	Potential for Effects to a Community[5]
Alfalfa	Ground-boom	270 m	30 m	0 m
Citrus	Airblast	510 m	60 m	30 m
Cotton	Ground-boom	270 m	30 m	0 m
Grapes	Airblast	120 m	30 m	30 m
Nursery	Ground-boom	510 m	60 m	30 m
Other Crops	Ground-boom, Seed treatment	60 m	30 m	0 m
Other Grains	Seed treatment	0 m	0 m	0 m
Other Orchards	Airblast	510 m	30 m	30 m
Other Row Crops	Ground-boom	180 m	30 m	0 m
Soybean	Ground-boom	60 m	30 m	0 m
Vegetable and Ground Fruit, NL48 Ag	Aerial	510 m	90 m	30 m
CONUS and NL48 Developed, Open Spaced Developed	Handheld equipment	0 m	0 m	0 m

UDL	Common Application Method[2]	Potential for Effects to an Individual[3]	Potential for Effects to a Population[4]	Potential for Effects to a Community[5]

[1]These distances reflect exposure at the use site and spray drift only given that it is the primary route of off-site exposure for terrestrial invertebrates. Distances account for both contact and dietary effects in adults and larval life stages; however, effects from both routes of exposure and to both lifestages may not occur within the entire exposure area based on differences in exposure and sensitivity. The distance is also the furtherest determined for bee and non-bee terrestrial invertebrates.
[2]The common application method for each UDL is considered in establishing the buffer distances for potential effects to populations and communities only (**Section 3.2.1**). The application method among those permitted on the label for a given UDL that results in the largest exposure area (generally aerial) is used to establish the buffer distance for individuals.
[3]Distances are used to establish the exposure area for each UDL for the May Affect/No Effect (MA/NE) and to evaluate direct effects in the Not Likely to Adversely Affect/Likely to Adversely Affect (NLAA/LAA) Determination.
[4]Distances are used to establish the exposure area for each UDL to evaluate direct effects in the predictions of Likely J and to evaluate PPHD effects to obligate relationships for the NLAA/LAA Determination and predictions of Likely Jeopardy (J).
[5]Distances are used to establish the exposure area for each UDL to evaluate PPHD effects to generalist relationships for the NLAA/LAA Determination and predictions of Likely J.
CONUS=contiguous United States; NL48=non-lower 48 states (includes Alaska, Hawaii, Puerto Rico, U.S. Virgen Islands, U.S. Samoa)

6.3.4 PPHD Effects

Listed terrestrial invertebrate species have generalist diet relationships with plants, aquatic invertebrates, other terrestrial invertebrates, and terrestrial vertebrates (*i.e.,* carrion) and a generalist relationship with plants for habitat. Several listed terrestrial invertebrate species also have obligate relationships to terrestrial plants and terrestrial invertebrates.

Based on the generic-taxa based screening-level assessment, the registered uses of acetamiprid are likely to have an effect on listed terrestrial invertebrate species that have PPHD relationships with plants, invertebrates, and terrestrial vertebrates. The registered uses are further likely to adversely affect listed terrestrial invertebrate species that have generalist relationships with other terrestrial invertebrates and aquatic invertebrates given the likelihood of adverse effects to invertebrate communities (**Section 6.3** and **Section 6.1**). The loss of invertebrate prey items will have the greatest impact among listed terrestrial invertebrate species that rely primarily or exclusively on terrestrial non-mollusk invertebrate, aquatic insect and/or crustacean species. Community-level effects are not likely for plants (**Section 6.7**); therefore, species that have a generalist relationship with these taxa are unlikely to experience adverse effects related to a decline in these dietary items or loss of habitat. Furthermore, it is unlikely that acetamiprid applications would have an adverse effect on the availability of carrion for species that rely on it.

Four lepidopteran species have a mutualistic relationship with ants and the Delta green ground beetle (*Elaphrus viridis*) has a dietary obligate relationship with springtails. Adverse PPHD effects to individuals and populations are likely for these species given the likely adverse effects to terrestrial insect populations. A total of 47 terrestrial invertebrate species have an obligate relationship with upland and/or semi-aquatic plants of which 23 rely on herbaceous plants and 24 rely on woody plants or trees. The registered uses of acetamiprid have the potential to impact the health of individual woody plant and tree species, particularly those occuring near use sites and with new growth, which will affect individual species co-localized with these woody plants; however, because acetamiprid is not likely to adversely affect populations of woody plants or trees, adverse PPHD effects are unlikely for the 24 species that have an obligate relationship with woody plant species. Of the 23 species that have obligate relationships to herbaceous plants, three lepidopteran species – Mitchell's satyr butterfly (*Neonympha mitchellii mitchellii*), Saint Francis satyr butterfly (*Neonympha mitchellii francisci*), and the Carson wandering skipper (*Pseudocopaeodes eunus obscurus*) – and two species of unnamed pomace fly (*Drosophila mulli* and *Drosophila obatai*) rely on monocots. Since the adverse population level effects are not likely for monocots (**Section 6.7**), these obligate relationships are not likely to be adversely affected by the registered uses. The remaining species have obligate relationships to dicot species only or in addition to monocot species. Since population level effects are likely for dicots (**Section 6.7**), these species may experience adverse PPHD effects.

6.3.5 Effects Determinations and Predictions of Likely Jeopardy

EPA made species determinations for 157 terrestrial invertebrate species listed as of February 16, 2022 (Table 39) for which there are NE determinations for 27 species. There are NLAA determinations for 47 species and LAA determination for 83 species. Of the 83 species with LAA determinations, EPA predicts that the registered uses of acetamiprid have no potential likelihood of future jeopardy for 63 species and there is a potential likelihood of future jeopardy for 20 species (**Table 41**). The following sections discuss factors and life history characteristics contributing to each determination and predicted likelihood of jeopardy and **Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification** provides additional species specific considerations.

Table 41. Number of Listed Species Effects Determinations and Predicted Potential Likelihood of Future Jeopardy for Terrestrial Invertebrates from Registered Uses of Acetamiprid.

Taxon	Number of Species[2]	NE	NLAA	LAA-Not Likely J	LAA-Likely J
Terrestrial Invertebrates[1]	157	27	47	63	20

J = jeopardy; NE = no effect; LAA = likely to adversely affect; NLAA = not likely to adversely affect.
[1]Terrestrial Invertebrates includes damselflies which have both a terrestrial and aquatic phase
[2]Reflects the species listed as of February 16, 2022.

Listed Species with NE Determinations

EPA based NE determinations on species that inhabit areas where exposure is not reasonably expected to occur at a level that could cause effects and took into account species habitat, overlap and diet. EPA made NE determinations for listed terrestrial invertebrates species with <1% overlap with all UDLs.

Listed Species with MA Determinations

For the rest of the terrestrial invertebrates, EPA made MA determinations because of the potential for direct effects. In addition to direct effects, EPA made MA determinations for any terrestrial invertebrate species consuming other invertebrate prey. Exposure and toxicity data suggest that there may be population-level effects to terrestrial invertebrates and aquatic insects in off-field areas through the reduction of prey for those species which consume other terrestrial invertebrates. For all species designated as MA, EPA applied risk modifiers and then classified as Not Likely to Adversely Affect (NLAA) and Likely to Adversely Affect (LAA).

Not Likely to Adversely Affect (NLAA) Determinations

NLAA determinations are driven by an assessment of the likelihood of direct effects and exposure occurring based on overlap and different habitat characteristics. EPA made NLAA determinations for species that are unlikely to experience adverse direct and PPHD effects, that have a range with <1% overlap with any individual UDL after refining the exposure area to account for likely adverse effects to individuals and with consideration of insecticide usage and crop acreage data from the CoA, and for species where life history indicate the likelihood of exposure and adverse effects is low. The main life history considerations for NLAA determinations included:

- The species is a terrestrial snail which is unlikely to experience adverse direct or PPHD effects (see below);
- species found in high altitude montane habitat, uninhabited islands, and interior forests where exposure is likely to be insignificant ; or,
- species found entirely on federal lands at high elevations where the likelihood of significant exposure is low (*i.e.,* Western glacier stonefly, Meltwater Iednian stonefly).

Terrestrial Snails

No data are available with which to quantify the toxicity of acetamiprid to terrestrial snails. However, as summarized in **Section 6.1**, aquatic mollusks (*i.e*., snails and mussels) have low sensitivity to acetamiprid. As a result, EPA determined no direct effects to aquatic mollusks from the registered uses of acetamiprid. In the absence of terrestrial snail effects data, this effects determination relies on the toxicity findings for aquatic mollusks as a surrogate for terrestrial snails. The majority of listed terrestrial snails are considered herbivorous, with several consuming fungi or dead invertebrate prey, and all relationships to other taxa are generalist. Although effects on individual terrestrial plants are indicated, registered uses of acetamiprid are not likely to affect terrestrial plant communities and as result, EPA considers PPHD effects to listed snails through generalist relationships with plants as unlikely. Adverse effects to fungi is also unlikely given that the chemical is not a fungicide. Many of the species that rely on fungi also inhabit forested areas which is not a use site for acetamiprid. Furthermore exposure from spray drift, the primary route of transport that will affect these species, is likely to be insignificant in this habitat. EPA, therefore, determined NLAA for terrestrial snails that rely on plants and fungi based on the weight of evidence. Since adverse effects to terrestrial invertebrates are likely, terrestrial snails .

Likely to Adversely Affect (LAA) Determinations

Of the MA species, LAA determinations are driven by an assessment of the likelihood of direct and PPHD effects and exposure occurring based on different habitat characteristics. Species designated as LAA had the potential for direct or PPHD effects via the consumption of non-mollusk invertebrate prey. EPA made LAA determinations for species that inhabit areas where exposure is expected to reasonably occur at levels that could cause effects directly to the species and/or through the species' PPHD. Although the majority of species classified as LAA had a high magnitude of effect, EPA applied several modifiers to species that influence the potential for exposure including:

- species inhabit cave systems and rely on external and internal sources of nutrients and forage (**Appendix I. Qualitative Analysis Approach**);
- exposure is likely overestimated for cliff species;
- species consumes multiple dietary items for which direct effects are not indicated;
- The species does not inhabit or forage at non-agricultural use sites

Listed Species Predictions of the Potential Likelihood of Future Jeopardy

After consideration of where direct and PPHD effects may occur to terrestrial invertebrates, there are 20 terrestrial invertebrate species with predicted potential likelihood of future jeopardy (**Table 42**). A majority of the species with predicted potential likelihood of future jeopardy have medium to high overlap with at least one agricultural UDL, and high magnitude of effect from direct effects and, for several species, PPHD effects related to decline in invertebrate prey availability or herbaceous host plants. Several species had medium to high overlap with non-agricultural UDLs only; however, the species life history indicated that it was likely to occupy and forage in non-agricultural use sites or the species has an aquatic-phase that is found in low volume waterbodies only which is likely to receive runoff from non-agricultural use sites resulting in adverse direct effects. All species that are predicted to have a likelihood of future jeopardy also have high vulnerability.

Table 42. Listed Terrestrial Invertebrate Species with Predicted Likelihood of Jeopardy from Registered Uses of Acetamiprid.

Entity ID	**Common Name (Scientific Name)**
420	Karner blue butterfly (*Lycaeides melissa samuelis*)
421	Langes metalmark butterfly (*Apodemia mormo langei*)
424	Mitchell's satyr butterfly (*Neonympha mitchellii mitchellii*)
428	Smith's blue butterfly (*Euphilotes enoptes smithi*)
430	Callippe silverspot butterfly (*Speyeria callippe callippe*)
432	Palos Verdes blue butterfly (*Glaucopsyche lygdamus palosverdesensis*)
435	Delta green ground beetle (*Elaphrus viridis*)
436	Valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*)
450	Fender's blue butterfly (*Icaricia icarioides fender*)
457	Ohlone tiger beetle (*Cicindela ohlone*)
458	Zayante band-winged grasshopper (*Trimerotropis infantilis*)
1361	Blackline Hawaiian damselfly (*Megalagrion nigrohamatum nigrolineatum*)
3412	Dakota skipper (*Hesperia dacotae*)
4326	Crimson Hawaiian damselfly (*Megalagrion leptodemas*)
4910	Salt Creek tiger beetle (*Cicindela nevadica lincolniana*)
7495	Taylor's checkerspot (*Euphydryas Editha taylori*)
8503	Casey's June beetle (*Dinacoma caseyi*)
10147	Poweshiek skipperling (*Oarisma poweshiek*)
10383	Rusty patched bumble bee (*Bombus affinis*)
10909	Miami tiger beetle (*Cicindelidia floridana*)

6.4 Birds and Reptiles

6.4.1 Direct Effects

6.4.1.1 Summary of Ecotoxicity Data for Birds and Reptiles

EPA evaluated acetamiprid toxicity to birds through acute oral exposure, subacute dietary exposure, and chronic dietary exposure. Avian toxicity data are available for 3 bird species which span 3 Orders: Galliformes [Northern bobwhite quail (*Colinus virginianus*)], Anseriformes [Mallard duck (*Anas platyrhynchos*)] and Passeriformes [Zebra finch (*Taeniopygia guttata*)] (**Table 43**). Avian species from the Order Passeriformes (*i.e.,* passerine species) exhibit the greatest sensitivity to acute oral and subacute dietary exposure. The acute oral LD_{50} and subacute dietary LC_{50} for the Zebra finch is 5.68 mg ai/kg bw and 58.2 mg ai/kg diet, respectively, and are one to two orders of magnitude more sensitive than the acute oral LD_{50} and subacute dietary LC_{50} reported for the Mallard duck (LD_{50} = 84.4 mg ai/kg bw; LC_{50} = 5,000 mg ai/kg diet) and Bobwhite quail (LC_{50} > 5,000 mg ai/kg diet). These acute toxicity data indicate that acetamiprid is very highly toxic to passerine species on an acute oral exposure basis and highly toxic to passerine species on a subacute dietary exposure basis while it is moderately toxic to practically non-toxic to other avian species.

Although the passerine species are the most sensitive on an acute oral and subacute dietary exposure basis, no chronic toxicity data are available for species from this Order. Chronic dietary studies are available from the Mallard duck and Bobwhite quail. In both species, growth effects (*i.e.*, decreased adult and hatchling body weight) were the most sensitive measurement endpoints reported with reproductive effects (*i.e.*, decreased number of eggs laid, viable embryos, and hatchling survival) detected at higher dietary exposure concentrations. The Mallard duck was more sensitive than Bobwhite quail to chronic dietary exposure, with growth and reproductive effects observed at approximately half the dietary concentrations where growth and reproductive effects were observed in the quail. Since no chronic data are available for passerine species, there is uncertainty as to the sensitivity of passerine species to chronic exposure and their relative sensitivity compared to other avian species.

EPA utilizes birds as surrogates for reptiles and terrestrial-phase amphibians and since neither acute nor chronic toxicity data are available for reptile or terrestrial-phase species, avian toxicity data serve as a surrogate for these taxa (USEPA, 2014).

Table 43. Most Sensitive Acetamiprid Toxicity Data for Birds.

Study Type	Test Substance (% ai)	Test Species	Toxicity Value	MRID Classification
Passeriformes				
Acute - Oral	TGAI (99.9%)	Zebra finch (*Taeniopygia gutta*)	LD_{50} = 5.68 mg ai/kg-bw	48407701 Acceptable
Subacute - Dietary	TGAI (>99%)	Zebra finch (*T. gutta*)	LC_{50} = 58.2 mg ai/kg-diet	48844901 Acceptable
Anseriformes				
Acute - Oral	TGAI (99.9%)	Mallard duck (*Anas platyrhynchos*)	LD_{50} = 84.4 mg ai/kg-bw	44651859 Acceptable
Subacute - Dietary	TGAI (99.9%)	Mallard duck (*A. platyrhynchos*)	LC_{50} > 5,000 mg ai/kg diet	44651861 Supplemental
Chronic	TGAI (97.8%)	Mallard duck (*A. platyrhynchos*)	NOAEC = 50 mg ai/kg-diet LOAEC = 99 mg ai/kg-diet	49342202 Acceptable
Galliformes				
Subacute - Dietary	TGAI (>99%)	Northern Bobwhite Quail (*Colinus virginianus*)	LC_{50} > 5,000 mg ai/kg diet	446518601 Supplemental
Chronic	TGAI	Northern Bobwhite Quail (*C. virginianus*)	NOAEC = 89.7 mg ai/kg-diet LOAEC = 184 mg ai/kg-diet	46555601 Acceptable

Note: LC_{50}=lethal concentration to 50% of organisms tested; TGAI=Technical Grade Active Ingredient; ai=active ingredient; NOAEC=No-Observed-Adverse-Effect-Concentration; LOAEC=Lowest-Observed-Adverse-Effect-Concentration; >Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested, or effects did not reach 50% at the highest concentration tested (USEPA, 2011).

6.4.1.2 Endpoint Selection

Table 44 below summarizes the exposure models and endpoints used to evaluate acute and chronic oral and dietary exposure to birds and reptiles at each level of biological organization. EPA uses these endpoints to estimate initial exposure-to-effect ratios for direct effects to birds and reptiles. Subsequent characterization including differences in Order sensitivity and exposure potential is then considered in the final direct effects conclusion.

Table 44. Description of Acetamiprid Toxicity Endpoints and Exposure Models Used in Direct Effects Analysis for Birds and Reptiles.

Level of Biological Organization	Exposure Models	Direct Effects Endpoints
Individual	On-Site: T-REX v. 1.5.2 (foliar uses and seed treatment) Off-Site: AgDrift® v. 2.1.1 (foliar uses only) Upper-bound residues for all dietary items and species specific body weight	Acute: LD_{50} = 5.68 mg ai/kg bw (LOC=0.1) LC_{50} = 58.2 mg ai/kg bw (LOC = 0.1) Chronic: NOAEC = 50 mg ai/kg diet (LOC = 1.0)
Population	On-Site: T-REX v. 1.5.2 (foliar uses and seed treatment) Off-Site: AgDrift® v. 2.1.1 (foliar uses only) Mean residues for all dietary items and species specific body weight	Acute: LD_{10} = 4.03 mg ai/kg bw (LOC=1.0) LC_{10} = 30.2 mg ai/kg bw (LOC = 1.0) Chronic: MATC = 70.4 mg ai/kg diet (LOC = 1.0)
Community		Acute: LD_{50} = 5.68 mg ai/kg bw (LOC= 1.0) LC_{50} = 58.2 mg ai/kg bw (LOC = 1.0) Chronic: MATC = 70.4 mg ai/kg diet (LOC = 1.0)

LC_x/LD_x = lethal concentration/dose to x% of the organisms tested (in this case, x is either 10 or 50%). LOC = Level of concern. NOAEC=No-Observed-Adverse-Effect-Concentration; LOAEC=Lowest-Observed-Adverse-Effect-Concentration; MATC = Maximum Acceptable Toxicant Concentration; the geometric mean of the NOAEC and LOAEC; LOC= level of concern

Since an SSD could not be developed, thresholds for individuals, populations, and communities are based on the most sensitive bird species tested for acute and chronic exposure. Dietary exposure following foliar applications and consumption of acetamiprid treated seeds are the two primary routes of exposure to acetamiprid in birds and reptiles and are modeled in T-REX (**Section 5.3**). No acceptable toxicity data are available for reptiles; therefore, the thresholds selected for birds are used as a surrogate to evaluate potential effects in these species. For foliar uses, upper-bound residues are considered for individuals and mean residues are considered to represent exposure to populations and communities.

EPA assesses two types of oral exposure in the direct effects analysis for birds: dose-based oral exposure which accounts for food intake based on species weight and feeding habits and represents a bolus dose exposure, and dietary exposure which reflect daily intake from diet and does not account for differences in food intake across species. EPA assessed acute oral exposure based on the LD_{50} of 5.68 mg ai/kg bw and assessed subacute dietary exposure based on the LC_{50} of 58.2 mg ai/kg diet for the Zebra finch. These endpoints are used to evaluate acute effects in both individuals and communities; however, for individuals the LOC is 0.1 whereas for communities the LOC is 1.0. For population-level effects, EPA used the LD_{10} of 4.03 mg ai/kg bw calculated based on a probit slope of 0.94 reported in the acute oral toxicity study with Zebra finch. EPA assessed population-level effects from subacute dietary exposure based on the LC_{10} of 30.2 mg ai/kg diet which is calculated based on a default probit slope of 4.5 since the probit slope was not reported in the study. For population-level effects, the acute toxicity endpoint represents the threshold for effects; therefore, the LOC is 1.0.

EPA based the chronic dietary toxicity endpoints selected to assess individual birds (*i.e.,* NOAEC), their populations, and their communities (*i.e.*, MATC) on an 8% reduction in food consumption in the Mallard duck that coincided with gross pathological findings in the digestive system and small decreases in weight gain at the LOAEC of 90 mg ai/kg diet. Based on these effects, EPA established the NOAEC and MATC at 50 mg ai/kg diet and 70.4 mg ai/kg diet, respectively. The selected chronic endpoint (*i.e*., the NOAEC or the MATC) represents the threshold for each level of biological organization (*i.e.,* the chronic LOC is 1.0).

6.4.2 Direct Effects Analysis

Birds and reptiles may be exposed to acetamiprid through dermal contact with residues on foliar or soil surfaces, inhalation of airborne residues during a spray application, consumption of plant dietary items, prey, or drinking water containing residues, or incidental ingestion of residues from soil. The diet is likely to be the most common route of exposure for listed bird and reptiles species.

The dietary needs of avian and reptilian species are diverse and include terrestrial and semi-aquatic plants, terrestrial invertebrates, mammals, birds, reptiles, amphibians, aquatic invertebrates, fish, carrion, pollen and nectar, and fungi. Residues in dietary items will be the result of deposition following foliar application, systemic transport of residues from soil to edible plant tissues, secondary exposure from terrestrial invertebrate prey that have consumed contaminated dietary items, and consumption of acetamiprid-treated seeds. Residues in terrestrial vertebrate prey and carrion may be another source of secondary exposure to acetamiprid residues; however, it is likely that the residue levels in the prey and carrion will be low when consumed by the avian or reptilian predator or scavenger given that acetamiprid is rapidly metabolized and excreted in birds (MRID 44988523) and mammals (USEPA 2020) without appreciable accumulation in tissues. Likewise, acetamiprid is not likely to bioaccumulate in aquatic organisms based on the chemical's physical chemical properties; therefore, consumption of acetamiprid residues in aquatic invertebrates, fish, aquatic-phase amphibian prey is likely to be a minor source of exposure relative to terrestrial prey/dietary items. Consequently, the effects analysis focused on exposure from plants (grasses, leaves, fruits, seeds, nectar), and arthropods.

Exposure from Foliar Uses
Table 45, Table 46, and **Table 47** summarizes the effects analysis for exposure through dietary items for bird and reptile individuals, populations, and communities following foliar applications. **Appendix E. Supplemental Tables for Direct Effects Analysis** presents dose- and dietary-based exposure-to-effect ratios for each UDL.

Table 45 reports the acute dose-based exposure-to-effect ratios for individuals and populations based on the reported body weight for listed birds and reptiles. The table reports EEC and exposure to effects ratio ranges for four different weight classes: very small (≤20 g), small (>20-100 grams), medium (>100-1,000 grams), and large (>1,000 grams). Upper-bound exposure estimates for all of the registered uses exceed the individual acute toxicity threshold for birds and reptiles that weigh <5,000 g and whose diet include grasses, nectar, leaves/flowers, and arthropods. Adverse effects in individuals from consumption of fruit/pods and seeds is a concern for at least one UDL for listed species that are under 4,500 g and 200 g, respectively. In general, listed species that weigh <5,000 g and consume fruit/pods or seeds also consume one of the other dietary items that is a concern for all UDLs. For species that are >5,000 g, residues in grasses exceed the acute threshold for all UDLs whereas, residues in arthropods and broadleaf plants exceed the acute threshold for all UDLs except the Soybeans and Other Crops.

Body weight of the bird/reptile species is more of a determining factor in which dietary items exceed the population-level threshold (**Table 45**). At least one UDL exceeds the acute population threshold for listed insectivores that weigh <5,000 g, herbivores that weigh <2,500 g, and nectivore species that weigh 100 g or less. Mean residues on fruit/pods exceed the acute population-level threshold for at least one UDL for species that weigh 20 g or less and estimated residues on seeds from foliar uses do not exceed the acute population threshold regardless of body weight. In general, mean residues in arthropods, grasses, broadleaf plants, nectar, and fruit/pods exceed the acute population threshold across all UDLs for listed species that weigh ≤100 g, ≤20 g, ≤15 g, ≤10g, and ≤7 g respectively. Conversely, population-level effects from consumption of dietary items that contain acetamiprid residues from foliar exposure are unlikely for listed bird and reptile species that weigh more than 5,000 g

Table 45. Dose-based Effects Analysis for Direct Effects to Listed Birds and Reptile Species from Registered Uses of Acetamiprid for Different Body Weight Categories and Forage.

Level of Biological Organization→	Individual			Population		
Dietary Item↓	Upper-bound Dose-based EEC Range (mg ai/kg-bw)	Exposure to Effects Ratio (EEC/Toxicity Endpoint)[1]	UDL Exceedances	Mean Dose-based EEC Range (mg ai/kg-bw)	Exposure to Effects Ratio (EEC/Toxicity Endpoint)[1]	UDL Exceedances
Very Small (<20 g)						
Grasses[2]	9.61-151	**1.57-25**	All UDLs	3.14-53.5	0.72-**12.6**	All UDLs[5]
Broadleaf Plants[3]	11.8-103	**1.93-19**		3.93-34.2	0.90-**8.75**	
Fruits/pods	1.31-13.5	0.21-**2.64**		0.61-6.31	0.14-**1.74**	
Seeds	0.29-0.44	0.05-0.09	No UDLs	Adverse effects are unlikely given lack of effects at individual level		
Arthropods[4]	8.21-307	**1.34-104**	All UDLs	5.68-212	**1.31-31.3**	All UDLs
Small (>20 to 100 g)						
Grasses[2]	6.21-62.0	0.84-**9.92**	All UDLs	2.03-20.3	0.39-**4.58**	All UDLs except Soybean and Other Crops
Broadleaf Plants[3]	7.73-79.1	**1.05-12.9**		2.58-26.4	0.49-**6.04**	
Fruits/pods	0.81-7.27	0.11-**1.09**		0.38-3.39	0.07-0.72	No UDLs
Seeds	0.19-1.70	0.03-0.26	No UDLs	Adverse effects are unlikely given lack of effects at individual level		
Arthropods[4]	4.96-55.1	0.65-**8.96**	All UDLs	3.43-38.1	0.63-**8.73**	All UDLs[6]
Medium (>100 to 1000 g)						
Grasses[2]	3.10-66.3	0.31-**7.80**	All UDLs	1.02-23.5	0.14-**3.89**	All UDLs except Soybean and Other Crops[7]
Broadleaf Plants[3]	3.35-44.1	0.32-**5.58**		1.12-14.7	0.15-**2.62**	
Fruits/pods	0.42-4.14	0.04-0.49	No UDLs	Adverse effects are unlikely given lack of effects at individual level		
Seeds	0.09-0.92	0.01-0.11				
Arthropods[4]	2.23-30.7	0.21-**3.88**	All UDLs	1.54-21.2	0.20-**3.78**	All UDLs except Soybean and Other Crops[8]
Large (>1000 g)						
Grasses[2]	2.32-31.5	0.15-**2.69**	All UDLs	0.82-11.2	0.07-**1.34**	Nursery, Vegetable and Ground Fruit, Other Orchards, and Citrus[9]
Broadleaf Plants[3]	1.30-19.9	0.08-**1.79**		0.43-6.63	0.04-0.84	No UDLs

Fruits/pods	0.19-2.13	0.01-0.19	No UDLs	Adverse effects are unlikely given lack of effects at individual level		
Seeds	0.04-0.44	<0.01-0.04				
Arthropods[4]	1.16-13.8	0.08-**1.23**	All UDLs	0.80-9.51	0.08-**1.20**	Nursery, Vegetable and Ground Fruit, Other Orchards, and Citrus

EEC=estimated environmental concentration

Bolded value exceeds the individual acute and chronic level of concern (LOC) of 0.1 and 1.0, respectively, or the population acute and chronic LOC of 1.0

[1] The endpoints selected to evaluate individual and population level effects are summarized in **Table 44.**

[2] The exposure to effects ratio for grasses is based on the short grass Kenaga values and are considered for both short and tall grass dietary items.

[3] Leaves EECs are based on the broadleaf plant Kenaga values and also serve as a surrogate for estimating exposure from consumption of flowers and fungi.

[4] Based on the arthropod Kenaga values and also serve as a surrogate for estimating exposure from soil-dwelling invertebrates.

[5]Residues in grasses/nectar and broadleaf plants for Soybeans and Other Crop UDLs do not exceed the population level threshold for species that are >10 and 15 grams, respectively. Residues in fruit do not excced the population level threshold from any UDL for species >19 grams and from Cotton, Alfalfa, Other Row Crops, Developed, Open-Spaced Developed, Soybean, and Other Crops UDLs for species that are >7 grams.

[6]Residues in arthropods for Soybeans and Other Crop UDLs do not exceed the population level threshold for species that are >35 grams.

[7]Residues in broadleaf plants for Cotton, Alfalfa, Other Row Crops, Developed, Open-Spaced Developed UDLs for species that are >300 grams.

[8]Residues in arthropods for Cotton, Alfalfa, Other Row Crops, Developed, Open-Spaced Developed UDLs for species that are >630 grams.

[9]Residues in grasses for all UDLs do not exceed the population level threshold for species that are >2,500 grams.

Table 46 reports the acute dose-based exposure-to-effect ratios for bird and reptile populations and communities based on generic body weight classes which informs the assessment of PPHD effects for listed species that rely on birds and reptiles. Mean residues for some or all UDLs exceed the acute population threshold for small (20 g) and medium (100 g) birds/reptiles that consume grasses, broadleaves, and arthropods. Except for the Soybean and Other Crop UDLs, multiple dietary items exceed the acute threshold for species in these weight classes across UDLs. EPA estimates acute exceedances for large (1,000 g) birds and reptiles only for mean residues in short grass and arthropods for at least one UDL and there are no exceedances of any dietary item in this weight class for Developed/Open Spaced Developed, Other Crops, Other Row Crops, and Soybean. Patterns in the UDL exceedances of the community-level acute threshold are similar to the population threshold, except that short grasses are the only dietary item with residues that exceed the acute threshold for large birds and reptiles. Mean residues in fruit/pods, and seeds do not exceed the acute population threshold for small, medium, or large birds and reptiles.

Table 46. Acute Dose-based Effects Analysis for Direct Effects to Non-listed Birds and Reptiles That Serve as Prey, Pollination, Habitat, or Dispersal (PPHD) for Listed Species.

Level of Biological Organization→	Mean Dose-based EEC Range (mg ai/kg-bw)	Population		Community	
Dietary Item↓		Exposure to Effects Ratio (EEC/Toxicity Endpoint)[1]	UDL Exceedances	Exposure to Effects Ratio (EEC/Toxicity Endpoint)[1]	UDL Exceedances
Small Birds/Reptiles (20 g)					
Short grass	7.3-50.3	**1.68-11.67**	All UDLs	**1.18-8.19**	All UDLs
Tall grass[2]	3.1-21.3	0.71-**4.94**	All UDLs except Other Crops and Soybeans	0.50-**3.47**	All UDLs except Other Crops and Soybeans
Leaves[3]	3.8-26.7	0.89-**6.18**		0.63-**4.34**	
Fruits/pods	0.6-4.1	0.14-0.96	No UDLs	No exceedances at population level	
Seeds	0.1-0.9	0.03-0.21			
Arthropods[4]	5.6-38.5	**1.29-8.92**	All UDLS	0.90-**6.26**	All UDLs except Other Crops and Soybeans
Medium Birds/Reptiles (100 g)					
Short grass	4.1-28.7	**0.75-5.23**	All UDLs except Other Crops and Soybeans	0.53-**3.67**	All UDLs except Other Crops and Soybeans
Tall grass[2]	1.8-12.2	0.32-**2.21**		0.22-**1.55**	Alfalfa, Citrus, Other Orchards, Vegetable and Ground Fruit, Nursery
Leaves[3]	2.2-15.2	0.40-**2.77**		0.28-**1.94**	Alfalfa, Citrus, Cotton, Other Orchards, Vegetable and Ground Fruit, Nursery
Fruits/pods	0.3-2.4	0.06-0.43	No UDLs	No exceedances at population level	
Seeds	0.1-0.5	0.01-0.10			
Arthropods[4]	3.2-22	0.58-**4.0**	All UDLs except Other Crops and Soybeans	0.40-**2.81**	All UDLs except Other Crops and Soybeans

Large Birds/Reptiles (1,000 g)					
Short grass	1.9-12.9	0.24-**1.66**	Alfalfa, Citrus, Cotton, Other Orchards, Vegetable and Ground Fruit, Nursery	0.17-**1.16**	Citrus, Other Orchards, Vegetable and Ground Fruit, Nursery
Tall grass[2]	0.8-5.4	0.10-0.70	No UDL Exceedances	No exceedances at population level	
Leaves[3]	1.0-6.8	0.13-0.88			
Fruits/pods	0.2-1.1	0.02-0.14			
Seeds	<0.1-0.2	<0.01-0.03			
Arthropods[4]	1.4-9.8	0.18-0.27	Citrus, Other Orchards, Vegetable and Ground Fruit, Nursery	0.13-0.89	No UDL Exceedances

EEC=estimated environmental concentration; GMO=genetically modified organism; UDL=use data layer.
Bolded value exceeds the population and community acute level of concern (LOC) of 1.0.
[1] The acute endpoints used to evaluate population and community-level effects in birds and reptiles are captured in **Table 44**.
[2] The exposure-to-effect ratios for grasses are based on the short grass Kenaga values and are considered for both short and tall grass dietary items.
[3] EECs for leaves are based on the broadleaf plant Kenaga values and also serve as a surrogate for estimating exposure from consumption of flowers and fungi.
[4] Based on the arthropod Kenaga values and also serve as a surrogate for estimating exposure from soil-dwelling invertebrates.

Table 47 reports the acute and chronic dietary-based exposure-to-effect ratios for individual birds and reptiles, their populations and communities. Since this route of exposure is not dictated by body weight, the results of this analysis apply to both listed species and birds/reptiles that serve as PPHD for other listed species. Acute and/or chronic dietary exposure exceed the individual threshold for all UDLs for grasses, broadleaf plants and arthropods. For fruit/pods/seeds, dietary exposure exceeds the acute and/or chronic threshold for Citrus, Other Orchard, Vegetable and Ground Fruit, and Nursery UDLs only. At the population level, acute dietary exposure from acetamiprid residues in short grass and arthropods exceed the avian toxicity threshold for the Citrus, Other Orchard, Vegetable and Ground Fruit, and Nursery UDLs only. Acetamiprid residues in tall grass, broadleaf plants, and fruit/seeds/pods do not exceed the acute population threshold and no dietary item exceeds the chronic population threshold. No dietary item exceedances the acute or chronic community threshold.

Table 47. Dietary-based Direct Effects Analysis for Direct Effects to Listed Birds and Reptiles and Non-Listed Species That Serve as PPHD for Listed Species of Birds.

Level of Biological Organization→	Individuals			Population			Community		
Dietary Item↓	**Upper-bound EEC (mg ai/kg)[1]**	**Exposure to Effects Ratio (EEC/Toxicity Endpoint)[2]**	**UDL Exceedances**	**Mean EEC (mg ai/kg)[3]**	**Exposure to Effects Ratio (EEC/Toxicity Endpoint)[4]**	**UDL Exceedances**	**Mean EEC (mg ai/kg)[3]**	**Exposure to Effects Ratio (EEC/Toxicity Endpoint)[4]**	**UDL Exceedances**
Short Grass	18-125	A: **0.31-2.15** C: 0.36-**2.50**	All UDLs	6.4-44.2	A: 0.21-**1.47** C: 0.09-0.63	Citrus, Other Orchard, Vegetable and Ground Fruit, Nursery	6.4-44.2	A: 0.11-0.76 C: 0.09-0.63	No UDL Exceedances
Tall Grass	8.3-57.2	A: **0.14**-**0.99** C: 0.17-**1.14**		2.7-18.7	A: 0.09-0.62 C: 0.04-0.27	No UDL Exceedances	2.7-18.7	A: 0.05-0.32 C: 0.04-0.27	
Broadleaf Plants	10.1-70.2	A: **0.17**-**1.21** C: 0.20-1.40		3.4-23.3	A: 0.11-0.78 C: 0.05-0.33		3.4-23.3	A: 0.06-0.40 C: 0.05-0.33	
Fruits, pods, seeds	1.1-7.8	A: 0.02-**0.13** C: 0.02-**0.16**	Citrus, Other Orchard, Vegetable and Ground Fruit, Nursery	0.5-3.6	A: 0.02-0.12 C: 0.02-0.05		0.5-3.6	A: 0.03-0.06 C: 0.02-0.05	
Arthropods	7.1-48.9	A: **0.12**-**0.84** C: 0.14-0.98	All UDLs	4.9-33.8	A: 0.16-**1.13** C: 0.07-0.48	Citrus, Other Orchard, Vegetable and Ground Fruit, Nursery	4.9-33.8	A: 0.08-0.58 C: 0.07-0.48	

The level of concern (LOC) for effects in individuals is 0.1 and the LOC for all other exposure scenarios is 1.0. **Bold** values indicate exceedance of the LOC. No chronic endpoints are available for contact exposure; therefore, the exposure to effects ratios presented in this table represent acute exposure only.
EEC=estimated environmental concentration; UDL = Use Data Layer;

Acute exposure is the driver of potential adverse effects to birds and reptiles from foliar uses. Exceedances of the acute thresholds for individuals and populations suggest that that listed bird/reptile species consuming those dietary items are likely to experience individual and population-level effects. The EECs calculated for each dietary item, however, reflect the peak upper-bound or mean residue level at the use site based on the maximum registered use rate within that UDL. EPA estimates that upper-bound acetamiprid residue levels will drop below the acute threshold for individuals in all dietary items for all bird weight classes within 322 days when considering use patterns with multiple applications and the shortest reapplication window, and within 285 days from a single application to an untreated use site. Likewise, EPA estimates that dietary items at use sites with mean residues drop to below the acute population threshold within 164 or 125 days from multiple and single applications, respectively. These estimates are based on a default 35-day foliar half-life. Terrestrial field dissipation data suggest that acetamiprid residues on the field are likely to dissipate quicker, though the rate of loss from foliar surfaces is uncertain and it is likely that residues could remain above the acute threshold for individuals and populations for an extended period of time based on the range of reported half-lives in those studies.

In order to consume enough residues to achieve a dose-based concentration likely to exceed the acute individual or population-level threshold, a birds would need to obtain <1 to 100% of its daily diet from the use site depending on the weight class, dietary item, and whether the use site contained upper-bound or mean residues. It is likely there will be forage available both on and off-site and unlikely that all use sites will be treated simultaneously. While spray drift is likely to deposit residues on dietary items away from the field presenting another source of dietary exposure, the extent to which this occurs is influenced by multiple factors (*e.g.*, application equipment, weather, extent of crop canopy). Based on exposure-to-effect ratios and output from the AgDrift® model, exceedances of the acute individual threshold are likely up to 305 meters from the field assuming all spray applications drift off field in the same direction; exceedances of the acute population threshold are likely up to 30 meters from a single spray event. Residues in these areas will be lower than on the field; however, the off-site exposure areas are likely to present more optimal foraging conditions compared to the use site for many listed birds and reptiles, particularly if the use site is a managed field.

For species of all sizes, EPA cannot rule out that an individual bird or reptile would forage regularly in areas with acetamiprid residues (either on or adjacent to the use site) and consume enough residues in their diet to reach the threshold for acute mortality. However, for populations, the weight of the species and the UDL will dictate the likelihood of multiple individuals experiencing these adverse effects. Smaller birds and reptiles (≤100 grams) are more likely to experience population-level effects given that individuals would need to obtain less of their diet from the use sites (as low as 3%). The likelihood of population-level effects increases further for UDLs where adverse effects are likely from consumption of dietary items off-site in addition to on-site. Given that the effect is acute mortality and residues are likely to remain above the population-level threshold for some time, it is likely that that the extent of mortality in individuals of smaller birds and reptiles that forage in and adjacent to use sites would affect the species population. For larger species (≥100 grams) which must forage more on at the use site (25% or more of diet) and, particularly for UDLs (*i.e.*, all UDLs except Citrus, Other Orchards, and Vegetable and Ground Fruit, see **Table 47**) where exceedances of the acute population threshold are limited to the field, it is unlikely that a large number of individuals would exhibit the foraging behavior necessary to result in widespread mortality that lead to a population level direct effect.

Within bird and reptile communities, small species are also likely to be adversely affected. Based on the spray drift analysis using AgDrift® (**Appendix F. Spray Drift Analysis**), community-level effects in birds and reptiles are likely only at the use site. Multiple dietary items for small species (20 grams) exceed the LC_{50} which increase the likelihood of different species with diverse feeding habits experiencing adverse effects and species of this size would not need to forage at use sites frequently to reach that threshold. While medium-sized (100 grams) birds and reptiles also exceed the LC_{50} for multiple dietary items, species that weigh more than 100 grams would need to consume 27% or more of their diet from use sites to exceed the LC_{50}, which could happen for an individual but is unlikely to occur at a scale that will adversely affect a community of bird species. For large birds and reptiles (1,000 grams), only residues on short grass exceed the community-level threshold and it is unlikely that many species of this size will feed exclusively on short grass from use sites reducing the likelihood of adverse effects to bird and reptile communities consisting primarily of larger species.

Seed Treatment

For seed treatment exposure, rather than presenting exposure-to-effect ratios, **Table 48** summarizes the number of seeds that would need to be consumed to reach the threshold for each level of biological organization as well as additional characterization on the foraging area and foraging time that is likely to lead to adverse effects. According to EPA's Refinements for *Risk Assessment of Pesticide Treated Seeds – Interim Guidance*[2] (and data derived from Benkman and Pulliam 1988[3]), the maximum size seed that an average 20-g passerine bird will consume is 60 mg, and the maximum size seed a 100-g passerine bird will consume is 120 mg. Seed treatments are permitted for canola, mustard, and potato seeds. Based on an average weight of one canola or mustard seed (*i.e.*, approximately 4.56 mg), these seeds could be consumed by any size of bird. On the other hand, the average seed potato weighs roughly 60 g; therefore, seed potatoes are likely too large to be consumed by smaller- and medium-sized birds. A direct effects analysis for seed potatoes is, therefore, only conducted for large birds.

For seed treatments of canola and mustard seed, small birds with sensitivity similar to the Zebra finch would need to consume between 1 to 6 and 2 to 4 seeds from the field to reach the acute and chronic thresholds, respectively, for individuals, populations and communities. For acute effects, small-sized species would need to forage between 5 to 6 seconds (or approximately 0.02% of their foraging time) over an area ranging from 0.39 to 0.67 ft^2 to exceed the individual level effects threshold. To exceed the population and community level effects acute thresholds (*i.e.,* the LD_{10} and LD_{50}, respectively), small species would need to forage between 14 to 34 seconds (or approximately 0.05-0.12% of their foraging time) over an area ranging from 1.18 to 4.0 ft^2.

Medium-sized birds would need to consume between 3 to 39 and 11 to 19 canola or mustard seeds from the field to reach the acute and chronic thresholds, respectively, for individuals, populations and communities. For acute effects, medium-sized species would need to forage between 14.6 to 19.6 seconds (or approximately 0.05-0.07% of their foraging time) over an area ranging from 1.18 to 2.67 ft^2 to exceed the individual level effects threshold. To exceed the population and community-level acute effects thresholds (*i.e.,* the LD_{10} and LD_{50}, respectively), medium-sized species would need to forage between 107 to 137 seconds (or approximately 0.37-0.66% of their foraging time) over an area ranging from 8.6 to 26 ft^2.

For seed treatments of canola and mustard seed, large-sized birds would need to consume between 43 to 556 and 108 to 195 seeds from the field to reach the acute and chronic thresholds, respectively, for individuals, populations and communities. Large-sized species would need to forage on canola and mustard seeds over an area ranging from 17 to 37 ft^2 to exceed the acute individual level effects threshold. To exceed the population and community-level effects acute thresholds (*i.e.,* the LD_{10} and LD_{50}, respectively), large-sized species would need to forage on canola and mustard seeds over an area ranging from 171 to 371 ft^2. For potatoes seeds, large-sized birds would need to consume between 1 to 3 and 1 seed from the field to reach the acute and chronic thresholds, respectively, for individuals, populations and communities. Large-sized species would need to forage over an area ranging from 125 to 300 ft^2 to exceed the individual level effects threshold. To exceed the population and community-level effects acute thresholds (*i.e.,* the LD_{10} and LD_{50}, respectively), large-sized species would need to forage over an area ranging from 125 to 900 ft^2.

All weight classes would need to forage over similar or smaller area and for a similar or shorter period of time to reach the chronic thresholds for individuals, populations, and communities; however, species would likely need to consume seeds exclusively from treated fields daily to elicit the adverse effects on growth. For all weight classes and UDLs, the area in which the species needs to forage accounts for <0.01% of their home range.

Minimum planting depths for canola and mustard seed is 0.5 inches and is 5 inches for potatoes based on information from the acetamiprid registrants. The planting depth of canola and mustard seed can further range up to 1.5 inches (USEPA 2022). Planted canola and mustard seeds are, therefore, likely to be available to all-sized granivore and omnivore listed and non-listed species that forage for seeds at use sites. Although there is some uncertainty with the degree to which larger bird species would consume seed potatoes, adverse effects to large birds from consumption of seed potatoes is likely to be minimal given the typical planting depth of 5 inches seed potatoes.

EPA considers adverse effects from ingestion of acetamiprid-treated mustard and canola seeds likely for small to medium-sized listed birds and reptiles that consume seeds for at least a portion of their diet. While the adverse effects are limited to the field, the low number of seeds, foraging time, and foraging area required to reach the individual and population thresholds suggest that even infrequent foraging at the use site around the time of planting would result in adverse effects. For listed birds, the likelihood of a population-level effects is further increased in species that forage in flocks. It is unlikely that all fields will be seeded at the same time; however, there will be some consistency in timing of planting given that these seeds need to be in the ground by specific dates to ensure adequate time for their germination and subsequent growth. After planting, the species may be exposed by unearthing the seeds or pulling the germinated seed from the ground after emergence. The extent to which the latter scenario results in exposure to the treated seed will depend on the rate of dissipation of acetamiprid from the seed coat and the amount of the seed coat that remains in/on the seedling after it is pulled to the surface. Post-emergence exposure to acetamiprid from treated seeds may also occur from eating plant foliage or arthropods that are consuming treated plants following systemic transport of residues to edible plant tissues, but it is likely to be much lower compared to consumption of the treated seed and the foliar EECs for broadleaf plants reported above. Notably, the labels for acetamiprid permit only spring planted canola and mustard seeds to be treated with acetamiprid. In a given growing season, the window for exposure to acetamiprid treated seeds is, therefore, the spring planting season for these crops. Exposure to treated seeds is unlikely for bird and reptile species that move through areas where mustard seed and canola are grown outside of the spring planting window (*e.g.,* migratory species).

The direct effects analysis for seed treatments addresses seeds planted on the field; however, it does not consider seed spills that may occur during the planting. If not cleaned up immediately, the seed spill will present an easily accessible and substantial source of forage for granivores and, given the larger number of seeds available, will likely result in higher exposure to treated seeds than estimated in T-REX. Seed spills are most likely to occur at the edge of fields around the planting time for the crop. The seeds are likely to be available for a short duration due to competition for the easily accessible seeds and any efforts to clean up the seed spill which will limit the number of individuals that are exposed to this large influx of seeds. Consequently, it is likely that seed spill events will result in acute exposure to some individuals that forage near where the spill occurs, but is unlikely to present a source of chronic exposure nor affect enough individuals to lead to population or community level effects.

Table 48. Direct Effects Analysis for Birds and Reptiles Exposed to Acetamiprid Treated Seeds.

Level of Biological Organization→	Individuals			Population			Community		
UDL →	Other Grains[1]	Other Crops[2]	Vegetable and Ground Fruit[3]	Other Grains[1]	Other Crops[2]	Vegetable and Ground Fruit[3]	Other Grains[1]	Other Crops[2]	Vegetable and Ground Fruit[3]
Small Birds/Reptiles (20 g)									
# Seeds to Exceed the Threshold	A: 1 C: 2-3	A: 1 C: 2	Seed is too large	A: 3-4 C: 3-4	A: 4 C: 3	Seed is too large	A: 5-6 C: 3-4	A: 5 C: 3	Seed is too large
Forage area of concern (ft2)	A: 0.39-0.67 C: 0.78-2.0	A: 0.48 C: 0.97		A: 1.18-2.67 C: 1.18-2.67	A: 1.94 C: 1.45		A: 1.96-4.0 C: 1.18-2.67	A: 2.42 C: 1.45	
Percent of Home Range (%)	A: <0.01% C: <0.01%	A: <0.01% C: <0.01%		A: <0.01% C: <0.01%	A: <0.01% C: <0.01%		A: <0.01% C: <0.01%	A: <0.01% C: <0.01%	
Forage time of concern (s)	A: 4.6-5.7 C: 9.2-17	A: 4.7 C: 9.4		A: 13.8-22.7 C: 13.8-22.7	A: 18.8-21.3 C: 14.1-16		A: 23.1-34 C: 13.8-22.7	A: 23.5-26.7 C: 14.1-16	
% of foraging time (%)	A: 0.02% C: 0.03-0.06%	A: 0.02% C: 0.03%		A: 0.05-0.08% C: 0.05-0.08%	A: 0.07% C: 0.05-0.06%		A: 0.08-0.12% C: 0.05-0.08%	A: 0.08-0.09% C: 0.05-0.06%	
Medium Birds/Reptiles (100 g)									
# Seeds to Exceed the Threshold	A: 3-4 C: 11-14	A: 3 C: 12	Seed is too large	A: 22-28 C: 15-19	A: 24 C: 17	Seed is too large	A: 31-39 C: 15-19	A: 34 C: 17	Seed is too large
Forage area of concern (ft2)	A: 1.18-2.67 C: 4.31-9.33	A: 1.45 C: 5.81		A: 8.6-19 C: 5.9-12.7	A: 11.6 C: 8.23		A: 12.2-26 C: 5.9-12.7	A: 16.5 C: 8.23	
Percent of Home Range (%)	A: <0.01% C: <0.01%	A: <0.01% C: <0.01%		A: <0.01% C: <0.01%	A: <0.01% C: <0.01%		A: <0.01% C: <0.01%	A: <0.01% C: <0.01%	
Forage time of concern (s)	A: 14.6-19.6 C: 53.4-68.7	A: 14.6 C: 58.6		A: 107-137 C: 72.8.93.2	A: 117 C: 83		A: 150-191 C: 72.8.93.2	A: 166 C: 83	
% of foraging time (%)	A: 0.05-0.07% C: 0.19-0.24%	A: 0.05% C: 0.20%		A: 0.37-0.48% C: 0.25-0.32%	A: 0.41% C: 0.29%		A: 0.52-0.66% C: 0.25-0.32%	A: 0.58% C: 0.29%	

Level of Biological Organization→	Individuals			Population			Community		
UDL →	Other Grains[1]	Other Crops[2]	Vegetable and Ground Fruit[3]	Other Grains[1]	Other Crops[2]	Vegetable and Ground Fruit[3]	Other Grains[1]	Other Crops[2]	Vegetable and Ground Fruit[3]
Large Birds/Reptiles (1,000 g)									
# Seeds to Exceed the Threshold	A: 43-56 C: 108-138	A: 48 C: 120	A: 1 C: 1	A: 308-394 C: 152-195	A: 343 C: 169	A: 1-2 C: 1	A: 435-556 C: 152-195	A: 483 C: 169	A: 1-3 C: 1
Forage area of concern (ft2)	A: 17-37 C: 42-54	A: 23 C: 58	A: 125-300 C: 125	A: 120-263 C:59.6-76.5	A: 166 C: 81.8	A: 125-600 C: 125	A: 171-371 C:59.6-76.5	A: 234 C: 81.8	A: 125-900 C: 125
Percent of Home Range (%)	A: <0.01% C: <0.01%	A: <0.01% C: <0.01%	A: <0.01% C: <0.01%	A: <0.01% C: <0.01%	A: <0.01% C: <0.01%	A: <0.01% C: <0.01%	A: <0.01% C: <0.01%	A: <0.01% C: <0.01%	A: <0.01% C: <0.01%

The level of concern (LOC) for effects in individuals is 0.1 and the LOC for all other exposure scenarios is 1.0. EEC=estimated environmental concentration; UDL = Use Data Layer; A= Acute; C = Chronic.

[1]Canola is the only seed treatment for the Other Grains UDL. The analysis used an application rate of 15.4 fl oz/100 lb seed, a seeding rate of 740,000 seeds/A and a range of 90,000 to 115,000 seeds/pound. Seeds are assumed to be lightly incorporated in soil based on seed planting depth of 0.5 to 1.5 inches with 15% of seeds available at the soil surface.

[2]Mustard seed is the only seed treatment for the Other Crops UDL. The analysis used an application rate of 15.4 fl oz/100 lb seed, a seeding rate of 600,000 seeds/A and 100,000 seeds/pound seeds. Seeds are assumed to be lightly incorporated in soil based on seed planting depth of 0.5 to 1.5 inches with 15% of seeds available at the soil surface.

[3]Potato seed is the only seed treatment for the Vegetable and Ground Fruit UDL. The analysis used an application rate of 0.3 fl oz/100 lb seed, a seeding rate of 14,520 to 34,848 seeds/A and 5 to 11 seeds/pound seeds. Seeds are assumed to be more thoroughly incorporated in soil based on seed planting depth of 5 inches with approximately 1% available at the soil surface.

Adverse effects to listed birds and reptiles are likely at the individual and population level from acute exposure to acetamiprid residues in dietary items resulting from foliar and seed treatment applications. Adverse effects may also result from chronic exposure; however, the species would need to feed regularly on exposed dietary items at use sites which may be more likely for individuals but not a population. At the individual level, adverse effects from foliar and seed treatment uses are likely for species of all sizes. Conversely, at the population level, adverse effects from foliar uses are most likely for small species (≤20 grams) whereas treated seeds are likely to adversely affect small- and medium-sized (≤1,000 g) species. The direct effects analysis is based on toxicity observed in a passerine species which exhibits greater sensitivity to acetamiprid compared to the other bird species tested. A quantitative evaluation of the sensitivity distribution across bird species is precluded due to the limited number of species tested; however, the increased sensitivity in the passerine species tested coupled with acute exceedances across multiple dietary items in the weight range of listed passerine species suggest a high likelihood of direct effects for the listed Passerine birds. Furthermore, the heightened sensitivity of passerine species and lack of chronic toxicity data suggest that the exposure-to-effect ratios for chronic exposure are likely underestimated at least for passerine species.

Regarding PPHD effects, obligate relationships with small birds or reptiles are likely to be adversely affected based on the direct effects analysis for population-level effects. For generalist relationships, bird and reptile communities consisting primarily of small-sized species are likely to be the most vulnerable to adverse effects from registered uses of acetamiprid. Since an SSD could not be created, the community level evaluation is based on the most sensitive species tested. Acute thresholds based on data for a less sensitive species (*i.e.*, the Mallard duck) would be approximately an order of magnitude higher and would not be exceeded by upper-bound or mean residues. Likewise, a bird or reptile would need to consume 10-15 times more seeds to reach the acute thresholds based on the endpoints for the Mallard duck for different levels of biological organization. Although community-level impacts to birds and reptiles cannot be discounted due to the limited number of species tested, the data suggest that within a bird community at least acute effects are more likely to manifest in the passerine species. Approximately 76% of bird species associated with agricultural fields or adjacent edge habitat are passerines (USEPA, 2015) and the direct effects analysis results indicate that bird communities in those areas and listed species that rely on them are vulnerable to adverse effects from acetamiprid.

6.4.3 Off-Site Transport Distances

Given that adverse effects to birds and reptiles are likely, EPA determined the extent to which off-site transport will contribute these adverse effects at each level of biological organization to define the exposure area for each UDL. Spray drift is likely to be the primary route of off-site transport contributing to direct effects in birds and reptiles for foliar applied uses. Spray drift may result in direct exposure to spray droplets, and deposition of residues on dietary items, and/or foliar, soil, and other surfaces that the species moves across. Runoff may contribute to residues in the soil or in plant tissues following systemic uptake; however, it is likely to be a minor route of exposure relative to spray drift. **Table 49** provides the furthest off-field distances within which spray drift may lead to direct effects to bird and reptile individuals, populations, and communities based on the toxicity thresholds for each level of biological organization. EPA then buffered out the UDLs by these distances to establish the exposure area when assessing the potential for adverse direct and PPHD effects to listed species individuals and populations.

Table 49. Off-Site Transport Distances (meters, m) Used for Estimating Spatial Overlap for Birds and Reptiles in Effects Determinations and Predictions of Likelihood of Jeopardy for Listed Species from Exposure to Acetamiprid through Spray Drift.[1]

UDL	Common Application Method[2]	Potential for Effects to an Individual[3]	Potential for Effects to a Population[4]	Potential for Effects to a Community[5]
Alfalfa	Ground-boom	240 m	0 m	0 m
Citrus	Airblast	240 m	30 m	0 m
Cotton	Ground-boom	210 m	0 m	0 m
Grapes	Airblast	180 m	0 m	0 m
Nursery	Ground-boom	305 m	0 m	0 m
Other Crops	Ground-boom, Seed treatment	60 m	0 m	0 m
Other Grains	Seed treatment	0 m	0 m	0 m
Other Orchards	Airblast	305 m	30 m	0 m
Other Row Crops	Ground-boom	150 m	0 m	0 m
Soybean	Ground-boom	60 m	0 m	0 m
Vegetable and Ground Fruit, NL48 Ag	Aerial	305 m	30 m	0 m
CONUS and NL48 Developed, Open Spaced Developed	Handheld equipment	0 m	0 m	0 m

[1] These distances reflect exposure at the use site and spray drift only given that it is the primary route of off-site exposure for birds and reptiles. Distances account for both acute and chronic effects; however, acute and chronic effects may not be a concern within the entire exposure area based on differences in exposure and sensitivity.

[2]The common application method for each UDL is considered in establishing the buffer distances for potential effects to populations and communities only (**Section 3.2.1**). The application method among those permitted on the label for a given UDL that results in the largest exposure area (generally aerial) is used to establish the buffer distance for individuals.

[3]Distances are used to establish the exposure area for each use data layer (UDL) for the May Affect/No Effect (MA/NE) and to evaluate direct effects in the Not Likely to Adversely Affect/Likely to Adversely Affect (NLAA/LAA) Determination.

[4]Distances are used to establish the exposure area for each UDL to evaluate direct effects in the predictions of Likely J and to evaluate PPHD effects to obligate relationships for the NLAA/LAA Determination and predictions of Likely Jeopardy (J).

[5]Distances are used to establish the exposure area for each UDL to evaluate PPHD effects to generalist relationships for the NLAA/LAA Determination and predictions of Likely J.

6.4.4 PPHD Effects

Listed birds have generalist relationships with plants, invertebrates, mammals, birds, reptiles, and amphibians for food and with plants for habitat. Listed reptiles have a generalist diet relationship with plants, invertebrates, fish, mammals, birds, amphibians, and other reptiles and a generalist relationship with plants and mammals (*i.e.,* use of other species burrows) for habitat. Obligate relationships for listed reptiles involve mammals and aquatic invertebrates and several listed birds have reported obligate relationships with benthic invertebrates and terrestrial plants.

Based on the generic-taxa based screening-level assessment, the registered uses of acetamiprid are likely have an effect on listed birds and reptiles that have PPHD relationships with plants, terrestrial vertebrates, and invertebrates. The registered uses are further likely to adversely affect listed bird and reptile species that have generalist or obligate relationships with invertebrates (**Section 6.1** and **Section 6.3**), reptiles, birds, and amphibians (**Section 6.4** and **Section 6.6**). The loss of prey items will have the greatest impact among listed birds and reptiles that rely primarily or exclusively on small- to medium-sized birds, amphibians, and reptiles, terrestrial non-mollusk invertebrate, and aquatic insect and/or crustacean species. Community-level adverse effects for small birds, amphibians, and reptiles are largely limited to use sites which decrease the likelihood of adverse PPHD effects for listed species that are likely to forage across multiple habitats or are unlikely to forage at use sites. Community-level effects are not likely for plants (**Section 6.7**) or mammals (**Section 6.5**); therefore, species that have a generalist relationship with these taxa are unlikely to experience adverse effects related to a decline in these dietary items or loss of habitat.

A total of 7 bird species have an obligate relationship with plants, all of which are to upland woody dicot or conifer species of plants. The registered uses of acetamiprid have the potential to impact the health of the woody plant and tree species (**Section 6.7**), particularly those occuring near use sites and with new growth, which will affect individual species co-localized with these woody plants; however, because acetamiprid is not likely to adversely affect populations of woody plants or trees, adverse PPHD effects are unlikely for the 7 avian species that have an obligate relationship with woody plant species. The only other obligate relationship among listed birds is the Everglade snail kite (*Rostrhamus sociabilis plumbeus*) which has a dietary obligate relationship with Florida apple snails (*Pomacea maculata*). Since adverse population-level effects are not likely for aquatic mollusks (**Section 6.1**), this obligate relationships is not likely to be adversely affected by the registered uses of acetamiprid. Two listed reptiles, the Louisiana pine snake (*Pituophis ruthveni*) and Eastern Massasauga rattlesnake (*Sistrurus catenatus*), have reported obligate relationships to mammals (*i.e.*, Bairds pocket gopher; *Geomys breviceps*) and aquatic invertebrates (crayfish), respectively. Since the adverse population-level effects are not likely for mammals (**Section 6.5**), the obligate relationship for the Louisiana pine snake is not likely to be adversely affected by the registered uses of acetamiprid. Crustaceans, however, are likely to be adversely affected at the population level; therefore, PPHD effects manifesting from the loss of burrow habitat in wetlands are likely for the Eastern Massasauga rattlesnake.

6.4.5 Effects Determination and Predictions of Likely Jeopardy

This BE considered a total of 99 bird and 45 reptile species were listed as of February 22, 2022. One bird species, the San Clemente sage sparrow, has since been delisted due to recovery. EPA made NE determinations for 4 bird and 3 reptile species, NLAA determinations for 28 bird and 17 reptile species, and LAA determinations for 66 bird and 25 reptile species. Of the 88 species with LAA determinations, EPA predicts that the registered uses of acetamiprid are not likely to jeopardize 64 bird and 24 reptile species; however, EPA predicts a potential likelihood of future jeopardy for 2 bird and 1 reptile species (**Table 50)**. The following section and **Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification** discusses in more detail the rationale for each determination and jeopardy prediction.

Table 50. Number of Listed Species Effects Determinations and Predictions of Likelihood of Jeopardy for Birds and Reptiles from Registered Uses of Acetamiprid.

Taxon	Number of Species[2]	NE	NLAA	LAA, Likely No J	LAA, Likely J
Birds	98*	4	28	64	2
Reptiles[1]	45	3	17	24	1

J = jeopardy; NE = no effect; LAA = likely to adversely affect; NLAA = not likely to adversely affect.
[1]Amphibians and Reptiles includes those species that have both a terrestrial and aquatic phase
[2]Reflects the species listed as of February 16, 2022.
*A total of 99 bird species were listed in February 2022; however, one bird species was delisted due to recovery.

Listed Species with No Effect (NE) Determinations

EPA made NE determinations for listed birds and reptiles that had no overlap with UDLs and the off-field areas identified (<1% overlap) when considering the exposure area in which an effect is likely.

Listed Species with May Affect (MA) Determinations

EPA made MA determinations for listed birds and reptiles whose range had ≥1% overlap with at least one UDL and is likely to experience direct effects and/or PPHD effects as a result of its relationships with invertebrates, terrestrial vertebrates, and dicot terrestrial and semi-aquatic plants.

Not Likely to Adversely Affect (NLAA) *Determinations*

NLAA determinations are driven by an assessment of the likelihood of direct and PPHD effects and exposure occurring based on different habitat characteristics and overlap. EPA made NLAA determinations for species that are unlikely to experience adverse direct and PPHD effects, that have a range with <1% overlap with any individual UDL after refining the exposure area to account for likely adverse effects to individuals and with consideration of insecticide usage and crop acreage data from the CoA, and for species where life history indicate the likelihood of exposure and adverse effects is low. The main life history considerations that drove NLAA determinations included:

- species found in or that forage primarily in the open ocean or occupy uninhabited islands where exposure from registered uses is likely to be insignificant (**Appendix I. Qualitative Analysis Approach**)
- species is delisted or proposed for delisting due to extinction
- the species is thought to be extirpated or has not been observed in the US for decades
- Species primary dietary item is mollusks (*i.e.*, Everglade snail kite)

Likely to Adversely Affect (LAA) *Determinations*

Of the MA species, LAA species are driven by an assessment of the likelihood of direct and PPHD effects from diet and based on different habitat characteristics. Species designated as LAA had the potential for direct and/or PPHD effects from the consumption of invertebrate or terrestrial vertebrate prey or an obligate relationships to dicot plants, and they inhabit areas where exposure is expected to reasonably occur at levels that could cause effects.

Potential Jeopardy Species

The predictions of likely jeopardy for listed birds and reptiles consider the magnitude of effect designations, the extent of spatial overlap between the species range and UDL after refinements, and additional information on life history and vulnerability that can influence the likelihood of a population level effect that could jeopardize its existence.

A potential likelihood of future jeopardy is not predicted for species that have low magnitude of effect and/or have low overlap (<5%) with the refined exposure area for any individual UDL or where the CoA data can be used to discount the likelihood of exposure based on low usage of insecticides or low acreage of registered crops for aggregate agricultural UDLs. Additional modifiers leading to a prediction of no likelihood of future jeopardy include:

- species is highly mobile, and has wide foraging area, and likely to forage in unaffected areas limited exposure and impacts of reduced prey base availability;
- The species is an opportunistic or generalist consumer and its dietary items include invertebrates and terrestrial vertebrates in addition other dietary items that are not likely to be adversely affected by the registered uses
- The species is unlikely to regularly rely on use sites for habitat or forage limiting the number of individuals that are likely to be impacted and overlap is <5% when considering off-site exposure only

Table 51 summarizes the listed bird and reptiles species for which EPA predicts a likelihood of jeopardy from registered uses of acetamiprid. A potential likelihood of future jeopardy is predicted for these species based on the following overlap and life history information:

- At least one UDL overlaps with >5% with the species range and, when available, CoA data indicate high acreage of insecticide usage and/or crop acreage for aggregate UDLs;
- Terrestrial insects and/or aquatic insects and crustaceans are the species preferred or only source of prey for some or all of the species life cycle.
- The species has an obligate relationship with crustaceans to use their burrows for shelter

In addition, all listed species that are predicted to have a potential likelihood of future jeopardy are medium to high vulnerability. Two bird and one reptile species are predicted to have a potential likelihood of future jeopardy resulting from currently registered uses of acetamiprid. The listed bird species are likely to be adversely affected by direct effects and/or reduction in prey availability at the use site and/or in off-site areas that receive spray drift and runoff. The listed reptile species is likely to be adversely affected by loss of burrow habitat due to a decline in crayfish populations in wetlands receiving spray drift and runoff from the use sites.

Table 51. Listed Bird and Reptile Species with Predicted Likelihood of Jeopardy from Registered Uses of Acetamiprid.

Entity ID	Common Name (Scientific Name)
Birds	
84	Yuma Ridgways (clapper) rail (*Rallus obsoletus* [=*longirostris*] *yumanensis*)
4296	Streaked horned lark (*Eremophila alpestris strigata*)
Reptiles	
7800	Eastern Massasauga (=rattlesnake) (*Sistrurus catenatus)*

6.5 Mammal Risk Characterization

6.5.1 Direct Effects

6.5.1.1 Summary of Ecotoxicity Data for Mammals

Mammalian toxicity data are available for the mammalian Orders Rodentia (*i.e.*, rats and mice), Carnivora (*i.e.*, dog), and Lagomorpha (*i.e.*, rabbits) and cover multiple durations of exposure, exposure routes (*i.e.*, oral gavage, dietary, dermal, and inhabitation), and a range of apical and non-apical endpoints. Acute oral, dermal, and inhalation toxicity was evaluated in the Norway rat (*Rattus norvegicus*) with reported LD_{50}/LC_{50} values of 146 mg/kg-bw, >2,000 mg/kg-bw, and >1.15 mg/L, respectively. Based on the acute oral toxicity data, EPA classified acetamiprid TGAI as moderately toxic to mammals on an acute exposure basis.

Toxicity from subchronic and chronic exposure is evaluated in rats, mice, dogs, and rabbits. The Norway rat was the most sensitive species tested for repeated exposure based on body weight adjusted endpoints. Growth (*i.e.,* reduced body weight and body weight gain) effects are noted across all mammalian species evaluated. Developmental delays and reproductive effects were also noted at similar or higher dose levels as the growth effects. There was no evidence of increased mortality in any species within the dose range tested (up to 51 mg ai/kg bw/day). On chronic exposure basis, the most sensitive effects were reduced body weight and body weight gain in the Norway rat over two years of exposure. The chronic NOAEC was established at 8.8 mg ai/kg-bw/day (160 mg ai/kg diet) based on 4-17% decrease in female body weight and 16% decrease in overall body weight gain at the LOAEL of 22.6 mg ai/kg bw/day (400 mg ai/kg diet). There is evidence of a progression in the growth effect in rats with increasing duration of exposure. Within the chronic toxicity study, there were no biologically significant effects on body weight until the second year of exposure in the 22.6 mg ai/kg bw/day treatment group. In the subchronic oral toxicity study and the 2-generation rat reproduction studies, dietary exposure occurs over 90 days and 1 year, respectively, and the growth effects in these studies were observed at 50-60 mg ai/kg bw with NOAECs established at 12-22 mg ai/kg bw. A similar progression in growth effects is observed in mice from subchronic (male NOAEL = 106 mg ai/kg bw) to the chronic (male LOAEL = 66 mg ai/kg bw) exposure. Reproductive effects including reduced pup weight, number of viable pups, and litter size were observed in rats only and at doses of 45-51 mg ai/kg bw. **Table 52** summarizes the most sensitive mammalian toxicity data for acetamiprid.

Table 52. Most Sensitive Acetamiprid Toxicity Data for Mammals.

Study Type	Test Substance (% ai)	Test Species	Toxicity Value	MRID Classification
Order Rodentia				
Mammal Acute Oral Toxicity	TGAI (99.5%)	Norway Rat (*Rattus norvegicus*)	LD_{50}= 146 mg ai/kg-bw	44651833 Acceptable
Mammal Acute Dermal Toxicity	TGAI	Norway Rat (*R. norvegicus*)	LD_{50}>2,000 mg/kg-bw	44651386 Acceptable
Mammal Acute Inhalation Toxicity	TGAI	Norway Rat (*R. norvegicus*)	LC_{50} > 1.15 mg/L	44651837 Acceptable
Chronic / Carcinogenicity Study (dietary)	TGAI (>99%)	Norway Rat (*R. norvegicus*)	NOAEC = 160 mg ai/kg-diet LOAEC = 400 mg ai/kg-diet NOAEL = 8.8 mg ai/kg-bw/day LOAEL = 22.6 mg ai/kg-bw/day Decreased body weight and body weight gain in females	44988429 Acceptable
Order Carnivora				
90-day oral toxicity study (dietary)	TGAI	Beagle dog (*Canis familiaris*)	NOAEL = 13 mg/ kg/day LOAEL = 32 mg/kg/day Reduced body weight gain in both sexes	44988424 Acceptable
Order Lagomorpha				
Developmental Toxicity (gavage)	TGAI	New Zealand White Rabbit (*Oryctolagus cuniculus*)	NOAEL = 15 mg/kg/day LOAEL = 30 mg/kg/day Body weight loss and decreased food consumption	Acceptable 44651848

Note: TGAI=Technical Grade Active Ingredient; ai=active ingredient; NOAEC=No-Observed-Adverse-Effect-Concentration; NOAEL=no-observed adverse effect level; LD_{50}=lethal dose to 50% of the organisms tested LOAEC=Lowest-Observed-Adverse-Effect-Concentration; LOAEL=lowest observed adverse effect level; >Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested, or effects did not reach 50% at the highest concentration tested (USEPA, 2011).

6.5.2 Endpoint Selection

Table 53 below summarizes the exposure models and toxicity endpoints used to evaluate acute and chronic oral and dietary exposure of mammals at each level of biological organization. These endpoints are used to estimate an initial exposure-to-effect ratios for direct effects to mammals. EPA utilizes subsequent characterization including the duration over which residues exceed thresholds and the percent of diet that would need to come from impacted areas in the final direct effects determinations.

Table 53. Description of Toxicity Endpoints and Exposure Models Used in Direct Effects Analysis for Mammals from Registered Uses of Acetamiprid.

Level of Biological Organization	Exposure Models	Direct Effects Endpoints
Individual	On-Site: T-REX v. 1.5.2 (foliar uses and seed treatment) Off-Site: AgDrift® v. 2.1.1 (foliar uses only) Upper-bound residues for all dietary items and species specific body weight	Acute: LD_{50} = 146 mg ai/kg bw (LOC=0.1) Chronic: NOAEC = 160 mg ai/kg diet (LOC = 1.0) NOAEL = 8.8 mg ai/kg bw (LOC = 1.0)
Population	On-Site: T-REX v. 1.5.2 (foliar uses and seed treatment) Off-Site: AgDrift v. 2.1.1 (foliar uses only) Mean residues for all dietary items and species specific body weight	Acute: LD_{10} = 76 mg ai/kg bw (LOC=0.1) Chronic: MATC = 253 mg ai/kg diet (LOC = 1.0) MATL = 14.1 mg ai/kg bw (LOC = 1.0)
Community		Acute: LD_{50} = 146 mg ai/kg bw (LOC=1.0) Chronic: MATC = 253 mg ai/kg diet (LOC = 1.0) MATL = 14.1 mg ai/kg bw (LOC = 1.0)

LCx/LDx = lethal concentration/dose to x% of the organisms tested (in this case, x is either 10 or 50%). LOC = Level of concern. NOAEC=No-Observed-Adverse-Effect-Concentration; LOAEC=Lowest-Observed-Adverse-Effect-Concentration; MATC/MATL = Maximum Acceptable Toxicant Concentration/Level which is the geometric mean of the NOAEC/NOAEL and LOAEC/LOAEL.

Since an SSD could not be developed, thresholds for individuals, populations, and communities are based on the most sensitive mammalian species tested for acute and chronic exposure. Dietary exposure following foliar applications and consumption of acetamiprid treated seeds are the two primary routes of exposure to acetamiprid in mammals and are modeled in T-REX (**Section 5**). For foliar uses, EPA considers upper-bound residues for individuals and mean residues to represent exposure to populations and communities.

Acute thresholds are based on mortality observed in the Norway rat following acute oral exposure. The LD_{50} of 146 mg ai/kg bw is used to evaluate acute effects in both individuals and communities; however, for individuals the LOC is 0.1 whereas for communities the LOC is 1.0. For population-level effects, EPA used the LD_{10} of 76 mg ai/kg bw which is calculated based on a default probit slope of 4.5 since the probit slope was not reported in the study. For population level effects, the acute endpoint represents the threshold for effects; therefore, the LOC is 1.0.

EPA assessed two routes of chronic oral exposure in the direct effects analysis for mammals: dose-based oral exposure (which accounts for food intake based on species weight and feeding habits and represents a bolus dose exposure) and dietary exposure reflecting daily intake from diet and does not account for differences in food intake across species. The chronic dietary-based toxicity endpoints selected to assess mammal individuals (*i.e.,* NOAEC), populations, and communities (*i.e.*, MATC) are based on a 4-17% reduction in body weight concurrent with a 16% reduction in body weight gain in the Norway rat at the LOAEC of 400 mg ai/kg diet (equivalent to 22.6 mg ai/kg bw/day). Based on these effects, the NOAEC and MATC are established at 160 mg ai/kg diet and 253 mg ai/kg diet, respectively (equivalent to 8.8 and 14.1 mg ai/kg bw/day, respectively). The selected chronic endpoint represents the threshold for each level of biological organization (*i.e.,* the chronic LOC is 1.0).

6.5.3 Direct Effects Analysis

The dietary needs of terrestrial mammalian species are diverse and include terrestrial and semi-aquatic plants, terrestrial invertebrates, mammals, birds, reptiles, amphibians, aquatic invertebrates, fish, carrion, pollen and nectar, and fungi. Acetamiprid residues in dietary items will be the result of deposition following foliar application, systemic transport of residues from soil to edible plant tissues, secondary exposure from terrestrial invertebrate prey that have consumed contaminated dietary items, and consumption of acetamiprid-treated seeds. Residues in terrestrial vertebrate prey and carrion may be another source of secondary exposure to acetamiprid; however, it is likely that the residue levels in the prey and carrion will be low when consumed to the mammal predator or scavenger given that acetamiprid is rapidly metabolized and excreted in birds (MRID 44988523) and mammals (USEPA 2020) without appreciable accumulation in tissues. Likewise, acetamiprid is not likely to bioaccumulate in aquatic organisms based on its physical chemical properties; therefore, consumption of acetamiprid residues in aquatic invertebrates, fish, and aquatic-phase amphibian prey is likely to be a minor source of exposure relative to terrestrial prey/dietary items. Consequently, the effects analysis focused on exposure from plants (grasses, leaves, fruits, seeds, nectar), and arthropods.

Exposure from Foliar Uses

Table 54, Table 55, and Table 56 summarize the effect analyses for exposure to dietary items following foliar applications in mammal individuals, populations, and communities. **Appendix E. Supplemental Tables for Direct Effects Analysis** presents dose- and dietary-based exposure-to-effect ratios for each UDL.

Table 54 reports the acute and chronic dose-based exposure-to-effect ratios for individuals and populations based on the reported body weight for listed mammals. The table reports EEC and exposure to effects ratio ranges for four different weight classes: very small (≤20 g), small (>20-100 grams), medium (>100-1,000 grams), and large (>1,000 grams). Upper-bound exposure estimates for foliar uses in the Alfalfa, Citrus, Cotton, Developed, Open Spaced Developed, Nursery, Other Orchard, Other Row Crops, and Vegetable and Ground Fruit UDLs exceed the individual acute or chronic toxicity threshold for all dietary items of listed herbivores and insectivores that weigh 100 grams or less, grasses and broadleaf plants for listed species that weigh 100-1,000 grams, and only grasses for species that weigh more than 1,000 grams. Among listed species that weigh 100 to 1,000 grams, acetamiprid residues in arthropod prey from uses in the Citrus, Other Orchard, Vegetable and Ground Fruit and Nursery UDLs exceed the chronic but not acute threshold and in species that weigh >1,000 to 1,500 grams, residues in arthropods from the Nursery UDL exceed the chronic threshold. Aside from grasses, acetamiprid residues in broadleaf plants resulting from uses in the Nursery UDL also exceed the chronic threshold for listed species that weight >1,000 grams. Adverse effects are not likely for individual listed species that weigh >5,000 grams or for listed species of any weight class that consume fruits/pods or seeds. Neither acute nor chronic individual thresholds are exceeded by foliar uses within the Soybeans and Other Crops UDLs.

EPA estimates exceedances of the individual-level thresholds across multiple dietary items and weight classes; however, exceedances of population-level thresholds occur in a much smaller subset of listed species (**Table 54**). Mean residue exposure estimates do not exceed the population-level acute threshold for UDL across any dietary items and weight classes. EPA estimates exceedances of the chronic threshold only for uses in the Citrus, Other Orchard, Vegetable and Ground Fruit and Nursery UDLs and only for listed mammals that weigh less than 15 g and consume arthropods or mammals weighing less than 70 grams that consume grasses when based on the NOAEC. However, acetamiprid residues in these dietary items are not estimated to reach levels where the adverse effects on growth are observed (*i.e.*, the LOAEL).

Table 54. Dose-based Effects Analysis for Direct Effects to Listed Mammal Species.

Level of Biological Organization→	Individual			Population		
Dietary Item↓	Upper-bound Dose-based EEC Range (mg ai/kg-bw)	Exposure to Effects Ratio (EEC/Toxicity Endpoint)[1]	UDL Exceedances	Mean Dose-based EEC Range (mg ai/kg-bw)	Exposure to Effects Ratio (EEC/Toxicity Endpoint)[1]	UDL Exceedances
Body Weight ≤20 g						
Grasses[2]	7.10-192	A: 0.02-**0.45** C: 0.39-**7.55**	All UDLs except Soybeans and Other Crops	2.32-56.7	A: 0.01-**0.15** C: 0.08-**1.54**	Nursery, Vegetable and Ground Fruit, Other Orchards, Citrus
Broadleaf Plants[3]	9.35-135	A:0.03-**0.28** C:0.50-**4.67**		3.29-45.0	A:0.01-0.09 C:0.11-0.97	No UDL exceedances
Fruits/pods	0.97-15	A: <0.01-0.03 C: 0.05-0.52	No UDL exceedances	Adverse effects are unlikely given lack of effects at individual level		
Seeds	0.24-3.33	A: <0.01-0.01 C: 0.01-0.12				
Arthropods[4]	6.35-94.0	A: 0.02-**0.20** C: 0.34-**3.25**	All UDLs except Soybeans and Other Crops	4.75-65.0	A:0.01-**0.14** C: 0.15-**1.40**	Nursery, Vegetable and Ground Fruit, Other Orchards, Citrus[7]
Body Weight of >20 to 100 g						
Grasses[2]	8.97-98.4	A: 0.04-**0.34** C: 0.70-**5.67**	All UDLs except Soybeans and Other Crops	3.18-34.8	A: 0.1-**0.12** C:0.15-**1.25**	Nursery, Vegetable and Ground Fruit, Other Orchards, Citrus[8]
Broadleaf Plants[3]	4.52-55.3	A: 0.02-**0.19** C: 0.37-**3.19**		1.63-18.5	A: 0.01-0.06 C: 0.08-0.66	No UDL exceedences
Fruits/pods	0.50-4.19	A: <0.01-0.02 C: 0.04-0.33	No UDL exceedances	Adverse effects are unlikely given lack of effects at individual level		
Seeds	0.13-1.37	A: <0.01 C: 0.01-0.06				
Arthropods[4]	3.51-38.5	A: 0.02-0.13 C: 0.27-**2.22**	All UDLs except Soybeans and Other Crops	2.43-26.7	A: 0.01-0.09 C: 0.12-0.96	No UDL exceedances
Body Weight of >100 to 1000 g						

Grasses[2]	2.04-48.1	A: 0.01-**0.25** C: 0.23-**4.18**	All UDLs except Soybeans and Other Crops	1.0-17.0	A:0.01-0.09 C: 0.09-0.92	No UDL exceedances
Broadleaf Plants[3]	3.99-27.0	A: 0.01-**0.14** C: 0.23-**2.35**		0.53-9.01	A:<0.01-0.05 C: 0.05-0.49	
Fruits/pods	0.20-2.35	A: <0.01-0.01 C: 0.03-0.24	No UDL exceedances	Adverse effects are unlikely given lack of effects at individual level		
Seeds	0.04-0.67	A: <0.01 C: 0.01-				
Arthropods[4]	1.21-18.8	A: 0.01-0.10 C: 0.17-**1.64**	Nursery, Vegetable and Ground Fruit, Other Orchards, Citrus	0.84-13.0	A:0.01-0.07 C:0.07-0.71	No UDL exceedances
Body Weight >1000 g						
Grasses[2]	0.22-16.5	A: 0.01-0.16 C: 0.14-2.65	All UDLs except Soybeans and Other Crops	0.08-5.83	A:<0.01-0.06 C:0.03-0.58	No UDL exceedances
Broadleaf Plants[3]	0.20-7.76	A: <0.01-0.05 C: 0.08-**1.38**	Nursery	0.04-2.59	A:<0.01-0.02 C: 0.02-0.29	
Fruits/pods	0.02-1.03	A: <0.01-0.01 C: 0.01-0.17	No UDL exceedances	Adverse effects are unlikely given lack of effects at individual level		
Seeds	0.01-0.11	A:<0.01 C: <0.01-0.03				
Arthropods[4]	0.14-6.45	A: <0.01-0.06 C: 0.07-**1.04**	Nursery[6]	0.10-4.46	A:<0.01-0.04 C: 0.03-0.45	No UDL exceedances

EEC=estimated environmental concentration; UDL=use data layer

Bolded value exceeds the individual acute and chronic risk levels of concern (LOC) of 0.1 and 1.0, respectively, or the population acute and chronic risk LOC of 1.0

[1]The endpoints selected to evaluate individual and population level effects are summarized in **Table 53**.

[2]The exposure-to-effect ratio for grasses is based on the Kenaga values for short grass and are considered for both short and tall grass dietary items.

[3]EECs in leaves are based on the Kenaga values for broadleaf plant and also serve as a surrogate for estimating exposure from consumption of flowers and fungi.

[4]Based on the arthropod Kenaga values and also serve as a surrogate for estimating exposure from soil-dwelling invertebrates.

[6]Residues in arthropods exceed the individual level threshold for the Nursery UDL only and only for the highest exposure use pattern for that UDL.

[7]Residues in arthropods does not exceed the population level threshold for any UDL in species that weigh >15 grams.

[8]Residues in grasses does not exceed the population level threshold for any UDL in species that weigh >70 grams.

Table 55 reports the acute and chronic dose-based exposure-to-effect ratios for mammal populations and communities based on generic body weight classes which informs the assessment of PPHD effects for listed species that rely on mammals. Estimated mean acetamiprid residues exceed the chronic population threshold for mammals foraging on short grass and arthropods and do not exceed the acute population-level threshold for any dietary item. At least one UDL exceeds the chronic population and community-level thresholds for listed species weighing ≤50 g that consume short grass and for mammalian insectivores weighing ≤20 g. Population- and community-level effects are unlikely from consumption of tall grass, broadleaf plants, fruits/pods, and seeds that contain residues from foliar applications. Likewise, adverse population and community-level effects from foliar applications are unlikely in listed mammal species that weigh more than 50 g.

Table 55. Acute and Chronic Dose-based Effects Analysis for Direct Effects to Non-Listed Mammals That Serve as Prey, Pollination, Habitat, or Dispersal (PPHD) for Listed Species.

Level of Biological Organization→	Mean Dose-based EEC Range (mg ai/kg-bw)	Population		Community	
Dietary Item↓		Exposure to Effects Ratio (EEC/Toxicity Endpoint)[1]	UDL Exceedances	Exposure to Effects Ratio (EEC/Toxicity Endpoint)[1]	UDL Exceedances
Small Mammals (15 g)					
Short grass	6.1-42.1	A: 0.04-0.25 C: 0.2-**1.36**	Citrus, Nurseries, Other Orchards, Vegetable and Ground Fruit	A: 0.02-0.13 C: 0.2-**1.36**	Citrus, Nurseries, Other Orchards, Vegetable and Ground Fruit
Tall grass[2]	2.57-17.9	A: 0.02-0.11 C: 0.08-0.58	No UDLs	No exceedances at population level	
Leaves[3]	3.22-22.3	A: 0.02 -0.13 C: 0.10-0.72			
Fruits/pods	0.50-3.47	A: 0.01-0.02 C: 0.02-0.11			
Seeds	0.11-0.77	A: <0.01 C: 0.01-0.02			
Arthropods[4]	4.65-32.2	A: 0.03-0.19 C: 0.15- **1.04**	Nurseries	A: 0.01-0.10 C: 0.15- **1.04**	Nurseries
Medium Mammals (35 g)					
Short grass	4.20-29.1	A: 0.03-0.22 C: 0.17-**1.16**	Citrus, Nurseries, Other Orchards, Vegetable and Ground Fruit	A: 0.02-0.11 C: 0.17-**1.16**	Citrus, Nurseries, Other Orchards, Vegetable and Ground Fruit
Tall grass[2]	1.78-12.3	A: 0.01-0.09 C:0.07-0.49	No UDLs	No exceedances at population level	
Leaves[3]	2.22-15.4	A: 0.02-0.11 C: 0.09-0.61			

Fruits/pods	0.35-2.40	A: 0.01-0.02 C: 0.01-0.10		
Seeds	0.08-0.53	A: <0.01 C: 0.01-0.02		
Arthropods[4]	3.21-22.3	A: 0.02-0.16 C:0.13-0.89		
Large Mammals (1,000 g)				
Short grass	0.97-6.75	A:0.02-0.12 C: 0.09-0.69	No UDL Exceedances	No exceedances at population level
Tall grass[2]	0.41-2.86	A:0.02-0.05 C:0.04-0.26		
Leaves[3]	0.52-3.58	A: 0.03-0.06 C: 0.05-0.33		
Fruits/pods	0.08-0.56	A: <0.01 C: 0.02-0.05		
Seeds	0.02-0.12	A: <0.01 C: <0.01-0.01		
Arthropods[4]	0.74-5.16	A: 0.01-0.09 C:0.07-0.48		

EEC=estimated environmental concentration; UDL=use data layer; A= Acute; C = Chronic

Bolded value exceeds the population and community acute or chronic risk levels of concern (LOC) of 1.0.

[1] The acute endpoints used to evaluate population and community-level effects in mammals are captured in **Table 53.**

[2] The exposure-to-effect ratio for grasses is based on the Kenaga values for short grass and are considered for both short and tall grass dietary items.

[3] Leaves EECs are based on the Kenaga values for broadleaf plants and also serve as a surrogate for estimating exposure from consumption of flowers and fungi.

[4] Based on the Kenaga values for arthropods and also serve as a surrogate for estimating exposure from soil-dwelling invertebrates.

EPA also calculated chronic dietary-based exposure-to-effect ratios for mammal individuals (**Table 56**). Since this route of exposure is not dictated by body weight, the results of this analysis apply to both listed species and mammals that serve as PPHD for other listed species. None of the registered uses exceed the chronic dietary-based thresholds for mammal individuals and therefore, do not exceed the chronic threshold for populations or communities.

Table 56. Chronic Dietary-based Exposure-to-Effect Ratios for Listed and Non-Listed Mammals from Use of Acetamiprid.

Level of Biological Organization→	**Individuals**		
Dietary Item↓	**Upper-bound EEC (mg ai/kg)** [1]	**Exposure to Effects Ratio (EEC/Toxicity Endpoint)**[2]	**UDL Exceedances**
Short Grass	18-125	0.1-0.8	No UDLs
Tall Grass	8.3-57.2	0.1-0.4	
Broadleaf Plants	10.1-70.2	0.1-0.4	
Fruits, pods, seeds	1.1-7.8	0.01-0.05	
Arthropods	7.1-48.9	0.04-0.31	

The level of concern (LOC) for chronic dietary effects in individuals is 1.0 EEC=estimated environmental concentration; UDL = Use Data Layer;

In order to consume enough residues to achieve a dietary concentration likely to cause the mortality or growth effects, a mammalian individual would need to obtain >22% or >13% of its daily diet, respectively, from use sites with upper-bound residues depending on the weight class and dietary item. Conversely, mammal individuals would need to consume 60% or more of its diet from the fields with mean residues to exceed the population level threshold for both mortality and growth.

Exposure From Seed Treatments

Table 57 summarizes the number of seeds that would need to be consumed to reach the threshold for each level of biological organization as well as additional characterization on the foraging area that is likely to lead to adverse effects. Seed size is not likely to limit seed selection for listed and non-listed granivore mammal species; therefore, a direct effects analysis for all seed treatment uses is conducted for all weight classes.

For canola and mustard seeds, small (15 g) mammals would need to consume between 19 to 210 and 11 to 23 seeds from the field to reach the acute and chronic thresholds, respectively, for individuals, populations and communities. Small-sized species would need to forage over an area ranging from 4.31 to 16 ft^2, 7.06 to 84 ft^2, and 7.06 to 161 ft^2 to exceed the individual, population, and community-level effects thresholds, respectively (equivalent to 0.03 to 1% of the species home range).

Medium-sized (35 g) mammals would need to consume between 36 to 456 and 22 to 44 canola or mustard seeds from the field to reach the acute and chronic thresholds, respectively, for individuals, populations and communities. Medium-sized species would need to forage over an area ranging from 7.45 to 19.4 ft^2, 13.3 to 158 ft^2, and 13.3 to 304 ft^2 to exceed the individual, population, and community-level effects thresholds, respectively (equivalent to 0.02 to 0.74% of the species home range).

Large-sized (1,000 g) mammals would need to consume between 266 to 5,634 and 266 to 544 canola or mustard seeds from the field to reach the acute and chronic thresholds, respectively, for individuals, populations and communities. Large-sized species would need to forage over an area ranging from 104 to 375 ft^2, 167 to 1,955 ft^2, and 167 to 3,756 ft^2 to exceed the individual, population, and community level effects thresholds, respectively (equivalent to <0.01 to 0.22% of the species home range).

For potatoes seeds, mammals would need to consume between 1 to 3 and 1 to 2 seeds from the field to reach the individual acute and chronic thresholds, respectively, and forage over an area ranging from 125 to 900 ft^2. To exceed the population and community-level effects acute thresholds, species would need to consume between 1 and 28 seeds (1 to 2 seeds for small- and medium-sized species), whereas species would need to consume 1 to 3 seeds to exceed the population and community chronic thresholds. These species would need to forage for seeds over an area ranging from 125 to 8,400 ft^2 (0.77 to 1.86% of the species home range) or 125 to 375 ft^2 (<0.01% to 0.77% of the species home range) to exceed the acute and chronic threshold, respectively.

Table 57. Direct Effects Analysis for Mammals Exposed to Acetamiprid Treated Seeds.

Level of Biological Organization→	Individuals			Population			Community		
UDL →	Other Grains[1]	Other Crops[2]	Vegetable and Ground Fruit[3]	Other Grains[1]	Other Crops[2]	Vegetable and Ground Fruit[3]	Other Grains[1]	Other Crops[2]	Vegetable and Ground Fruit[3]
Small Mammals (15 g)									
# Seeds to Exceed the Threshold	A: 19-24 C: 11-15	A: 21 C: 13	A: 1 C: 1	A: 98-126 C: 18-23	A: 109 C: 20	A: 1 C: 1	A: 189-241 C: 18-23	A: 210 C: 20	A: 1 C: 1
Forage area of concern (ft^2)	A: 7.45-16.0 C: 4.31-5.88	A: 10.2 C: 6.29	A: 125-300 C: 125	A: 38.4-84.0 C: 7.06-9.02	A: 52.8 C: 9.68	A: 125-300 C: 125	A: 74.1-161 C: 7.06-9.02	A: 102 C: 9.68	A: 125-300 C: 125
Percent of Home Range (%)	A: 0.05-0.10% C: 0.03-0.04%	A: 0.06% C: 0.04%	A: 0.77-1.86% C: 0.77%	A: 0.24-0.52% C: 0.04-0.06%	A: 0.33% C: 0.06%	A: 0.77-1.86% C: 0.77%	A: 0.46-1.0% C: 0.04-0.06%	A: 0.63% C: 0.06%	A: 0.77-1.86% C: 0.77%
Medium Mammals (35 g)									
# Seeds to Exceed the Threshold	A: 36-46 C: 22-27	A: 40 C: 24	A: 1 C: 1	A: 186-237 C: 34-44	A: 206 C: 38	A: 1 C: 1	A: 357-456 C: 34-44	A: 396 C: 38	A: 1-2 C: 1
Forage area of concern (ft^2)	A: 7.45-16.0 C: 8.63-10.6	A: 19.4 C: 11.6	A: 125-300 C: 125	A: 72.9-158 C: 13.3-17.3	A: 99.7 C: 18.4	A: 125-300 C: 125	A: 140-304 C: 13.3-17.3	A: 192 C: 18.4	A: 125-600 C: 125
Percent of Home Range (%)	A: 0.03-0.07% C: 0.02-0.03%	A: 0.05% C: 0.03%	A: 0.31-0.73% C: 0.31%	A: 0.18-0.39% C: 0.03-0.04%	A: 0.24% C: 0.04%	A: 0.31-0.73% C: 0.31%	A: 0.34-0.74% C: 0.03-0.04%	A: 0.47% C: 0.04%	A: 0.31-1.47% C: 0.31%
Large Mammals (1,000 g)									
# Seeds to Exceed the Threshold	A: 441-563 C: 266-340	A: 490 C: 295	A: 1-3 C: 1-2	A: 2,295-2,933 C: 426-544	A: 2,550 C: 473	A: 7-14 C: 1-3	A: 4,409-5,634 C: 426-544	A: 4,899 C: 473	A: 13-28 C: 1-3
Forage area of concern (ft^2)	A: 173-375 C: 104-133	A: 237 C: 143	A: 125-900 C: 125-250	A: 900-1,955 C:167-213	A: 1,234 C: 229	A: 875-4,200 C: 125-375	A: 1,729-3,756 C:167-213	A: 2,371 C: 229	A: 1,625-8,400 C: 125-375
Percent of Home Range (%)	A: 0.01-0.02% C: <0.01%	A: 0.01% C: <0.01%	A: <0.01-0.05% C: <0.01-0.01%	A: 0.05-0.11% C: <0.01-0.01%	A: 0.07% C: 0.01%	A: 0.05 -0.24% C: <0.01-0.02%	A: 0.10-0.22% C: <0.01-0.01%	A: 0.14% C: 0.01%	A: 0.09 -0.49% C: <0.01-0.02%

Level of Biological Organization→	Individuals			Population			Community		
UDL →	Other Grains[1]	Other Crops[2]	Vegetable and Ground Fruit[3]	Other Grains[1]	Other Crops[2]	Vegetable and Ground Fruit[3]	Other Grains[1]	Other Crops[2]	Vegetable and Ground Fruit[3]

The level of concern (LOC) for effects in individuals is 0.1 and the LOC for all other exposure scenarios is 1.0. EEC=estimated environmental concentration; UDL = Use Data Layer; A= Acute; C = Chronic.

[1]Canola is the only seed treatment for the Other Grains use data layer (UDL). The analysis used an application rate of 15.4 fl oz/100 lb seed, a seeding rate of 740,000 seeds/A and a range of 90,000 to 115,000 seeds/pound. Seeds are assumed to be lightly incorporated in soil based on seed planting depth of 0.5 to 1.5 inches with 15% of seeds available at the soil surface.

[2]Mustard seed is the only seed treatment for the Other Crops UDL. The analysis used an application rate of 15.4 fl oz/100 lb seed, a seeding rate of 600,000 seeds/A and 100,000 seeds/pound seeds. Seeds are assumed to be lightly incorporated in soil based on seed planting depth of 0.5 to 1.5 inches with 15% of seeds available at the soil surface.

[3]Potato seed is the only seed treatment for the Vegetable and Ground Fruit UDL. The analysis used an application rate of 0.3 fl oz/100 lb seed, a seeding rate of 14,520 to 34,848 seeds/A and 5 to 11 seeds/pound seeds. Seeds are assumed to be more thoroughly incorporated in soil based on seed planting depth of 5 inches with approximately 1% available at the soil surface.

Assuming that a small (15 g), medium (35 g) or large (1,000 g) mammal eats 21, 15 and 3% of their body weight per day, then this is equivalent to 690, 1,200, and 6,600 canola/mustard seeds per day. Consequently, a listed species that consumes seeds as a primary or exclusive part of their diet could achieve an exposure level that would exceed the acute and chronic thresholds for individuals, populations, and communities. It is more likely that seeds will be a primary dietary item for smaller mammals compared to larger species and among the listed species, seeds are the primary dietary item for species that weigh up to 151 grams. Foraging for these treated seeds would occur on bare fields which may be less desirable for smaller species given that it renders them more vulnerable to predation. While fewer potato seeds are necessary to exceed the acute and chronic threshold, a majority of the seeds will be buried further in the ground requiring more effort and time on the bare field to extract the seed. Seed spills that may occur during the planting also present a source of exposure for granivore mammals. If not cleaned up immediately, the seed spill will present an easily accessible and substantial source of forage and, given the larger number of seeds available, will likely result in higher exposure to treated seeds than estimated in T-REX. Seed spills are most likely to occur at the edge of fields around the planting time for the crop. The seeds are likely to be available for a short duration due to competition for the easily accessible seeds and any efforts to clean up the seed spill which will limit the number of individuals that are exposed to this large influx of seeds. Consequently, it is likely that seed spill events will result in acute exposure to some individuals that forage near where the spill occurs, but is unlikely to present a source of chronic exposure nor affect enough individuals to lead to population or community level effects.

EPA cannot rule out that an individual mammal would forage regularly in areas with acetamiprid residues (either on or adjacent to the use site) and consume enough acetamiprid residues in their diet to reach the threshold for mortality or growth effects. As a result, direct effects to listed mammal individuals are likely from the registered uses of acetamiprid. However, at the population level, adverse effects from foliar uses are likely only from chronic exposure. The growth effects that are the basis for the chronic exposure analysis were observed in a two year dietary study. While the duration of exposure required to result in reduced growth is uncertain, less sensitive endpoints for growth were identified in studies with shorter exposure duration suggesting that long-term repeated exposure is necessary to achieve growth effects at the LOAEL established in the two-year chronic toxicity study. Adverse effects are not likely for populations or communities when considering the endpoints from the 90-day subchronic study and the rat 2-generation reproduction study. This suggests that the mammals would have to consume residues repeatedly for over a year to achieve the dose level that exceeds the chronic threshold for populations and communities. It is unlikely that multiple individuals from a species will both consume a majority of their diet from the use site and do so repeatedly over a year.

Similarly, relatively few canola and mustard seeds would need to be consumed by small- and medium-sized mammals to exceed the chronic population-level threshold, but treated seeds would not be available year-round given that acetamiprid treatment is only permitted for seeds that are planted in the spring which limits the exposure window. Acute exposure to treated seeds is more likely, particularly for smaller mammal species that consume seeds as a major component of their diet, but the species would need to forage for over 10% of its diet on the treated field which is considered unlikely behavior for multiple individuals of a species given the lack of cover on the field at the time of planting and the availability of seeds off-site (either from plants or cached from the previous year) or from fields that do not plant acetamiprid treated seeds which will not contain residues that exceed the acute population threshold. The FWS reports that all listed mammalian granivores consume seeds from specific types of plants in locations that are not agricultural fields which reduces the likelihood of population-level effects for these species. Consequently, EPA considers population-level effects in mammals unlikely for both listed and non-listed species. EPA also considers community-level effects unlikely given that foliar and seed treatment uses are unlikely to affect mammal populations.

While individual effects to listed mammal species cannot be discounted for acute or chronic exposure, EPA considers it is unlikely that the registered uses of acetamiprid will cause adverse direct effects to listed mammalian populations or adversely affect listed species that rely on mammals for PPHD.

Aquatic Mammals

A number of listed mammal species occupy aquatic ecosystems. Listed whales, sea lions, sea otters, polar bears, and seals forage in the open ocean and either occupy open ocean habitat exclusively, or primarily with some aspect of its life cycle spent on the shore (*i.e.,* sea lions basking in the sun on rocks) for purposes other than forage. Exposure in the open ocean could be through residues in the diet, or contact with residues in the water, and exposure through inhalation or dermal interception of spray droplets may occur for species that are on the shore on the day of application. The West Indian manatee (*Trichechus manatus*), conversely, moves through and forages in both estuarine/marine and freshwater environments and can be exposed through drinking freshwater in addition to contact and dietary exposure.

EPA considers dietary exposure of mammals to acetamiprid in the open ocean as unlikely to be significant due to dilution and low potential for bioaccumulation (**Appendix I. Qualitative Analysis Approach**). Since these species do not forage while on land, dietary exposure while in terrestrial habitats is not expected. Although dermal and inhalation exposure to species that come onto shore may occur, the exposure window would be limited to the day of application, the application would need to occur adjacent to nesting or basking sites, these species spend a relatively short portion of their life on the shore and the terrestrial area of their range is small fraction of their total range which lowers the likelihood of exposure. Furthermore, acetamiprid exhibits low acute dermal and inhalation toxicity in mammals. Contact exposure in the aquatic environment is also unlikely to lead to adverse effects due to dilution and low dermal toxicity. The skin of many marine mammals is also much thicker than the terrestrial mammal species evaluated in dermal toxicity studies which further reduces the likelihood of dermal toxicity in these species.

A separate semi-quantitative analysis was conducted for drinking water exposure for the West Indian manatee. When traveling through freshwater, the species occupies medium to large waterbodies with flowing water. Ingestion of residues from drinking freshwater is estimated to be at most 0.0092 mg ai/kg-bw/day based on the average daily water consumption of an individual (145 ml/kg-bw/day[44]) and the highest aquatic EEC for the farm pond (63.1 µg ai/L). This value is approximately three orders of magnitude below the chronic threshold for individual and population-level effects in mammals indicating a low likelihood of adverse effects from this route of exposure. There are a number of uncertainties in this analysis including use of a dietary endpoint to evaluate drinking water exposure, extrapolating toxicity endpoints from the rat to evaluate a mammal that is orders of magnitude larger, and evaluating exposure from a model waterbody that does not account for flow in the exposure

[44] Physiological Ecology and Bioenergetics Lab, University of Central Florida. https://sciences.ucf.edu/biology/PEBL/current-research/manatee-studies/do-manateesneed-to-drink-fresh-water/

estimates. Given that toxicity is likely to be low across all likely routes of exposure, adverse direct effects to individuals and populations of aquatic mammals are not likely.

6.5.4 Off Site Transport

EPA determined the extent to which off-site transport will contribute these adverse effects at each level of biological organization to define the exposure area for each UDL. Since adverse effects are only likely at the individual level, the off-site distance is only determined for that level of biological organization. Spray drift is likely to be the primary route of off-site exposure contributing to direct effects in mammals. Spray drift may result in direct exposure to spray droplets, and deposition of residues on dietary items, and/or foliar, soil, and other surfaces that the species moves across. Runoff may contribute to residues in the soil or in plant tissues following systemic uptake; however, it is likely to be a minor route of exposure relative to spray drift. **Table 58** provides the furthest off-field distances within which spray drift may lead to direct effects to mammals individuals based on the toxicity thresholds for that level of biological organization. Residues on dietary items deposited by spray drift exceed the individual thresholds within ~10 meters (30 feet) of the field assuming all spray applications drift off field in the same direction (**Appendix F. Spray Drift Analysis**). EPA then buffered out the UDLs by these distances to establish the exposure area when assessing the potential for adverse direct effects to individual listed mammals. As no population or community-level adverse effects are likely, the UDL exposure areas do not need to be buffered out to account for PPHD effects to listed species that rely on mammals.

Table 58. Off-Site Transport Distances (meters, m) Used for Estimating Spatial Overlap for Mammals in Effects Determinations and Predictions of Likelihood of Jeopardy from Registered Uses of Acetamiprid.[1]

UDL	Common Application Method[2]	Potential for Effects to an Individual[3]	Potential for Effects to a Population[4] and Community[5]
Alfalfa	Ground-boom	30 m	Adverse effects are not likely
Citrus	Airblast	30 m	Adverse effects are not likely
Cotton	Ground-boom	30 m	Adverse effects are not likely
Grapes	Airblast	30 m	Adverse effects are not likely
Nursery	Ground-boom	30 m	Adverse effects are not likely
Other Crops	Ground-boom, Seed treatment	0 m	Adverse effects are not likely
Other Grains	Seed treatment	0 m	Adverse effects are not likely
Other Orchards	Airblast	30 m	Adverse effects are not likely
Other Row Crops	Ground-boom	30 m	Adverse effects are not likely
Soybean	Ground-boom	Adverse effects not likely	
Vegetable and Ground Fruit, NL48 Ag	Aerial	30 m	Adverse effects are not likely
CONUS and NL48 Developed, Open Space Developed	Handheld equipment	0 m	Adverse effects are not likely

[1]These distances reflect exposure at the use site and spray drift only given that it is the primary route of off-site exposure for mammals. Distances account for both acute and chronic effects; however, acute and chronic effects may not be a concern within the entire exposure area based on differences in exposure and sensitivity.

UDL	Common Application Method[2]	Potential for Effects to an Individual[3]	Potential for Effects to a Population[4] and Community[5]

[2]The common application method for each UDL is considered in establishing the buffer distances for potential effects to populations and communities only (**Section 3.2.1**). The application method among those permitted on the label for a given UDL that results in the largest exposure area (generally aerial) is used to establish the buffer distance for individuals.
[3]Distances are used to establish the exposure area for each use data layer (UDL) for the may affect/no effect (MA/NE) and to evaluate direct effects in the Not Likely to Adversely Affect/Likely to Adversely Affect (NLAA/LAA) determinations.
[4]Distances are used to establish the exposure area for each UDL to evaluate direct effects in the predictions of Likely J and to evaluate prey, pollination, habitat, or dispersal (PPHD) effects to obligate relationships for the NLAA/LAA determination and predictions of Likely Jeopardy (J).
[5]Distances are used to establish the exposure area for each UDL to evaluate PPHD effects to generalist relationships for the NLAA/LAA Determination and predictions of Likely J.

6.5.5 PPHD Effects

Listed mammals have generalist diet relationships with plants, invertebrates, birds, reptiles, terrestrial-phase amphibians, fish, and other mammals and generalist relationship with plants and mammals (*e.g.,* use of other species burrows) for habitat. Several listed mammal species also have obligate relationships to terrestrial plants, mammals, and fish. Based on the generic-taxa based screening-level assessment, the registered uses of acetamiprid are likely to have an effect on listed mammal species that have PPHD relationships with plants, terrestrial vertebrates, and invertebrates.

The registered uses are further likely to adversely affect listed mammal species that have generalist or obligate relationships with invertebrates (**Section 6.1** and **Section 6.3**), reptiles and birds (**Section 6.4**), and amphibians (**Section 6.6**). The loss of prey items will have the greatest impact among listed mammal species that rely primarily or exclusively on small- to medium-sized birds, amphibians, and reptiles, and terrestrial non-mollusk invertebrate, aquatic insect and/or crustacean species. Community-level adverse effects for small birds, amphibians, and reptiles are largely limited to use sites, which decreases the likelihood of adverse PPHD effects for listed species that are likely to forage across multiple habitats or are unlikely to forage at use sites. Community-level effects are not likely for plants (**Section 6.7**) or mammals (**Section 6.5**); therefore, species that have a generalist relationship with these taxa are unlikely to experience adverse effects related to a decline in these dietary items or loss of habitat.

Mammalian species with obligate relationships include the Columbia Basin pygmy rabbit (*Brachylagus idahoensis*) which has a dietary and habitat relationship with the woody dicot sagebrush, the Canada lynx (*Lynx canadensis*), and Killer whale (*Orcinus orca*) which have dietary relationships with the snowshoe hare and salmonid species, respectively, and the Black-footed ferret (*Mustela nigripes*) which rely on prairie dogs as a food source and for use of their burrows as shelter. The registered uses of acetamiprid have the potential to impact the health of the woody plant and tree species, particularly those occuring near use sites and with new growth, which will affect individual species co-localized with these woody plants; however, because acetamiprid is not likely to adversely affect populations of woody plants or trees, adverse PPHD effects are unlikely for Columbia Basin pygmy rabbit. Population-level effects are not likely for mammals; therefore, adverse effects related to a decline in these prey/dietary items or loss of shelter are not likely for the Canada lynx and Black-footed ferret. While population-level effects are also not likely for fish (**Section 6.2**), the Killer whale relies in part on threatened and endangered salmonid species. Some but not all populations of the listed salmonid species are predicted to be adversely affected at the population level from the registered acetamiprid uses (**Section 6.2**).

Consequently, adverse effects to Killer whale individuals cannot be discounted. It is, however, unlikely to lead to a population-level effect in this species given that many of the populations of threatened and endangered salmonids species that are not likely to be adversely affected by acetamiprid which would limit the impacts on the overall prey base of the Killer whale.

6.5.6 Effects Determination

EPA considered a total of 94 mammals in this listed species assessment and made NE determinations for 8 of those species, NLAA determinations for 33 species, and LAA determinations for 53 species (**Table 59**). Of the 53 species with LAA determinations, EPA predicts that the registered acetamiprid uses are not likely to jeopardize 52 mammalian species and there is a likelihood to jeopardize 1 mammalian species. The rationale for each determination and J prediction is summarized below and discussed in more detail for each species in **Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification.**

Table 59. Number of Listed Species Effects Determinations and Predictions of Likelihood of Jeopardy for Mammals from Registered Uses of Acetamiprid.

Taxon	Number of Species[1]	NE	NLAA	LAA, Not Likely J	LAA, Likely J
Mammals	94	8	33	52	1

J=Jeopardy; LAA=Likely to Adversely Affect; NE=No Effect; NLAA=Likely to Adversely Affect
[1]Reflects the species and critical habitats listed as of February 16, 2022.

Listed Species with No Effect Determinations

EPA made NE determinations for species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects and took into consideration habitat, overlap and diet. EPA made NE determinations for listed mammals that had no overlap with UDLs and the off-field areas identified (<1% overlap) when considering the exposure area in which an effect is likely.

Listed Species with May Affect (MA) Determinations

EPA made MA determinations for listed mammal species whose range had ≥1% overlap with at least one UDL and is likely to experience direct effects at the individual level from seed consumption and contaminated dietary items on- and off-site, the potential for PPHD effects from the loss of invertebrate or vertebrate prey and plant dietary items.

Not Likely to Adversely Affect (NLAA)

NLAA determinations are driven by an assessment of the likelihood of direct effects and exposure occurring based on different habitat characteristics. EPA made NLAA determinations for species that are unlikely to experience adverse direct and PPHD effects, that have a range with <1% overlap with any individual UDL after refining the exposure area to account for likely adverse effects to individuals and with consideration of insecticide usage and crop acreage data from the CoA, and for species where life history indicate the likelihood of exposure and adverse effects is low. The main life history considerations that drove NLAA determinations included:

- species found interior forest habitat and no registered forestry uses, thereby rendering exposure highly unlikely;
- species found in or forage primarily in the open ocean where exposure from registered uses is likely to be insignificant (**Appendix I. Qualitative Analysis Approach**)
- species is delisted or proposed for delisting due to extinction
- the species is thought to be extirpated or has not been observed in the US for decades

Likely to Adversely Affect (LAA)

Of the MA species, LAA species are driven by an assessment of the likelihood of direct and PPHD effects from diet and based on different habitat characteristics. Species designated as LAA had the potential for adverse direct and/or PPHD effects from the consumption of invertebrate or terrestrial vertebrate prey or an obligate relationships to dicot plants, and they inhabit areas where exposure is expected to reasonably occur at levels that could cause effects.

Species with Potential Jeopardy Determinations

The predictions of likely jeopardy for listed mammals consider the magnitude of effect designations, the extent of spatial overlap between the species range and UDL after refinements, and additional information on life history and vulnerability that can influence the likelihood of a population level effect that could jeopardize its existence. Given that population level adverse effects are considered unlikely to occur in listed mammals, the predictions of potential likelihood of future jeopardy focused on the likelihood of adverse effects resulting from reduced prey/dietary item availability or habitat degredation.

A potential likelihood of future jeopardy is not predicted for species that have low magnitude of effect and/or have low overlap (<5%) with the refined exposure area for any individual UDL or where the CoA data can be used to discount the likelihood of exposure based on low usage of insecticides or low acreage of registered crops for aggregate agricultural UDLs. Additional life history characteristics leading to a prediction of no likelihood of future jeopardy include:

- species is highly mobile, has wide foraging area, and occupies multiple habitat types. These species are capable of seeking out prey in unaffected areas if its prey base is deficient in areas impacted by pesticide application. Additionally, not all fields will be sprayed at once reducing the likelihood that the species entire foraging area will be impacted.
- The species is an opportunistic or generalist consumer and its dietary items include invertebrates and terrestrial vertebrates in addition other dietary items that are not likely to be adversely affected by the registered uses.
- The species' primary prey is terrestrial vertebrates and is unlikely to forage regularly at use sites where adverse effects to that prey base are likely to occur.
- The open spaced developed and developed UDLs are the only uses likely contributing to adverse effects and it is unlikely the species will regularly rely on those use sites for habitat or forage.
- The species has an obligate relationship to woody dicot species for diet and habitat (*i.e.*, Columbia Basin Pygmy rabbit).

Table 61 summarizes the listed mammals species for which EPA predicts a likelihood of jeopardy from registered uses of acetamiprid. A potential likelihood of future jeopardy is predicted for these species based on the following overlap and life history information:

- At least one UDL overlaps with >5% with the species range and, when available, CoA data indicate high acreage of insecticide usage and/or crop acreage for aggregate UDLs;
- Terrestrial insects and/or aquatic insects and crustaceans are the species preferred or only source of prey for some or all of the species life cycle.

In addition, all listed species that are predicted to have a potential likelihood of future jeopardy are high vulnerability. One mammal species is predicted to have a potential likelihood of future jeopardy resulting from currently registered uses of acetamiprid. This species is likely to be adversely affected due to a reduction in prey availability in off-site habitat that receives spray drift and runoff.

Table 60. Listed Mammal Species with Predicted Likelihood of Jeopardy from Registered Uses of Acetamiprid.

Entity ID	Common Name (Scientific Name)
58	Buena Vista Lake ornate shrew (*Sorex ornatus relictus*)

6.6 Amphibians

6.6.1 Direct Effects

6.6.1.1 Summary of Ecotoxicity Data for Amphibians

Toxicity data for amphibians are limited to a single study identified in the open literature (**Table 61**). The ECOTOX review conducted for this BE identified a study (Saka and Tada, 2021) that reports acute and chronic toxicity of four systemic insecticides to the aquatic only Western Clawed Frog (*Xenopus tropicalis*). For the acute exposure, a range-finding study was performed and when greater than 50% mortality was not observed at the highest concentration tested (100 mg/L), a definitive test was not conducted. A chronic toxicity test was conducted which included a negative control and two chemical groups at concentrations of 0.1 and 1.0 mg/L. The conclusion of the chronic study was that acetamiprid did not directly affect amphibians through their larval stages at concentrations that occur in paddy water. Since both the acute and chronic exposures resulted in a non-definitive endpoint, EFED also considered fish toxicity data (**Table 28**) as a surrogate for aquatic and aquatic-phase amphibians (USEPA, 2014). Reliance on fish data to assess acute and chronic effects is supported by the consistency in the lack of toxicity in aquatic-phase amphibians and fish at comparable concentrations.

Toxicity data are not available on acute or chronic toxicity to amphibians with a terrestrial-phase. In the absence of toxicity data on terrestrial-phase amphibians, EFED used avian toxicity data (**Table 43**) as a surrogate for these taxa (USEPA, 2014).

Table 61. Acetamiprid Toxicity Data for Amphibians.

Study Type	Test Substance (% ai)	Test Species	Toxicity Value	ECOTOX Record Number and Study Classification
Acute and Chronic exposure to Amphibians	TGAI (>98%)	Western Claw Frog (*Xenopus tropicalis*)	Acute: 96-h LC_{50} >100,000 µg/L Chronic (all endpoints): NOAEC =1,000 µg/L LOAEC > 1,000 µg/L	186741 Qualitative

Note: TGAI=Technical Grade Active Ingredient; NOAEC=No-Observed-Adverse-Effect-Concentration; LC_{50}=lethal concentration to 50% of the organisms tested LOAEC=Lowest-Observed-Adverse-Effect-Concentration; NC = not calculated; >Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested, or effects did not reach 50% at the highest concentration tested (USEPA, 2011).

6.6.1.2 Endpoint Selection

Since no toxicity data are available for terrestrial-phase amphibians, EPA relied on the same endpoints and models that were used for birds and reptiles (**Table 43**). Acute LC_{50} values for the aquatic-phase amphibians and fish are all non-definitive (*i.e.,* greater than the highest concentration tested); therefore, an acute endpoint was not selected for aquatic-phase amphibians. Chronic toxicity to aquatic phase amphibian individuals was evaluated based on the reported NOAECs for aquatic-phase amphibians (1,000 µg ai/L) and fish (19,200 µg ai/L). The highest concentration tested in the acute studies and the NOAEC are compared to the highest aquatic EEC in all waterbodies to characterize the likelihood of adverse effects to individuals. Endpoints are not selected to evaluate adverse effects in aquatic-phase amphibian populations and communities given that adverse effects are unlikely for individuals in all waterbodies (**Section 6.6**).

6.6.2 Direct Effects Analysis

Terrestrial-phase Amphibians

Based on the direct effect analysis for birds and reptiles (**Section 6.4**), terrestrial-phase amphibians are likely to be adversely affected at the individual, population, and community-level. At the individual level, adverse effects from foliar and seed treatment uses are likely for species of all sizes. Conversely, at the population level, adverse effects from foliar uses are most likely for small species (<100 grams) whereas treated seeds are likely to adversely affect small and medium-sized (<1,000 g) species. Among amphibian communities, those consisting primarily or exclusively of small species with a terrestrial-phase are the most likely to experience adverse effects.

Aquatic Amphibians

Based on available data on aquatic-phase amphibians and the fish data used as a surrogate for aquatic-phase amphibians, direct effects are unlikely for aquatic-phase amphibians at the individual and population level. Acute and chronic adverse effects in aquatic-phase amphibians were not observed at concentrations up 100,000 and 1,000 µg ai/L, respectively, which are an order of magnitude or greater than the highest aquatic EEC (*i.e.*, 240 µg/L from the wetland) across all waterbodies evaluated. Adverse effects in fish are also noted only at concentrations (*i.e.*, >19,200 µg ai/L) well above the EECs indicating low likelihood of adverse effects to individuals or populations of amphibian species in their aquatic phase.

While EPA does not consider effects to aquatic-phase amphibians likely, overall, adverse population-level direct effects are likely for all listed amphibians that weigh less than 100 grams and are terrestrial only or have a terrestrial phase. According to EPA's database, none of the listed amphibian species consume seeds; therefore, the seed treatment uses are unlikely to contribute to adverse direct effects in these species. Adverse PPHD effects are also likely for listed species that have obligate or generalist relationships with small terrestrial amphibian species or small amphibians that have a terrestrial phase.

6.6.3 Off-Site Transport

Given that adverse effects to amphibians are likely, EPA determined the extent to which off-site transport will contribute these adverse effects at each level of biological organization to define the exposure area for each UDL. Spray drift is likely to be the primary route of off-site exposure contributing to direct effects to terrestrial-phase amphibians. Spray drift may result in direct exposure to spray droplets, and deposition of residues on dietary items, and/or foliar, soil, and other surfaces that the species moves across. Runoff may contribute to residues in the soil or in plant tissues following systemic uptake; however, it is likely to be a minor route of exposure relative to spray drift. Since adverse effects to aquatic-phase amphibians are unlikely, EPA did not incorporate drift distances for aquatic habitats into the UDL exposure area. The distances for terrestrial-phase amphibians are identical to those reported for birds and reptiles in **Table 49** of **Section 6.4.** Briefly, individual-level effects are likely up 305 meters from the use site and population-level adverse effects are likely up to 30 meters from the use site. Adverse effects to amphibian communities are likely only at the use sites.

6.6.4 PPHD Effects

Listed amphibians have generalist diet and habitat relationships with plants, aquatic and terrestrial invertebrates, mammals (*i.e.,* use of burrows of small mammals) and other amphibians. EFED's listed species database does not report on whether several aquatic amphibian species rely on upland or semi-aquatic plants for habitat; therefore, EFED initially assumed these species have a generalist relationship with upland and semi-aquatic plants even if not explicitly stated in the habitat description. Obligate relationships among listed amphibians are with terrestrial plants and mammals. Based on the generic-taxa based screening-level assessment, the registered uses of acetamiprid are likely to have an effect on listed amphibian species that have PPHD relationships with plants, terrestrial vertebrates, and invertebrates.

EPA has determined that the registered uses are further likely to adversely affect listed amphibian species that have generalist or obligate relationships with invertebrates (**Section 6.1** and **Section 6.3**), reptiles, amphibians, and birds, which are commonly prey-predator relationships. The loss of prey items will have the greatest impact among listed amphibian species that rely primarily or exclusively on small birds, amphibians, and reptiles, and terrestrial non-mollusk invertebrate, aquatic insect and/or crustacean species. Community-level adverse effects for small birds, amphibians, and reptiles are largely limited to use sites, which decreases the likelihood of adverse PPHD effects for listed species with generalist relationships to these taxa that are likely to forage across multiple habitats or are unlikely to forage at use sites. Since EPA has determined that community-level effects are not likely for plants

(**Section 6.7**) or mammals (**Section 6.5**), species that have a generalist relationship with these taxa are unlikely to experience adverse effects related to a decline in these dietary items or loss of habitat.

Obligate relationships for listed amphibians include the California tiger salamander (*Ambystoma californiense*) which rely on the burrows of small mammals for shelter and the Golden Coqui [*Eleutherodactylus jasperi*]]) which rely on bromeliads, a family of monocot upland terrestrial plants, for habitat. Adverse effects are not likely for populations of monocot terrestrial plants (**Section 6.7**) nor mammals (**Section 6.5**); therefore, adverse PPHD effects to these species are unlikely to occur through these obligate relationships.

6.6.5 Effects Determination and Predictions of Likely Jeopardy

EPA considered a total of 38 amphibian species in this BE. No NE determinations was made for listed amphibian species. EPA made NLAA determinations for 4 species, and LAA determination for 34 species. Of the 34 species with LAA determinations, EPA predicts that the registered acetamiprid uses are not likely to jeopardize 30 species and there is a likelihood to jeopardize 4 species. The number for each determination and J prediction is summarized in **Table 62** and discussed in more detail for each species in **Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification.**

Table 62. Number of Listed Species Effects Determinations and Predictions of Likelihood of Jeopardy for Amphibians from Registered Uses of Acetamiprid.

Taxon	Number of Species[1]	NE	NLAA	LAA, Not Likely J	LAA, Likely J
Amphibians	38	0	4	30	4

J=Jeopardy; LAA=Likely to Adversely Affect; NE=No Effect; NLAA=Likely to Adversely Affect
[1]Reflects the species and critical habitats listed as of February 16, 2022.

Listed Species with No Effect Determinations

EPA made NE determinations for listed amphibians that either had no likelihood of direct and PPHD effects or had no overlap with UDLs and the off-field areas identified (<1% overlap) when considering the exposure area in which an effect is likely. None of the listed amphibian species meet this criteria; therefore, there are no NE determinations made for this action.

Listed Species with May Affect (MA) Determinations

EPA made MA determinations for listed amphibians whose range had $\geq$1% overlap with at least one UDL and is likely to experience direct effects and/or PPHD effects as a result of its relationships with invertebrates, terrestrial vertebrates, and dicot terrestrial and semi-aquatic plants.

Not Likely to Adversely Affect (NLAA)

NLAA determinations are driven by an assessment of the likelihood of direct effects and exposure occurring based on different habitat characteristics. EPA made NLAA determinations for species that are unlikely to experience adverse direct and PPHD effects, that have a range with <1% overlap with any individual UDL after refining the exposure area to account for likely adverse effects to individuals and with consideration of insecticide usage and crop acreage data from the CoA, and for species where life history indicate the likelihood of exposure and adverse effects is low. The main life history considerations that drove NLAA determinations included:

- species found interior forest habitat and no registered forestry uses, thereby rendering exposure highly unlikely;

Likely to Adversely Affect (LAA)

Of the MA species, LAA species are driven by an assessment of the likelihood of direct and PPHD effects from diet and based on different habitat characteristics. Species designated as LAA had the potential for direct and/or PPHD effects from the consumption of invertebrate or terrestrial vertebrate prey or an obligate relationships to dicot plants, and they inhabit areas where exposure is expected to reasonably occur at levels that could cause effects.

Species with Potential Jeopardy Determinations

The predictions of likely jeopardy for listed amphibians consider the magnitude of effect designations, the extent of spatial overlap between the species range and UDL after refinements, and additional information on life history and vulnerability that can influence the likelihood of a population level effect that could jeopardize its existence.

A potential likelihood of future jeopardy is not predicted for species that have low magnitude of effect and/or have low overlap (<5%) with the refined exposure area for any individual UDL or where the CoA data can be used to discount the likelihood of exposure based on low usage of insecticides or low acreage of registered crops for aggregate agricultural UDLs. Additional life history characteristics leading to a prediction of no likelihood of future jeopardy include:

- The species is unlikely to utilize agricultural fields based on habitat description and all UDLs have <5% overlap when only considering the off-site exposure area.
- The open spaced developed and developed UDLs are the only uses likely contributing to adverse effects and it is unlikely the species will regularly rely on those use sites for habitat or forage.
- The species' habitat is medium to high flowing waterbodies only and modeled concentrations are within 2x of the community level threshold for aquatic invertebrates. Dilution in these habitats is not accounted for in modeling but is likely to result in concentrations at levels that will not adversely affect the aquatic invertebrate prey base.

Table 63 summarizes the listed amphibian species for which EPA predicts that acetamiprid has a likelihood of jeopardy. A potential likelihood of future jeopardy is predicted for these species based on the following overlap and life history information:

- At least one UDL overlaps with >5% with the species range and, when available, CoA data indicate high acreage of insecticide usage and/or crop acreage for aggregate UDLs;
- Terrestrial insects and/or aquatic insects and crustaceans are the species preferred or only source of prey for some or all of the species life cycle.

In addition, all listed species that are predicted to have a potential likelihood of future jeopardy are medium to high vulnerability. Two amphibian species are predicted to have a potential likelihood of future jeopardy resulting from currently registered uses of acetamiprid. The listed amphibian species are likely to be adversely affected by direct effects and reduction in prey availability at the use site and in off-site areas that receive spray drift and runoff.

Table 63. Listed Amphibian Species with Predicted Likelihood of Jeopardy.

Entity ID	Common Name (Scientific Name)
188	Santa Cruz long-toed salamander (*Ambystoma macrodactylum croceum*)
203, 4773, 8395	California tiger salamander (*Ambystoma californiense*)

6.7 Plants

6.7.1 Direct Effects

6.7.1.1 Plant Toxicity and Effects

Terrestrial Plants

Terrestrial plant toxicity data are available for 10 species covering dicot plants, and graminoid and non-graminoid monocot plants. Available data evaluated effects from pre-emergent (*i.e.,* seedling emergence) and post-emergence exposure (*i.e.,* vegetative vigor) with two acetamiprid TEPs ranging in purity from 70-71.1% ai. All studies tested concentrations ranging from 0.59 to 0.67 lbs ai/A which are above the highest single application rate of 0.52 lbs ai/A permitted on registered labels. **Table 64** presents the most sensitive endpoints identified for monocots and dicot species from pre- and post-emergence exposure.

In the seedling emergence study, decreased shoot length was the most sensitive measurement endpoint. Tomato (*Lycopersicon esculentum*) and cucumber (*Cucumis sativus*) were the most sensitive dicots species (IC_{25} = 0.16 lbs ai/A, NOAEC = 0.077 lbs ai/A, and LOAEC = 0.15 lbs ai/A based on reduced shoot length); onion (*Allium cepa*) is the most sensitive monocot species (IC_{25} = 0.23 lbs ai/A, NOAEC = 0.077 lbs ai/A, and LOAEC = 0.15 lbs ai/A based on reduced shoot length). All other species tested in the seedling emergence studies did not achieve a 25% effect on survival, emergence, or growth up to the highest concentration tested.

In the vegetative vigor studies, lettuce (*Lactuca sativa*) is the most sensitive dicot species and shoot length is the most sensitive endpoint tested in this species (IC_{25} = 0.0056 lbs ai/A, NOAEC = 0.0025 lbs ai/A, and LOAEC = 0.005 lbs ai/A). An IC_{25} for dry weight was also estimated in this species at 0.012 lbs ai/A. The growth effects observed in lettuce occur at concentrations that are orders of magnitude lower than those causing growth effects in the most sensitive monocot species perennial ryegrass (*Lolium perenne*; IC_{25} = 0.46 lbs ai/A, NOAEC = 0.31 lbs ai/A, and LOAEC = 0.59 lbs ai/A based on decreased dry weight) and the next most sensitive dicot, turnips (*Brassica rapa*; IC_{25} = 0.2 lbs ai/A, NOAEC = 0.31 lbs ai/A, and LOAEC = 0.59 lbs ai/A based on decreased dry weight). None of the other species tested in the vegetative vigor studies exhibited a 25% effect on survival or growth up to the highest concentration tested.

Table 64. Most Sensitive Acetamiprid Toxicity Data for Terrestrial Plants.

Exposure Timing	Test Substance (% ai)	Most Sensitive Test Species	Toxicity Value	MRID Classification
Monocotyledonous Plants				
Pre-emergence (Seedling Emergence)	TEP Acetamiprid Wettable Powder NI-25 (71.1%)	Onion (*Allium cepa*)	IC_{25} = 0.23 lbs ai/A NOAEC = 0.077 lbs ai/A LOAEC = 0.15 lbs ai/A Based on a reduction in onion dry weight	44988413 Supplemental (for seedling emergence only) 49356501 Acceptable
Post Emergence (Vegetative Vigor)	TEP Acetamiprid Wettable Powder NI-25 (71.1%)	Ryegrass (*Lolium pereene*)	IC_{25} = 0.46 lbs ai/A NOAEC = 0.31 lbs ai/A LOAEC = 0.59 lbs ai/A Based on a reduction in ryegrass dry weight	44988413 Acceptable
Dicotyledonous Plants				
Pre-emergence (Seedling Emergence)	TEP Acetamiprid Wettable Powder NI-25 (71.1%)	Cucumber (*Cucumis sativus*),Tomato (*Lycopersicon esculentum*)	IC_{25} = 0.16 lbs ai/A NOAEC = 0.077 lbs ai/A LOAEC = 0.15 lbs ai/A Based on a reduction in cucumber and tomato shoot length	44988413 Supplemental (for seedling emergence) 49356501 Acceptable
Post Emergence (Vegetative Vigor)	TEP Acetamiprid Wettable Powder NI-25 (70.4-71%)	Lettuce (*Lactuca sativa*)	IC_{25} = 0.0056 lbs ai/A NOAEC = 0.0025 lbs ai/A LOAEC = 0.005 lbs ai/A Based on a reduction in lettuce shoot length	44988413 Acceptable 45921401 Supplemental

IC_{25}=25% inhibition concentration; TGAI=Technical Grade Active Ingredient; TEP= Typical end-use product; a.i.=active ingredient; NOAEC=No-Observed-Adverse-Effect-Concentration; LOAEC=Lowest-Observed-Adverse-Effect-Concentration

Aquatic Plants

Aquatic plant toxicity data are available for four species of non-vascular plants and one species of vascular plant. The EC_{50} values for the vascular aquatic plant species (Duckweed; *Lemna gibba*) and the non-vascular species including the freshwater diatom *Navicula pelliculosa*, the estuarine/marine diatom *Skeletonema costatum*, the green algae *Raphidocelis subcapitata*, and the blue-green algae *Anabaena flos-aquae* are non-definitive (**Table 65**). No adverse effects on growth or survival were detected up to the highest concentrations tested, which ranged from 1,000 to 1,300 µg ai/L, with any aquatic plant species.

Table 65. Most Sensitive Acetamiprid Toxicity Data for Aquatic Plants.

Vascular/Non-Vascular	Test Substance (% ai)	Test Species	Toxicity Value	MRID Classification
Vascular Aquatic Plants	TGAI (99.9%)	Duckweed (*Lemna gibba*)	14-d EC_{50} > 1,000 µg ai/L NOAEC = 1,000 µg ai/L	44988415 Acceptable
Non-Vascular Aquatic Plants	TGAI (99.9%)	Estuarine/ marine diatom (*Skeletonema costatum*)	5-d EC_{50} > 1,000 µg ai/L NOAEC = 1,000 µg ai/L	44988418 Acceptable
	TGAI (99.9%)	Freshwater diatom (*Navicula pelliculosa*)	5-d EC_{50} > 1,100 µg ai/L NOAEC = 1,100 µg ai/L LOAEC > 1,100 µg ai/L	44988417 Acceptable
	TGAI (99.9%)	Green algae (*Raphidocelis subcapitata*)	5-d EC_{50} > 1,200 µg ai/L NOAEC = 1,200 µg ai/L	44988414 Acceptable
	TGAI (99.9%)	Blue-green algae (*Anabaena flos-aquae*)	5-d EC_{50} > 1,300 µg ai/L NOAEC = 1,300 µg ai/L	44988416 Acceptable

Note: EC_{50}=50% effect concentration; TGAI=Technical Grade Active Ingredient; ai=active ingredient; NOAEC=No-Observed-Adverse-Effect-Concentration; LOAEC=Lowest-Observed-Adverse-Effect-Concentration; > Greater than values designate non-definitive endpoints where no effects were observed at the highest level tested (USEPA, 2011).

6.7.1.2 Endpoint Selection

Table 66 below summarizes the exposure models and endpoints used to evaluate upland and semi-aquatic plants at each level of biological organization. These endpoints are used to estimate an initial exposure-to-effect ratio for direct effects to terrestrial plants. Based on the generic taxa-based screening-level assessment (PRA; **Section 2.1.2**), direct effects to aquatic plants are not likely and, therefore, endpoints were not selected for this evaluation. A comparison of the concentrations tested and the aquatic EECs across the different waterbodies is also provided below to contextualize the likelihood of effects.

Table 66. Description of Toxicity Endpoints and Exposure Models Used in Direct Effects Analysis for Birds and Reptiles.

Level of Biological Organization	Exposure Models	Direct Effects Endpoints
Individual	On/Off-Site: PAT v. 2.7 Off-Site: AgDrift® v. 2.1.1 Wetland and Other Low-Volume Waterbodies – Peak W-PEZ EEC Terrestrial – Peak T-PEZ EEC	Monocot: NOAEC = 0.077 lbs ai/A (LOC=1.0) Dicot: NOAEC = 0.0025 lbs ai/A (LOC = 1.0)
Population		Monocot: IC_{25} = 0.23 lbs ai/A (LOC=1.0) Dicot: IC_{25} = 0.0056 lbs ai/A (LOC = 1.0)
Community		Monocot: IC_{25} = 0.23 lbs ai/A (LOC=1.0) Dicot: IC_{25} = 0.0056 lbs ai/A (LOC = 1.0) With consideration of other toxicity data including the non-definitive endpoints for other monocot and dicot species tested data

ICx = concentration at which x% inhibition (in this case, x is 25%). LOC = Level of concern. NOAEC=No-Observed-Adverse-Effect-Concentration; LOAEC=Lowest-Observed-Adverse-Effect-Concentration; PAT=Plant Assessment Tool; MATC = Maximum Acceptable Toxicant Concentration which represents the geometric mean of the NOAEC and LOAEC; T-PEZ = terrestrial plant exposure zone; W-PEZ = wetland plant exposure zone

An SSD could not be developed for terrestrial plants given that most species reported non-definitive IC_{25} values; therefore, thresholds for individuals, populations, and communities are based on the most sensitive monocot and dicot species tested. Toxicity data are not available to assess effects directly in ferns and allies, conifers and cycads, and lichens. While aquatic toxicity data are available for cyanobacteria and green algae, they are not representative of a terrestrial exposure pathway, leaving it uncertain as to whether the observed effects are likely to occur in lichen. Since no data are available, the most sensitive terrestrial plant endpoints are used as a surrogate to evaluate effects to fern and allies, conifer and cycad, and lichen species.

Individual level thresholds for monocots and dicots are based on growth effects observed from pre-emergent exposure and post-emergent exposure in onion (*A. cepa*) and lettuce (*L. sativa*), respectively. For monocots, individual-level and population-level effects are assessed based on the most sensitive NOAEC of 0.077 lb ai/A and IC_{25} of 0.23 lb ai/A, respectively, which is based on decreased shoot length in onion. For dicots and other plant species that are not monocots, individual-level and population-level effects are assessed based on the most sensitive NOAEC of 0.0025 lbs ai/A and IC_{25} of 0.0056 lbs ai/A, respectively, which is based on decreased dry weight in lettuce. For community-level effects, EPA relied on the most sensitive IC_{25} values but also considered all available toxicity data for other monocot and dicot species including those with non-definitive endpoints to characterize the range of sensitivities within and between plant types that would cover homogenous and diverse plant communities. For all levels of biological organization, the endpoints represents the threshold for effects; therefore, the LOC is 1.0.

6.7.2 Direct Effects Analysis

Listed plant species include lichens, ferns and allies, conifers, cycads, and flowering monocot and dicot plants. All listed plants species occupy dry, upland terrestrial and/or semi-aquatic habitats. Plants in semi-aquatic habitats are emergent species, generally with shoots and leaves extending above the surface of the water and roots inundated or in moist soil following dry down. While several emergent species may also tolerate aquatic habitat where the plant is fully submerged for a period of time, none of the species grow in those habitats exclusively. All listed plant species are vascular except for the lichen species which are a symbiotic relationship of green algae or blue-green algae with fungi. There are no currently listed non-vascular aquatic plants species.

Direct effects to upland plants may result from direct spray during application at the use site and direct effects to upland, semi-aquatic, and aquatic plants may result from exposure to acetamiprid that is transported off-site. Since there are no direct applications to water associated with this action, direct spray exposure is not likely for semi-aquatic and aquatic plants. Spray drift and runoff are likely to be the primary mechanisms for off-site transport of acetamiprid and will be the main sources of exposure to plants that do not establish at the use site. For treated seeds, while drift may occur from abraded seeds, runoff is likely to result in higher exposure as it transports residues either from the seed surface or in the soil off-site.

The effects analysis for terrestrial species individuals, populations, and communities are summarized in **Table 67**. Detailed results for each PAT and PWC scenario are provided in **Appendix E. Supplemental Tables for Direct Effects Analysis**. At least one scenario for all registered uses within the Alfalfa, Citrus, Cotton, Nursery, Other Orchards, Other Row Crops, Vegetable and Ground Fruit, and Soybean UDLs result in EECs in upland and semi-aquatic environments exceeds the toxicity threshold for monocot and dicot terrestrial and semi-aquatic plant individuals. For dicot species, the registered seed treatment uses in the Other Grains and Other Crops UDL also exceed the individual threshold for terrestrial and semi-aquatic plants. The same UDLs exceed the population-level threshold for upland dicot species. The same UDLs exceed the population-level threshold for semi-aquatic dicot species with the exception of the Other Grains and Other Crops UDLs. The Vegetable and Ground Fruit UDL is the only UDL for which scenarios exceed the population-level threshold for monocot upland and semi-aquatic plants. Although there are exceedances of the population-level threshold for monocot plants, a majority of the Vegetable and Ground Fruit scenarios do not exceed this threshold. Among the monocot species tested, onion is the only species where growth effects were observed in a concentration range that overlaps with the T-PEZ and W-PEZ EECs. Given that few scenarios are exceeded, it is unlikely that the registered uses of acetamiprid in the Vegetable and Ground Fruit UDL will adversely affect enough monocot individuals to result in a population-level effect. Conversely, a majority of scenarios across the UDLs exceed the population-level threshold for dicots indicating a greater likelihood of adverse population-level effects in dicot species. Registered uses in the Developed and Open Spaced Developed UDLs are not likely to elicit adverse effects to individuals or populations of upland or semi-aquatic plants off-site.

The exposure-to-effect ratios for adverse effects to monocot and dicot plant communities are identical to the ratios reported for population-level adverse effects since the same thresholds are used to represent both levels of biological organization. Plant communities consist of herbaceous and/or woody species which will have a range of sensitives to acetamiprid. Except for lettuce and onion, the monocot and dicot species tested either exhibited no adverse effects within the range of permitted application rates or adverse effects are only observed at concentrations above the upland and wetland EECs for all registered uses. Given the overall lack of sensitivity among the tested herbaceous species, it is unlikely that the registered uses of acetamiprid will adversely affect herbaceous plant communities. Toxicity data for woody species are not available to assess potential impacts to those species; however, several products are registered as tree injections and foliar applications are permitted in orchards and on ornamental trees with no timing restrictions which suggest that woody species are tolerant of acetamiprid, at least at the application rates registered for those uses. In the absence of toxicity information on woody species, EPA assumed that acetamiprid could adversely affect new growth on woody species and as a result may impact individuals, but would not adversely affect established trees and as a result is unlikely to adversely affect more diverse plant communities consisting of herbaceous and woody species.

Table 67. Effects Analysis for Terrestrial and Semi-aquatic Plant Species at Each Level of Biological Organization from Registered Uses of Acetamiprid.

Level of Biological Organization →			Individual		Population		Community	
Habitat	**Monocot/Dicot**	**Peak 1-in-10-yr EEC (lbs ai/A)**	**Exposure to Effects Ratio (EEC/Toxicity Endpoint)[3]**	**UDL Exceedances**	**Exposure to Effects Ratio (EEC/Toxicity Endpoint)[3]**	**UDL Exceedances**	**Exposure to Effects Ratio (EEC/Toxicity Endpoint)[3]**	**UDL Exceedances**
Upland	Monocot	<0.01 – 0.32[2]	0.01 – **4.19**	All UDLs except Developed/Open Spaced Developed, Other Grains, Other Crops	<0.01 – **1.40**	Vegetable and Ground Fruit	Community level effects are not likely given the unique sensitivity observed in a small number of species and low sensitivity observed in monocot species overall	
	Dicot[1]		0.19 – **129**	All UDLs except Developed/Open Spaced Developed	0.08 – **57.7**	All UDLs except Developed/Open Spaced Developed		
Semi-Aquatic	Monocot	<0.01 – 0.24	<0.01 – **3.13**	All UDLs except Developed/Open Spaced Developed, Other Grains, Other Crops	<0.01 – **1.05**	Vegetable and Ground Fruit	Community level effects are not likely given the unique sensitivity observed in a small number of species and low sensitivity observed in dicot species overall	
	Dicot[1]		0.10 – **96**	All UDLs except Developed/Open Spaced Developed	0.04 – **43.0**	All UDLs except Developed/Open Spaced Developed, Other Grains, Other Crops		

EEC=estimated environmental concentration; UDL=use data layer

Bolded values exceed the risk to terrestrial plant level of concern (LOC) of 1.0.

[1]Individual and population magnitude of effect for upland and semi-aquatic dicot species is used as a surrogate for lichens, ferns and allies, conifers, and cycads that occupy these habitats since toxicity data specific to non-flowering plant species are not available and the dicot endpoints are the most protective.

[2] The EECs for upland plants represent sheet flow runoff within 30 meters from the field and spray drift exposure up to 15 meters from the field.

[3] Toxicity endpoints used for this analysis at each level of biological organization are captured in**Table 64 Table 66**.

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The upland and semi-aquatic exposure-to-effect ratios presented in **Table 68** reflect exposure to plants that have established off-site. Direct exposure to acetamiprid is likely to occur for plant species that establish at use sites during the spray application windows and these species will experience greater exposure to the chemical compared to species that establish in off-site habitats. A majority of the listed plant species are not likely to establish in managed row crop fields; however, depending on habitat requirements, some species may be present in Developed, Open-Spaced Developed, and other agricultural use sites (*e.g.*, Orchards). Spray applications at the maximum permitted rate for UDLs where listed plants may establish exceed the individual and population-level adverse effects thresholds for dicots. Maximum permitted application rates in non-Ag and non-row crop agricultural UDLs also exceed the individual level threshold for monocots whereas only uses within the Nursery and Orchard UDLs exceed the population level threshold.

Notably, a majority of incidents (27 out of a total of 35 incidents in the U.S.) reported in the IDS associated with use of acetamiprid products are for terrestrial plants. There are 27 incidents reported for acetamiprid involving adverse effects to plants. Most of the incidents occurred prior to publication of the 2017 PRA, a majority of which were classified with a certainty of "possible". Incidents reported up to >45% of plants affected and included species of flowers, rose/parsley, trees, edible plants, rose bushes, and vegetables (See USEPA 2017 for more detail). Since 2017, there have been 14 additional incidents reported involving terrestrial plants. All plant incidents reported using a ready-to-use formulations [Acetamiprid RTU Insecticide (EPA Reg. No. 8033-21) & Acetamiprid Concentrate Insecticide (EPA Reg. No. 8033-107)] that is registered for applications in residential settings.

A direct effects analysis was not conducted for aquatic plants given that the generic taxa screening-level analysis indicated that registered uses of acetamiprid were unlikely to have an effect on species within this taxa. As noted earlier, the highest EEC (*i.e.*, 240 µg ai/L) across the low volume waterbodies, wetlands, and larger volume waterbodies is approximately 4 times lower than the highest concentration tested at which no adverse effects to growth or survival were detected in aquatic plants, which further supports the conclusions of the screening-level analysis. Therefore, EPA believes it is unlikely that a listed species will experience adverse effects from their generalist or obligate relationship to aquatic plants.

6.7.3 Off-Site Transport

Given that adverse effects are likely for upland and semi-aquatic monocot and dicot plants, EPA determined the extent to which off-site transport will contribute these adverse effects at each level of biological organization to define the exposure area for each UDL. Spray drift and runoff are likely to be the primary routes of off-site exposure contributing to direct effects in plants. Spray drift distances to reach the individual threshold for monocots and dicots range from 0 to 10 meters and 48 to 305 meters, respectively. Adverse effects to monocot populations are limited to the use site for the Citrus and Nursery UDLs only; however, the population level threshold for dicot species is exceeded between 0 and 43 meters from the use site across UDLs (**Appendix F. Spray Drift Analysis**). **Table 68** provides the furthest off-field distances within which spray drift and runoff may lead to direct effects to plant individuals and populations based on the toxicity thresholds for the different levels of biological organization. Since adverse effects are not likely at the community level, off-site transport distance was not assessed for that level of biological organization. EPA then buffered out the UDLs by these distances to establish the exposure area when assessing the potential for adverse direct effects to listed plant species and listed species that rely on plants for PPHD.

Table 68. Off-Site Transport Distances (meters, m) Used for Estimating Spatial Overlap for Upland and Semi-Aquatic Plants in Effects Determinations and Predictions of Likelihood of Jeopardy from Registered Uses of Acetamiprid.[1]

UDL	Common Application Method[2]	Potential for Effects to an Individual[3] (Upland/Semi-Aquatic Distance)		Potential for Effects to a Population[4] (Upland/Semi-Aquatic Distance)	
		Monocots	Dicots	Monocots	Dicots
Alfalfa	Ground-boom	30/300 m	90/300 m	Adverse effects are not likely.	60/300 m
Citrus	Airblast	30/300 m	150/300 m	0 m	30/300 m
Cotton	Ground-boom	30/300 m	90/300 m	Adverse effects are not likely.	30/300 m
Grapes	Airblast	30/300 m	60/300 m	Adverse effects are not likely	30/300 m
Nursery	Ground-boom	30/300 m	305 m	0 m	120/300 m
Other Crops	Ground-boom, Seed treatment	30/300 m	60/300 m	Adverse effects are not likely.	30/300 m
Other Grains	Seed treatment	30/300 m	30/300 m	Adverse effects are not likely.	30/300 m
Other Orchards	Airblast	30/300 m	120/300 m	Adverse effects are not likely.	30/300 m
Other Row Crops	Ground-boom	30/300 m	60/300 m	Adverse effects are not likely.	30/300 m
Soybean	Ground-boom	30/300 m	30/300 m	Adverse effects are not likely.	30/300 m
Vegetable and Ground Fruit, NL48 Ag	Aerial	30/300 m	90/300 m	Adverse effects are not likely.	60/300 m
CONUS and NL48 Developed, Open Spaced Developed	Handheld equipment	Adverse effects are unlikely for this UDL			

[1] These distances reflect exposure at the use site and spray drift and runoff exposure off-site. Distances account for adverse effects from both runoff and spray drift; however, effects from both routes of exposure may not occur within the entire exposure area.

UDL	Common Application Method[2]	Potential for Effects to an Individual[3] (Upland/Semi-Aquatic Distance)		Potential for Effects to a Population[4] (Upland/Semi-Aquatic Distance)	
		Monocots	Dicots	Monocots	Dicots

[2] The common application method for each use data layer (UDL) was considered in establishing the off-site distance for population and community level adverse effects.
[3]Distances are used to establish the exposure area for each UDL for the May Affect/No Effect (MA/NE) determinations and to evaluate direct effects in the Not likely to Adversely Affect/Likely to Adversely Affect (NLAA/LAA) determinations.
[4]Distances are used to establish the exposure area for each UDL to evaluate direct effects in the predictions of Likely J and to evaluate prey, pollination, habitat or dispersal (PPHD) effects to obligate relationships for the NLAA/LAA Determination and predictions of Likely J.

6.7.4 PPHD Effects

Based on the FWS Final Malathion BiOp (USFWS, 2022), listed terrestrial plants are categorized according to 11 assessment groups (**Table 69**). These groups reflect commonalities in taxonomy (*e.g.,* monocots, dicots, ferns, conifers) and reproductive strategy (*e.g.,* self-fertilization, asexual reproduction, biotic pollination vectors).

Table 69. Plant Assessment Groups Used for Draft Effect Determinations and Predicted Jeopardy for Listed Terrestrial Plants.

Plant Group #	Group	Reproductive Strategy[1]	# Listed Species
1	Lichens	Asexual reproduction	2
2	Ferns and Allies	Sexual and asexual reproduction, wind dispersal of spores	38
3	Conifers & Cycads	Wind dispersal of pollen, 1 species rely on mammals for seed dispersal	4
4	Monocots,	Abiotic Pollination vectors, abiotic + biotic dispersal mechanisms	41
5	Monocots	Out-crossers with Biotic Pollination vectors	9
6	Monocots	Biotic Pollination vectors; asexual reproduction or self-fertilization	20
7	Monocots	Biotic Pollination vectors; other reproductive mechanisms unknown	19
8	Dicots	Abiotic Pollination vectors	12
9	Dicots	Out-crossers with Biotic Pollination vectors	244
10	Dicots	Biotic Pollination vectors; asexual reproduction or self-fertilization	114
11	Dicots	Biotic Pollination vectors, other reproductive mechanisms unknown	431
NA	Dicots	Pollination mechanism unknown (2 species), presumed by USFWS to be extinct (1 species) and insect pollination (1 species)	4
[1]Source: Final Malathion Biological Opinion (USFWS, 2021)			

Listed plants may be affected by acetamiprid through impacts to their biotic pollinator or dispersal mechanisms or impacts to the species' habitat. Listed plant species have generalist relationships with terrestrial invertebrates (bees and non-bees), mammals, and birds for pollination and dispersal. Several listed plant species also have reported obligate relationships with terrestrial plants, fungi, birds, bees, and non-bee terrestrial invertebrates. Although listed plants likely rely to some extent on other plants within their community to maintain habitat quality (*e.g*., temperature regulation), PPHD relationships with other terrestrial plants are not well defined for most plant species. Consequently, EPA assumed that a plant species did not rely on other terrestrial plants unless an obligate relationship is specified. Based on the generic taxa-based screening-level assessment, the registered uses of acetamiprid are likely to have an effect on relationships with other upland terrestrial and semi-aquatic plants, terrestrial invertebrates (bees and non-bees), birds, and mammals.

The registered uses are further likely to adversely affect listed plant species that have generalist or obligate relationships with terrestrial invertebrates (**Section 6.3**) and birds. Generalist relationships that involve bees or non-bee terrestrial insect pollinators are most likely to experience adverse effects on reproductive success given that community-level effects are likely for this taxon and the exposure area in which community-level effects are likely is greater compared to birds for most UDLs (**Section 6.4**). While most listed plant species are not likely to establish on managed agricultural fields, attractive crops or other plant species (**Section 6.3**) will be present at use sites indicating that invertebrate pollinators for a given listed species may be exposed both at use sites where the plants do not occur and, for some UDLs, in off-site locations where the listed plant species do occur. The likelihood of adverse PPHD effects to pollination mechanisms, however, decreases when adverse community-level effects are likely only at the use site. Not all uses sites will be treated at the same time and a species' pollinators will not forage exclusively at treated use sites, which decreases the likelihood of a community-level impact to pollinators. This applies to most UDLs for bird pollinators (**Section 6.4**) and for a smaller subset of UDLs for terrestrial invertebrate pollinators (**Section 6.3**). For these cases, adverse effects are still likely to affect reproduction in individual plants that rely on them for pollination, but EPA does not expect this to manifest in a population-level effect in listed plant species unless the on-site area includes a large portion of the species range. Community-level effects are not likely for other plants or mammals (**Section 6.5**); therefore, species that have a generalist relationship with these taxa are unlikely to experience adverse effects related to a decline in these dietary items or loss of habitat.

A total of 31 listed plant species have reported obligate relationships including to terrestrial invertebrates (17 species covering invertebrates from the Orders Hymenoptera and Lepidoptera) and birds (2 species) for pollination, terrestrial plants (6 species), and fungi (8 species). Adverse effects to bird and terrestrial invertebrate populations are likely; therefore, adverse effects to plants that rely on these taxa for pollination are also likely. Since obligate relationships are more explicit as to whether the plant species relies on bees and/or non-bee terrestrial invertebrates for pollination, EPA tailors the exposure area considered in evaluating the likelihood of adverse PPHD effects to those plants to the evaluations of bees and non-bees. The two species with an obligate relationship to birds rely specifically on hummingbirds. Although not from the Order Passeriformes, hummingbird species are small birds that consume nectar as a primary food source and is likely to experience adverse population-level effects based on the direct effects analysis for this taxon (**Section 6.4**). The two species that have an obligate relationship to birds also have obligate relationships with invertebrate pollinators. EPA made similar considerations on the likelihood of adverse effects to these obligate pollinator relationships relating to the extent to which population-level effects are likely at use sites and off-site.

Among the six species with obligate relationships to terrestrial plants, three species including the Soft-leaved painbrush (*Castilleja mollis*), Lanai sandalwood (*Santalum haleakalae var. lanaiense*), and Pennell's birds-beak (*Cordylanthus tenuis ssp. capillaris*) rely on woody dicot plants, one species [Veritys dudleyi (*Dudleya verity*)] relies on lichens, one species [Red Hills vervain (*Verbena californica*)] relies on monocot plants, and one species [Lake County stonecrop (*Parvisedum leiocarpum*)] the type of plants was not specified. The registered uses of acetamiprid have the potential to impact the health of the woody plant and tree species, particularly those occuring near use sites and with new growth, which will affect individual species co-localized with these woody plants; however, because acetamiprid is not likely to adversely affect populations of woody plants or trees, adverse PPHD effects are unlikely for three species that rely on woody dicot species. Similarly, population-level adverse effects are not likely for monocot species; thus, adverse PPHD effects to the one species that relies monocot species is unlikely. Adverse population-level effects cannot be ruled out for the remaining two species because data are not available to assess toxicity to lichen species and thus the most sensitive toxicity data were used as a surrogate and it is unknown if the other species relies on dicot plants. Adverse effects are not likely to fungi from the registered uses of acetamiprid; therefore, mycorrhizal symbiotic relationships for the eight species that rely on fungi is not likely to be adversely affected.

The evaluation of PPHD relationships with terrestrial animals is focused primarily on pollinators because more information is available on those relationships. Plants that depend upon terrestrial invertebrates and vertebrates for seed dispersal mechanisms are also considered for potential PPHD effects. Birds and terrestrial invertebrates (*e.g.,* harvester ants) are known seed dispersers; however, information on the role of terrestrial animals in seed dispersal of listed plants is limited. To the extent that available information identifies terrestrial invertebrates and birds as significant contributors to seed dispersal, it will be considered in the assessment of PPHD effects on listed plants.

6.7.5 Effects Determinations and Predictions of Likely Jeopardy

EPA considered a total of 938 listed plant species in this listed species assessment. EPA made a NE determination for 234 species, NLAA determinations for 116 species, and LAA determinations for 588 species. Of the 588 species with LAA determinations, EPA predicts that the registered uses of acetamiprid are not likely to jeopardize 466 plant species and there is a likelihood of jeopardy for 122 plant species (**Table 70)**. The rationale for the effects determinations and predictions of likely J are discussed below and in more detail for each species in **Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification**

Table 70. Number of Listed Species Effects Determinations and Predicted Likelihood of Jeopardy for Plants from Registered Uses of Acetamiprid.

Taxon	Number of Species[1]	NE	NLAA	LAA, Not Likely J	LAA, Likely J
Plants	938	234	116	466	122

J=Jeopardy; LAA=Likely to Adversely Affect; NE=No Effect; NLAA=Likely to Adversely Affect
[1]Reflects the species listed as of February 16, 2022.

Listed Species with No Effect (NE) Determinations

EPA based NE determinations on the potential for direct and PPHD effects discussed above, overlap, and the species' habitat. The NE determinations for listed plants were based on species that inhabit areas where exposure is not reasonably expected to occur. Additionally, all listed plant species in assessment groups 1-4 and 8 depend solely on abiotic and non-invertebrate biotic mechanisms of pollination and/or asexual reproduction (*e.g.,* vegetative propagation). Therefore, the potential for PPHD effects on listed terrestrial plants via interference with biotic-mediated pollination mechanisms is not likely for these species. However, direct effects to these species may still result in an effect if the species is in a habitat where exposure is likely. Given that direct and/or PPHD effects are likely for species from all plant groups, the NE determinations for plants were made only for species where there is a <1% overlap with UDLs inclusive of off-field areas.

Listed Species with May Effect (MA) Determinations

For those plants where direct effects are likely and/or which rely on terrestrial invertebrates for pollination and/or dispersal and had ≥1% overlap with at least one UDL, EPA made a MA determination because direct and/or PPHD effects may occur. Listed plants in assessment groups 5, 6 and 7 are all monocots that employ biotic pollination mechanisms alone (*e.g.,* birds, insects), or in combination with other abiotic pollination methods. Similarly, listed plants in groups 9-11 are dicots that use biotic means of pollination. Notably, listed plants in groups 7 and 11 do not have information to define the specific mechanism of biotic-mediated pollination. For plants in groups 7 and 11, EPA assumed pollination to be primarily driven by terrestrial invertebrates.

Not Likely to Adversely Affect (NLAA)

NLAA determinations are driven by an assessment of the likelihood of direct and PPHD effects and exposure occurring based on different habitat characteristics. EPA made NLAA determinations for species that inhabit areas where exposure is not reasonably expected to occur at levels that could cause effects. Species received an NLAA determination if their range overlap was <1% for each UDL after refining the exposure area to account for the likelihood of adverse effects to individuals or when the CoA data indicated crop acreage for aggregate Ag UDLs and/or insecticide usage on agricultural land was low in counties where the species' range is located. In addition, EPA also classified species that are likely extinct as NLAA. For species where overlap suggested potential for adverse effects to individuals, the most impactful species life history characteristics that drove NLAA determinations included:

- species are found in montane/remote habitats (cliff faces, volcanic regions, uninhabited islands).
- species is likely extinct.

Likely to Adversely Affect (LAA)

Of the MA species, LAA species are driven by an assessment of the likelihood of direct and PPHD effects from the loss of terrestrial invertebrates for pollination and/or dispersal and exposure occurring based on different habitat characteristics. Species designated by EPA as LAA were likely to be adversely affected through direct effects and/or PPHD effects from the loss of terrestrial invertebrates for pollination and/or dispersal and inhabit areas where exposure is expected to reasonably occur at levels that could cause effects.

Species with Potential Jeopardy Determinations

Table 71 identifies the listed plant species for which EPA predicts acetamiprid is likely to result in jeopardy. Species with a predicted likelihood of jeopardy have a range that overlaps >5% with at least one agricultural UDL after refining the exposure area to account for the likelihood of adverse effects to population. For species where agricultural UDLs are the driver, the CoA data indicated crop acreage for aggregate Ag UDLs are high in counties where the species' range is located and insecticide usage is either high or not reported. In addition to meeting these overlap criteria, species with likely jeopardy predictions have the following life history characteristics:

- Species inhabit areas where exposure is not likely to be overestimated by EPA's models;
- Species relies on terrestrial invertebrates for pollination and/or dispersal

Table 71. Listed Plant Species with Predicted Likelihood of Jeopardy from Registered Uses of Acetamiprid.

Entity ID	Common Name (Scientific Name)
496	San Diego thornmint (*Acanthomintha ilicifolia*)
500	San Diego ambrosia (*Ambrosia pumila*)
502	Del Mar manzanita (*Arctostaphylos glandulosa ssp. crassifolia*)
505	Pallid manzanita (*Arctostaphylos pallida*)
507	Braunton's milk-vetch (*Astragalus brauntonii*)
511	Ventura Marsh Milk-vetch (*Astragalus pycnostachyus var. lanosissimus*)
512	Coastal dunes milk-vetch (*Astragalus tener var. titi*)
513	Star cactus (*Astrophytum asterias*)
514	Nevin's barberry (*Berberis nevinii*)
522	Fleshy owl's-clover (*Castilleja campestris ssp. succulenta*)
527	Hoover's spurge (*Chamaesyce hooveri*)
528	Purple amole (*Chlorogalum purpureum*)
529	Orcutt's spineflower (*Chorizanthe orcuttiana*)
530	Suisun thistle (*Cirsium hydrophilum var. hydrophilum*)
531	La Graciosa thistle (*Cirsium loncholepis*)
532	Vine Hill clarkia (*Clarkia imbricata*)
541	Conejo dudleya (*Dudleya abramsii ssp. parva*)
544	Laguna Beach liveforever (*Dudleya stolonifera*)
546	Lompoc yerba santa (*Eriodictyon capitatum*)
559	Otay tarplant (*Deinandra (=Hemizonia) conjugens*)
566	Contra Costa goldfields (*Lasthenia conjugens*)
573	Nipomo Mesa lupine (*Lupinus nipomensis*)
578	Few-flowered navarretia (*Navarretia leucocephala ssp. pauciflora (=N. pauciflora)*)
579	Many-flowered navarretia (*Navarretia leucocephala ssp. plieantha*)
585	Lake County stonecrop (*Parvisedum leiocarpum*)
586	Lyon's pentachaeta (*Pentachaeta lyonii*)
593	Calistoga allocarya (*Plagiobothrys strictus*)
596	Hickman's potentilla (*Potentilla hickmanii*)
599	Hartweg's golden sunburst (*Pseudobahia bahiifolia*)
600	San Joaquin adobe sunburst (*Pseudobahia peirsonii*)
610	Keck's Checker-mallow (*Sidalcea keckii*)
611	Wenatchee Mountains checkermallow (*Sidalcea oregana var. calva*)
612	Kenwood Marsh checker-mallow (*Sidalcea oregana ssp. valida*)
620	Northern wild monkshood (*Aconitum noveboracense*)
637	Four-petal pawpaw (*Asimina tetramera*)
647	Sonoma sunshine (*Blennosperma bakeri*)
651	Texas poppy-mallow (*Callirhoe scabriuscula*)
652	Tiburon mariposa lily (*Calochortus tiburonensis*)
653	Brooksville bellflower (*Campanula robinsiae*)

Entity ID	Common Name (Scientific Name)
655	Small-anthered bittercress (*Cardamine micranthera*)
661	Fragrant prickly-apple (*Cereus eriophorus var. fragrans*)
665	Ewa Plains `akoko (*Euphorbia skottsbergii var. skottsbergii*)
667	Chorro Creek bog thistle (*Cirsium fontinale var. obispoense*)
668	Fountain thistle (*Cirsium fontinale var. fontinale*)
669	Presidio clarkia (*Clarkia franciscana*)
678	Salt marsh bird's-beak (*Cordylanthus maritimus ssp. maritimus*)
679	Palmate-bracted bird's beak (*Cordylanthus palmatus*)
711	San Diego button-celery (*Eryngium aristulatum var. parishii*)
712	Contra Costa wallflower (*Erysimum capitatum var. angustatum*)
730	Marin dwarf-flax (*Hesperolinon congestum*)
734	Dwarf-flowered heartleaf (*Hexastylis naniflora*)
739	Slender rush-pea (*Hoffmannseggia tenella*)
754	Sebastopol meadowfoam (*Limnanthes vinculans*)
761	White birds-in-a-nest (*Macbridea alba*)
763	Walker's manioc (*Manihot walkerae*)
764	Mohr's Barbara's buttons (*Marshallia mohrii*)
784	Antioch Dunes evening-primrose (*Oenothera deltoides ssp. howellii*)
790	Furbish lousewort (*Pedicularis furbishiae*)
802	San Diego mesa-mint (*Pogogyne abramsii*)
819	Green pitcher-plant (*Sarracenia oreophila*)
828	Nelson's checker-mallow (*Sidalcea nelsoniana*)
835	Short's goldenrod (*Solidago shortii*)
841	Metcalf Canyon jewelflower (*Streptanthus albidus ssp. albidus*)
852	Cooley's meadowrue (*Thalictrum cooleyi*)
875	Sensitive joint-vetch (*Aeschynomene virginica*)
876	Sandplain gerardia (*Agalinis acuta*)
881	Marsh Sandwort (*Arenaria paludicola*)
886	Coachella Valley milk-vetch (*Astragalus lentiginosus var. coachellae*)
889	Encinitas baccharis (*Baccharis vanessae*)
891	Decurrent false aster (*Boltonia decurrens*)
900	No common name (*Chamaecrista glandulosa var. mirabilis*)
903	Monterey spineflower (*Chorizanthe pungens var. pungens*)
914	Okeechobee gourd (*Cucurbita okeechobeensis ssp. okeechobeensis*)
920	Leafy prairie-clover (*Dalea foliosa*)
927	Santa Ana River woolly-star (*Eriastrum densifolium ssp. sanctorum*)
930	Clay-Loving wild buckwheat (*Eriogonum pelinophilum*)
931	Loch Lomond coyote thistle (*Eryngium constancei*)
932	Snakeroot (*Eryngium cuneifolium*)
935	Minnesota dwarf trout lily (*Erythronium propullans*)
940	Monterey gilia (*Gilia tenuiflora ssp. arenaria*)
960	Pondberry (*Lindera melissifolia*)

Entity ID	Common Name (Scientific Name)
967	Rough-leaved loosestrife (*Lysimachia asperulaefolia*)
972	Spreading navarretia (*Navarretia fossalis*)
976	Canby's dropwort (*Oxypolis canbyi*)
977	Fassett's locoweed (*Oxytropis campestris var. chartacea*)
988	Otay mesa-mint (*Pogogyne nudiuscula*)
991	Harperella (*Ptilimnium nodosum*)
994	Alabama canebrake pitcher-plant (*Sarracenia rubra ssp. alabamensis*)
995	Mountain sweet pitcher-plant (*Sarracenia rubra ssp. jonesii*)
997	Florida skullcap (*Scutellaria floridana*)
1008	Howell''s spectacular thelypody (*Thelypodium howellii ssp. spectabilis*)
1014	Wide-leaf warea (*Warea amplexifolia*)
1022	Springville clarkia (*Clarkia springvillensis*)
1024	Longspurred mint (*Dicerandra cornutissima*)
1026	Steamboat buckwheat (*Eriogonum ovalifolium var. williamsiae*)
1031	Scrub lupine (*Lupinus aridorum*)
1042	Relict trillium (*Trillium reliquum*)
1045	Texas prairie dawn-flower (*Hymenoxys texana*)
1046	Garrett's mint (*Dicerandra christmanii*)
1055	Kern mallow (*Eremalche kernensis*)
1059	Lakeside daisy (*Hymenoxys herbacea*)
1077	Texas ayenia (*Ayenia limitaris*)
1078	California jewelflower (*Caulanthus californicus*)
1081	Butte County meadowfoam (*Limnanthes floccosa ssp. californica*)
1082	Bakersfield cactus (*Opuntia treleasei*)
1090	San Jacinto Valley crownscale (*Atriplex coronata var. notatior*)
1123	San Joaquin wooly-threads (*Monolopia (=Lembertia) congdonii*)
1126	Kincaid's Lupine (*Lupinus sulphureus ssp. kincaidii*)
1145	Gambel's watercress (*Rorippa gambellii*)
1150	Leedy's roseroot (*Rhodiola integrifolia ssp. leedyi*)
1164	California seablite (*Suaeda californica*)
1171	Yadon's piperia (*Piperia yadoni*i)
1191	Florida torreya (*Torreya taxifolia*)
1199	Louisiana quillwort (*Isoetes louisianensis*)
1204	Mat-forming quillwort (*Isoetes tegetiformans*)
1233	Willamette daisy (*Erigeron decumbens*)
1881	Whorled Sunflower (*Helianthus verticillatus*)
2810	Slickspot peppergrass (*Lepidium papilliferum*)
4565	White Bluffs bladderpod (*Physaria douglasii ssp. tuplashensis*)
7167	Kentucky glade cress (*Leavenworthia exigua laciniata*)
10076	Vandenberg monkeyflower (*Diplacus vandenbergensis*)
10290	Robust spineflower (*Chorizanthe robusta var. robusta*)

7 Federally Listed Designated Critical Habitats

7.1 Effects Determinations and Predictions of Likely Adverse Modification

A total of 826 critical habitats were designated as final as of February 16, 2022.[45] Since the same considerations apply for all species with CH, the critical habitat determinations and predictions of the likely adverse modification for each taxa are discussed collectively.

EPA made NE determinations for 295 CH, NLAA determinations for 224 CH, and LAA determinations for 310 CH. Of the 310 critical habitat with LAA determinations, EPA predicts that the registered uses of acetamiprid are not likely to adversely modify (*i.e.,* LAA- Not Likely AM) 259 CH and likely to adversely modify (*i.e.,* LAA-Likely AM) 51 CH (**Table 72)**. The rationale for each effects determination and prediction of the likelihood of adverse modification is discussed below and in more detail in **Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification**

Table 72. Number of Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification from Registered Uses of Acetamiprid.

Taxon	Number of CH[1]	NE	NLAA	LAA, Not Likely AM	LAA, Likely AM
Critical Habitat	826	293	224	258	51

AM= Adverse Modification; NE=No effect; NLAA = Not Likely to Adversely Affect; LAA=Likely to Adversely Affect
[1]Reflects critical habitats listed as of February 16, 2022.

No Effect (NE)

EPA based the NE/MA determinations for CH on the overlap of the CH with UDL exposure areas t, the likelihood of an effect to the CH as determined by the direct and PPHD effects for the species that depends on the CH, and the likelihood that significant exposure could occur based on the habitat type. EPA based the NE determinations for designated CH on areas where exposure is not reasonably expected to occur at levels that could cause effects, and/or for CH in which effects are not likely. Further considerations included:

CH received an NE determinations if it had one or more of the following characteristics:

- Effects are unlikely for the CH based on the lack of direct and PPHD effects for the species that depends on the CH;
- CH is located in areas where exposure is not reasonably expected to occur at levels that could cause effects (*e.g.,* CH for whales),
- The CH has < 1% overlap with the exposure area for all UDLs when considering the area in which any effects to the CH could occur.

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[45] This count of endangered and threatened species reflects separate species in addition to listed distinct population segments (DPS) or evolutionarily significant units (ESUs) as of 2022.

May Affect (MA)

For designated CHs, EPA made a MA determination if there was a potential for an effect and the CH had >1% overlap with at least one UDL. For all CH designated as MA, EPA further considered both the likelihood of adverse effects to the relevant PBFs (**Section 4**) that are primary constituent elements of the CHs and overlap with UDL exposure areas that are refined to focus on the geographic area in which adverse effects are likely. Based on this analysis, EPA classified CH as Not Likely to Adversely Affect (NLAA) or Likely to Adversely Affect (LAA).

Not Likely to Adverse Effect (NLAA)

For CHs with MA determinations, NLAA/LAA determinations were driven by an assessment of the likelihood of adverse effects to the physical and biological factors (PBFs) and exposure occurring based on location relative to the UDLs and different habitat characteristics. EPA assigned the CH an NLAA determination if it had one or more of the following characteristics:

- The CH did not include one or more of the relevant PBFs described in **Section 4**
- PBFs were not reported for the CH and an assessment of PPHD effects used as a surrogate indicated a low likelihood of adverse effects to the species that depends on the CH;
- CH is located in areas where exposure is likely to be insignificant for the relevant PBFs (*e.g.,* interior forest for PBFs including terrestrial animal species, remote islands);
- The CH has < 1% overlap with the exposure area for all UDLs when considering the area in which adverse effects to the PBFs could occur.
- The CH overlap is >1% with agricultural UDLs only but there is low usage of insecticides and/or low acreage of the crops in that UDL grown within the counties that overlap with the CH.
-

Likely to Adverse Effect (LAA)

EPA determined CHs as LAA if they had relevant PBFs that are likely to be adversely affected and the overlap with the CH and at least one UDL exposure area exceeded 1%. For CH that received an LAA determination, EPA further considered the vulnerability and specificity of the relevant PBFs and/or PPHD when used as a surrogate (*e.g.*, if aquatic invertebrate prey base is a PBF, does it specify phyla or groups of species that may be more sensitive), special management considerations to determine if certain uses sites are included in the CH, and higher thresholds for overlap with UDL exposure areas. Based on this analysis, EPA predicted either no likelihood of adverse modification (NAM) or a likelihood of adverse modification (AM).

Predictions of Likely Adverse Modification

EPA's predictions of likely adverse modification for designated CHs are based on the likelihood of adverse effects to the PBFs, the extent of spatial overlap between the CH area and UDL when considering the special management considerations where relevant, and various modifiers (*e.g.,* type of habitat and location, likelihood of adverse effects to species or groups of species identified as PBFs) that can influence the likelihood of exposure and effects. After applying all refinements and considering the effects modifiers listed above, EPA predicted that 258 designated CHs are not likely to be adversely modified (NAM). CH that received an NAM determinations if it had one or more of the following characteristics:

- The CH has <5% for overlap with the exposure area for all UDLs and when considering the special management considerations.
- The CH overlap is >5% with agricultural UDLs only but usage of insecticides and/or acreage of the crops in that UDL grown within the counties that overlap with the CH account for <5% of the CH area.

EPA predicted likely adverse modification for the remaining 51 CHs, which cover CH for 4 amphibians, 7 aquatic invertebrate, 3 birds, 11 fish, 2 mammals, 14 plants, 0 reptiles, and 10 terrestrial invertebrate listed species. EPA predicted likely adverse modification for these CHs because the CH area overlaps greater than 5% with at least one UDL, adverse effects are likely to the CH PBFs that include habitat quality (*i.e.,* likely direct population-level effects to the species), non-mollusk invertebrates, birds, reptiles, or terrestrial-phase amphibians as necessary for prey, pollination, or dispersal, and overall usage of insecticides and acreage of crops with registered uses in areas where the CH is located are high (*i.e.*, account for >5% of the CH area).

8 Conclusions

This BE for acetamiprid concludes that on-and off-field adverse direct effects to individuals are likely to terrestrial vertebrates and invertebrates and off-field effects are likely to upland and semi-aquatic plants, and aquatic invertebrates listed species. At the species level, however, adverse direct effects are likely only in listed invertebrates, birds, reptiles, and terrestrial-phase amphibians, and dicotyledonous plants. Listed species that have obligate relationships to the dicotyledonous plants, and obligate or generalist relationships to invertebrates, birds, reptiles, or terrestrial-phase amphibians are likely to experience adverse PPHD effects. The likelihood of direct and PPHD effects, however, will vary among species that fall within the aforementioned categories, due to life history such as habitat requirements, foraging habits and dietary preferences, and the location of the species' habitat relative to registered use sites. Adverse effects and adverse modification of CH are likely for CH with physical and biological features that include invertebrates, birds, reptiles, and terrestrial-phase amphibians as prey, pollinators, or dispersal agents.

EPA completed the BE to provide determinations for all listed species and CH overlapping with the action area of registered acetamiprid uses. In this assessment, EPA considered all agricultural and non-agricultural UDL overlaps, inclusive of the furthest drift and runoff extent, when making effects determinations at the individual level (MA). As the assessment moved to NLAA/LAA determinations and predictions of the likelihood of J/AM, EPA made refinements to the UDL exposure areas based on acetamiprid usage, refined on- and off-site exposure assumptions, and selection of thresholds and exposure estimates that were more reflective of adverse effects to the species and its PPHD. Additionally, EPA incorporated insecticide usage data and crop acreage to refine the Agency's understanding how the registered uses of acetamiprid within each UDL contribute to potential exposure. The primary offsite transport routes leading to potential adverse direct, PPHD, or CH effects include diet, dermal/contact, and respiration in aquatic environments. Other transport routes include both spray drift and runoff. Adverse effects that will result in individual or population-level impacts are likely to occur up to 792 or 305 meters from the field, respectively, depending on the species, its habitat, the use, and the application method.

Two species, one of which also had designated critical habitat, were delisted due to recovery since February 2022.EPA determined NE for 277 species and 290 designated critical habitats (CH), based primarily on no overlap (<1%) due to occuring only outside of the action area, no direct toxicity, and/or no dependency on terrestrial vertebrates, aquatic and terrestrial invertebrates, or plants for PPHD. For those listed species and CHs with MA determinations, EPA distinguished whether acetamiprid is likely to affect an individual when considering the species-specific habitat, life history, and other considerations of exposure and toxicity. EPA made NLAA determinations for 432 listed species and 224 CHs. A majority of the NLAA determinations were based upon unlikely exposure due to the habitat or when specific physical and biological factors (PBFs) for the CHs are not expected to be impacted by acetamiprid. EPA made LAA determinations for 1,005 listed species and 311 CHs. These listed species were either: invertebrate, terrestrial vertebrate, or plant species that may be directly affected; listed animals that rely upon invertebrates for prey; or listed plants that rely upon insects or birds for pollination or dispersal. For all CHs with LAA determinations, PBFs related to habitat quality for listed invertebrates and birds, and invertebrates and birds that serve as prey, pollinators or dispersers were the primary factors leading to the determination.

EPA further evaluated the LAA species and designated CH and made predictions about the potential likelihood of future jeopardy to any listed species or adverse modification of any designated CH from the use of acetamiprid. Of the species with LAA determinations, EPA predicted a potential likelihood of future jeopardy for 169 listed species. EPA also predicted a potential likelihood of future adverse modification of 51 designated CHs. These were identified primarily for terrestrial invertebrates, birds, fish, plants, and CHs that are either directly impacted and/or are highly dependent on terrestrial or aquatic non-mollusk invertebrates and have a high to medium overlap. The predicted potential likelihood of future J/AM for listed species and designated CHs is summarized in **Table 73.**

Table 73. Number of Listed Species Effects Determinations and Predictions of Likelihood of Jeopardy or Adverse Modification by Taxon Based on Current Uses of Acetamiprid.[1]

Taxon	NE	MA-NLAA	MA-LAA	Predicted Likely J/AM	Total Species/CH
Amphibians[2]	0	4	34	4	38
Aquatic Invertebrates	1	140	33	9	174
Birds	4	28	66	2	99*
Fish	0	47	122	10	170*
Mammals	8	33	53	1	94
Plants	234	116	588	122	938
Reptiles[3]	3	17	25	1	45
Terrestrial Invertebrates[4]	27	47	83	20	157
Total Listed Species	277	432	1,005	169	1715
Designated Critical Habitat	290	224	311	51	826*

*Total is higher than the sum of the determinations/predictions of likely J/AM because one or more species from this taxa were delisted due to recovery since February 2022.

[1] CH = critical habitat; NE = no effect; NLAA = not likely to adversely affect; LAA = likely to adversely affect; J = jeopardy; AM = adverse modification

[2] Reflects the species and critical habitats listed as of February 16, 2022.

[3] ”Amphibians” and “Reptiles” include those species that have both a terrestrial and aquatic phase.

[4] ”Terrestrial Invertebrates” includes damselflies which have both a terrestrial and aquatic phase.

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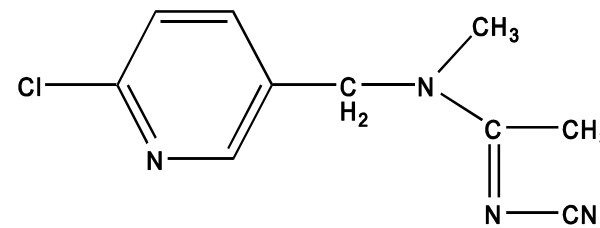
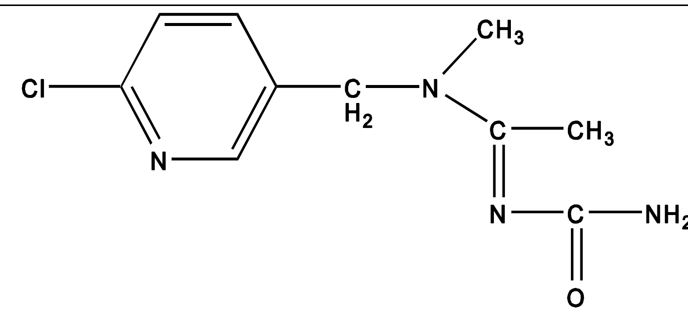
10 List of Acronyms

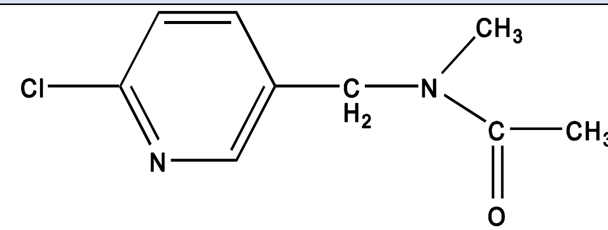
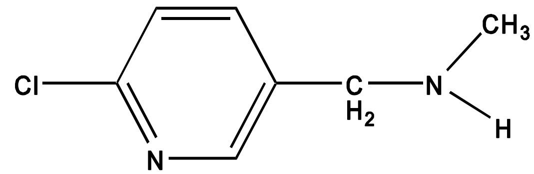
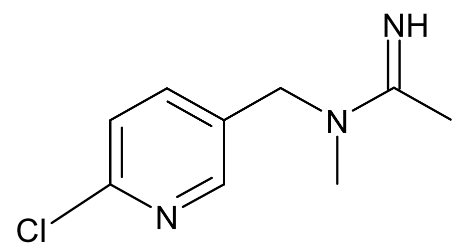
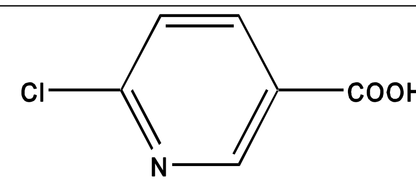
ACR	Acute-to-Chronic Ratio
BE	Biological Evaluation
BEAD	Biological and Economic Analysis Division
Bee-REX	Bee Residue EXposure model
BiOp	Biological Opinion
CDL	Cropland Data Layer
CH	Critical Habitat
DT_{50}	Dissipation time required for the concentration to decline to half of the initial value
EC_{25}	Concentration leading to 25% effect
EC_{50}	Concentration leading to 50% effect
EEC	Estimated Environmental Concentration
EFED	Environmental Fate and Effects Division
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FGDC	Federal Geospatial Data Committee
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
GIS	Geographic Information System
HED	Health Effects Division
IC_{25}	Concentration leading to 25% inhibition
IDS	Incident Data System
LAA	Likely to Adversely Affect
LC_{50}	Concentration leading to 50% mortality
LD_{50}	Dose leading to 50% mortality
LOAEC	Lowest Observed Adverse Effect Concentration
LOAEL	Lowest Observed Adverse Effect Level
LOC	Level of Concern
MA	May Affect
MRID	Master Record Identification
NC	Not Calculated
NE	No Effect
NLAA	Not Likely to Adversely Affect
NMFS	National Marine Fisheries Service
NOAEC	No Observed Adverse Effect Concentration
NOAEL	No Observed Adverse Effect Level
NOEC	No Observed Effect Concentration
NOEL	No Observed Effect Level
NWIS	National Water Information System
PBF	Physical or Biological Features
PPHD	Prey, Pollination, Habitat and/or Dispersal
PWC	Pesticide in Water Calculator
RQ	Risk Quotient
TGAI	Technical Grade Active Ingredient
T-REX	Terrestrial Residue EXposure model
UDL	Use Data Layer
USDA	United States Department of Agriculture

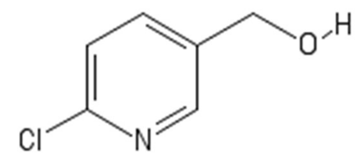
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
VVWM	Variable Volume Water Body Model
WQP	Water Quality Portal

Appendix A. Chemical Structures of Acetamiprid and its Degradates

Table A1. Structures of Acetamiprid and Its Environmental Transformation Products.

Code Name/ Synonym/ **Chemical Name/ Formula/MW/ SMILES**	**Chemical Structure**
Acetamiprid **IUPAC:** (E)-N[1]-[(6-chloro-3-pyridyl)methyl]-N[2]-cyano-N[1]-methyl **CAS: (1*E*)-*N*-[(6-chloro-3-pyridinyl)methyl]-*N*'-cyano-*N*-methylethanimidamide** **CAS No.:** 135410-20-7 **Formula:** $C_{16}H_{11}CLN_4$ **MW:** 222.68 g/mol **SMILES:** Clc1ncc(cc1)CN(\C(=N\C#N)C)C	
IM-1-2 **IUPAC:** N^2-carbamoyl-N^1-((6-chloro-3-pyridyl)-methyl)-N^1-methylacetamidine **CAS No:** **Formula:** **MW:** 240.69g/mole	

Code Name/ Synonym/ **Chemical Name/ Formula/MW/ SMILES**	**Chemical Structure**
IM-1-3 **IUPAC**: N-((6-chloro-3-pyridyl)methyl)-N-methylacetamide	
IM-1-4 **IUPAC:** N-methyl(6-chloro-3-pyridyl)methylamine **MW:** 155.5 g/mole **SMILES:** C1=C(C=CC(=C1)CN(C)[H])Cl	
IM-1-5 **IUPAC:** (E)-N1-[(6-chloro-3-pyridyl)-methyl]-N2-cyano-N1-methylacetamidine	
IC-0 **IUPAC:** 6-chloronicotinic acid	

Code Name/ Synonym/ Chemical Name/ Formula/MW/ SMILES	Chemical Structure
IM-0 **IUPAC:** 6-chloro-3-pyridylmethanol **SMILES:** C1=C(N=CC(=C1)CO[H])Cl	

Abbreviations MW =molecular weight.

Appendix B. Animal and Plant Effects Data

The attached excel spreadsheet reports the toxicity data considered quantitatively or qualitatively in the direct effects analysis for each taxa in this biological evaluation.

Appendix C. Label Summary and UDL Crosswalk

The attached excel spreadsheet summarizes the uses and associated labels evaluated in this BE. It also provides a crosswalk of those uses with the respective UDLs.

Appendix D. Aquatic Exposure Modeling Input Files and Results Summary

The PWC (version 2.001) pond and wetland and PAT (version 2.8) batch input files and results summary for the acetamiprid aquatic modeling are provided below.

Acetamiprid Modeling Summary 7

Acetamiprid_Batch_Wetland.csv

Acetamiprid_Batch_Pond.csv

AcetamipridROC_Batch_Pond.csv

AcetamipridROC_Batch_Wetland.csv

Acetamiprid_Residential_Batch.csv

Acetamiprid_Residential_WL_Batch.csv

AcetamipridROC_Residential_Batch.csv

AcetamipridROC_Residential_WL_Batch.csv

Acetamiprid_PAT_Batch.csv

AcetamipridROC_PAT_Batch.csv

AcetamipridROC_Residential_PAT_Batch.csv

Acetamiprid_Residential_PAT_Batch.csv

An Example PWC output file is given below.

Summary of Water Modeling of Citrus_2x0.25+0.05_A_1 and the USEPA Standard Pond

Estimated Environmental Concentrations (EECs) for Citrus_2x0.25+0.05_A_1 are presented in **Table D-1** for the USEPA standard pond with the 276652-21451-70_Orchard evergreen-r01-B field scenario. A graphical presentation of the year-to-year acute values is presented in **Figure D-1**. These values were generated with the Pesticide Water Calculator (PWC), Version 2.001. Critical input values for the model are summarized in **Tables D-2** and D-3.

This model estimates that about 1.6% of Citrus_2x0.25+0.05_A_1 applied to the field eventually reaches the water body. The main mechanism of transport from the field to the water body is by spray drift (77.4% of the total transport), followed by runoff (22.6%) and erosion (0.01%).

In the water body, the pesticide dissipates with an effective water column half-life of 796.4 days. (This value does not include dissipation by transport to the benthic region; it includes only processes that result in removal of pesticide from the complete system.) The main source of dissipation in the water column is metabolism (effective average half-life = 943.5 days) followed by photolysis (5108.5 days) and volatilization (6.151736E+09 days).

In the benthic region, pesticide dissipation is negligible (1365.1 days). The main source of dissipation in the benthic region is metabolism (effective average half-life = 1367.2 days) followed by burial (884259.4 days). The vast majority of the pesticide in the benthic region (96.08%) is sorbed to sediment rather than in the pore water.

Table D-1. Estimated Environmental Concentrations (ppb) for Citrus_2x0.25+0.05_A_1.

1-day Avg (1-in-10 yr)	16.96
4-day Avg (1-in-10 yr)	16.86
21-day Avg (1-in-10 yr)	16.55
60-day Avg (1-in-10 yr)	16.11
365-day Avg (1-in-10 yr)	13.88
Entire Simulation Mean	11.92

Table D-2. Summary of Model Inputs for Citrus_2x0.25+0.05_A_1.

Scenario	276652-21451-70_Orchard evergreen-r01-B
Cropped Area Fraction	1
Koc (ml/g)	227.2
Water Half-Life (days) @ 20 °C	481
Benthic Half-Life (days) @ 20 °C	697
Photolysis Half-Life (days) @ 40 °Lat	34
Hydrolysis Half-Life (days)	0
Soil Half-Life (days) @ 20 °C	353
Foliar Half-Life (days)	0
Molecular Weight	222.68
Vapor Pressure (torr)	7.5E-10
Solubility (mg/l)	4250
Henry's Constant	2.11E-12

Table D-3. Application Schedule for Citrus_2x0.25+0.05_A_1.

Date (Mon/Day)	Type	Amount (kg/ha)	Eff.	Drift
6/1	Above Crop (Foliar)	0.28	0.95	0.125
6/8	Above Crop (Foliar)	0.28	0.95	0.125
6/15	Above Crop (Foliar)	0.056	0.95	0.125

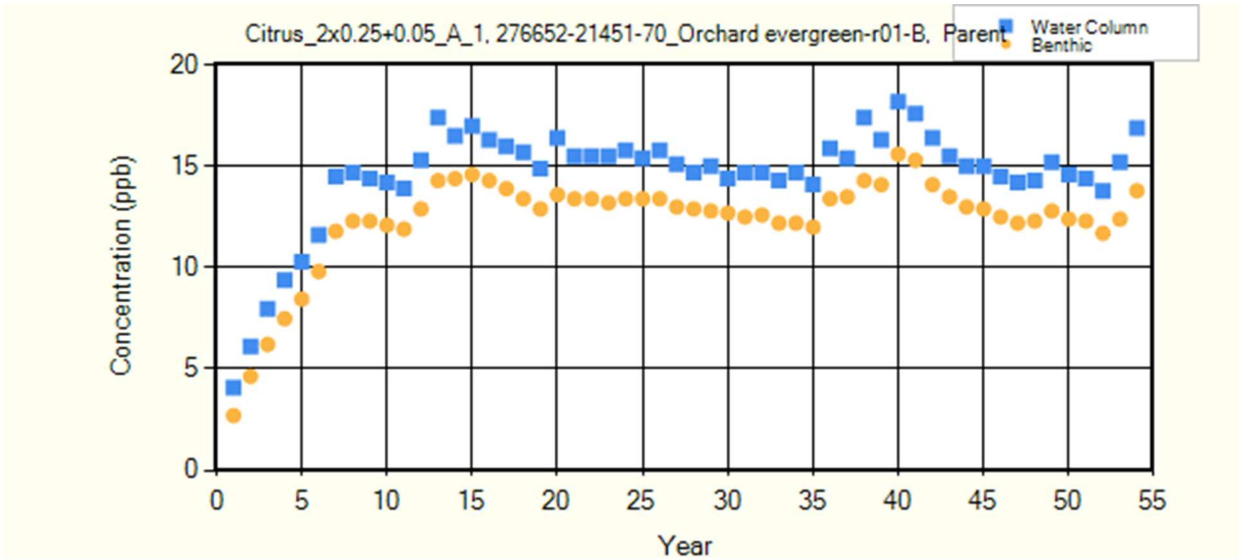


Figure D-1. Yearly Highest 1-day Average Concentrations

Appendix E. Supplemental Tables for Direct Effects Analysis

The attached excel spreadsheet provides supplemental tables with detailed information on the effects analysis for taxa that is summarized in **Section 6**. The tabs in this spreadsheet are separated by taxa and present the modeled EECs and exposure to effects ratios for each UDL for the primary routes of exposure. Exposure to effects ratios are not presented for fish, aquatic plants, or aquatic-phase amphibians because the generic taxa-based screening level assessment of medium volume and larger waterbodies and subsequent analysis of low volume waterbodies in this BE concluded that the registered uses of acetamiprid are unlikely to directly affect these taxa based on low toxicity at the modeled EECs.

Appendix F. Spray Drift Analysis

The attached excel spreadsheet presents the spray drift distances estimated for different levels of biological organization for each taxa where direct effects are a concern. The spreadsheet also includes the use patterns and modeling assumptions relied on to estimate the spray drift distances.

Appendix G. Open Literature Study Reviews

The attached document presents a summary of the open literature studies that were reviewed for potential inclusion in this biological evaluation.

Appendix H. Aquatic Invertebrate Species Sensitivity Distribution

The attached word document presents the species sensitivity distribution analysis for aquatic invertebrates considering all available acute toxicity data for freshwater and estuarine/marine invertebrates.

Appendix I. Qualitative Analysis Approach

This appendix contains general discussions of species that were assessed using a qualitative analysis. In general, species are evaluated qualitatively when the overlap and/or exposure models are not considered to be representative of the species life history. Species that are assessed qualitatively include those that are likely extinct, those that have an exposure pathway EPA considers to be incomplete, and those for which EPA considers exposure models to be unreliable. Each are discussed below and are included in the rationale for the determination.

SPECIES THAT ARE LIKELY EXTINCT

Species recommended for delisting due to extinction by the Services are presumed extinct and receive a NLAA determination. NLAA determinations are made for these species as exposure from the action is not reasonably certain to occur, and, therefore, effects on the species are not likely. Species are only presumed extinct after a recommendation to delist is made by the Services in a review document (e.g., Recovery plan, 5-year review).

SPECIES EXPOSURE PATHWAY CONSIDERED INCOMPLETE

For acetamiprid, three types of species characteristics led to a conclusion that the direct effects exposure pathway is incomplete: species that only occur on uninhabited islands, species that predominantly occur in the open ocean and terrestrial species that only occur in caves. Additional explanation of why the exposure pathway is incomplete for these three types of species habitats is provided below.

Species whose ranges only occur on uninhabited islands are not expected to be exposed to acetamiprid because acetamiprid is not reasonably expected to be applied in areas not inhabited by humans. The majority of acetamiprid use is on agricultural uses, which would not be expected to occur on uninhabited islands.

Exposures to species that predominantly occur in the open ocean (*e.g.,* whales) or rely on ocean species (*e.g.,* seabirds) are reasonably expected to be discountable. This is because acetamiprid is not applied directly to the ocean, and sources of acetamiprid via runoff and spray drift that reach the open ocean are diluted, and acetamiprid does not bioaccumulate.

Acetamiprid is not registered for applications within caves. Exposures to terrestrial organisms living within caves are expected to be discountable. The major transport routes of acetamiprid from treatment sites to non-target areas include spray drift and runoff. Since caves are enclosed, spray drift transport is not reasonably expected to result in exposures to cave dwelling organisms. Runoff transport and mobility of acetamiprid may lead to it reaching groundwater that is associated with caves. Therefore, for aquatic species that inhabit caves (e.g., Barton Springs salamander), exposures and associated risks are assessed in the quantitative risk analysis.

For listed terrestrial species that are obligate to caves (e.g., spiders), exposure from water is discountable. The atmosphere of the inner cave (where these obligate cave species live) is saturated with water vapor. Species have adapted to this hydrating environment by increasing their permeability such that they "become freshwater animals living in an aerial environment" (Howarth 1987). This means that species get the majority of their water needs met by the atmosphere and from consumption of their prey. For terrestrial obligate cave species, water sources are limited to the condensation in the cave and on cave walls resulting from groundwater sources or from detritus/guano. Acetamiprid is classified as non-volatile and as a result, is not likely to be present in water vapor or condensation water that may occur in caves.

Another possible route of exposure is from leaf litter, animal droppings, and carcasses that may fall or be washed into cave systems. While there is evidence in the literature indicating that animal feces (*e.g.*, guano) and carcasses contaminated with pesticides have been found in cave systems (*e.g.*, Land, *et al.* 2019; Eidels, *et al*. 2012; Eidels, *et al.* 2007; Land 2001; MacFarland 1998; and Sandel 1999), acetamiprid residues in these studies were not analyzed as they focused on other pesticides (*e.g.*, organochlorines, organophosphates, carbamates). Based on the physical properties of acetamiprid, residues are not likely to be present at high concentrations because it is rapidly metabolized and excreted from the body. Therefore, exposures to species that rely on food items that are derived from exterior sources are discountable.

While EPA considers direct exposure to terrestrial cave species to be unlikely, PPHD effects cannot be discounted. Listed terrestrial cave species rely on food and nutrient sources that are internal and external of the cave system and include species such as cave crickets that move in and out of the cave habitat. Since a source of their diet will occupy habitat outside of the cave system, there is a potential for exposure to these prey species and a subsequent decline in the prey available may have an adverse effect depending on the use sites in proximity to the cave system. As a result, the analysis of cave species focused on the likelihood of adverse effects resulting from impacts to the species' nutrient sources. For all terrestrial cave species, the overlap indicated uses sites are in proximity to the cave systems these species occupy; therefore, it is likely that impacts to the species' invertebrate prey base will result in an adverse effect to individuals and an LAA determination was made. However, since all of these species have multiple sources of nutrients, EPA concluded the reduced availability of invertebrate prey was unlikely to contribute to a population level adverse effect.

EXPOSURE MODELS CONSIDERED UNRELIABLE FOR ASSESSED SPECIES

At this time, the current exposure models used in this assessment do not estimate exposures for all types of pesticide applications, all habitat types, or for all potential exposure routes relevant to listed species. Therefore, there may be uncertainty in the exposure values being used for a particular species based on what potential uses its range or critical habitat may overlap with, what type of habitat the species is found in, or what the main potential exposure route(s) might be. For species and critical habitats that have not been determined to be NE or NLAA based on the above analyses, consideration is given to how well the conceptual model of the relevant exposure model(s) matches up with the specific species being assessed. If the model estimates are not considered representative of the exposure of the species (due to an inconsistency in the exposure model and assessed species' habitat), a qualitative analysis is conducted.

The qualitative analysis considered whether exposures to acetamiprid are reasonably certain to occur given the habitat of the listed species (e.g., ocean, beach, and/or freshwater habitats) and, if exposures are expected to occur, are impacts to an individual likely. The analysis also considered the potential for effects to the prey, pollination, habitat and/or dispersal (PPHD) of the species and whether those effects would rise to the level of impacting an individual of a listed species.

AQUATIC SPECIES

This discussion focuses primarily upon species that have marine and estuarine habitats. Effects to marine mammals (e.g., pinnipeds, mustelids, polar bear, manatee), sea birds, and sea turtles are considered for both aquatic and terrestrial exposures. Effects to fish and corals are considered for aquatic exposures only. Since acetamiprid is not considered bioaccumulative and is not expected to accumulate in the tissue of prey, EPA expects exposure from eating contaminated fish would be very low. In the marine environment, exposure of these species to conventional pesticides is not reasonably expected to reach the estuarine/marine environments at concentrations high enough to impact an individual of a species because of dilution. Additionally, tidal reversal in freshwater streams and vertical stratification of the freshwater inflow due to differences in salinity and temperature can enhance the mixing process at the freshwater/marine interface and disperse potential pesticide concentrations that may occur in freshwater streams and rivers that discharge into marine environments, limiting the potential for a pesticide to reach individuals of the listed species.

Marine mammals, sea birds, and sea turtles may also spend a portion of their life-cycle (*i.e.,* breeding and basking) on shore, so the potential for exposure in the terrestrial environment is also considered. Potential exposure routes include inhalation and dermal interception of spray droplets on the day of application. Since these species do not forage while on land, dietary exposure while in terrestrial habitats is not expected. Based on the points below, exposure at concentrations high enough to impact an individual are not reasonably expected to occur for these species.

- In a quantitative assessment, the overlap analysis assumes that all individuals of the species are in the terrestrial portion of their range, which represents a relatively small fraction of the entire range of the species. This artificially inflates the overlap numbers resulting in low confidence in the potential for exposure.
- While in the terrestrial environment, exposure of these species would be limited to spray drift from use sites adjacent to nesting or basking sites. The potential for exposure in the terrestrial environment is limited because on the day of application, acetamiprid would have to be transported by wind blowing from the application site toward the beach with little opportunity for interception of spray droplets.
- The duration of potential exposures would be limited as these species spend a relatively short amount of time on the shore for basking and/or breeding purposes. For example, sea turtles spend the vast majority of their lives in aquatic habitats but use beaches to lay eggs, other species such as seals may bask on the shore.
- In addition, several of the species only occur in aquatic and terrestrial areas that are in Alaska. These species include the bearded seal, the Pacific walrus, the ringed seal, and the polar bear. Although, there are some potential pesticide use sites found in Southcentral Alaska, they are likely limited and/or largely removed from coastal areas. A limited amount of land is used for growing grains and fruits and vegetables, based on USDA's Census of Agriculture data for Alaska (2012). Most of these crops are grown in the interior of the state (e.g., near Fairbanks). Although, there are some potential agricultural use sites found in Southcentral Alaska (e.g., forage crops), they are limited and largely removed from coastal areas. Therefore, pesticide exposure to these species is not reasonably expected to occur.

Effects to the PPHD of marine mammals, fish, sea birds, sea turtles, and corals are also considered. The listed species considered rely on more than one dietary item, most of which are entirely marine. In estuarine/marine environments, exposures to conventional pesticides are not reasonably expected to decrease prey populations.

Two species were given additional consideration for this exposure pathway and are discussed below. These species are the Western manatee and the killer whale.

The Western manatee forages in freshwater, as well as marine environments and requires freshwater on a regular basis. There is a great deal of uncertainty in estimating potential acetamiprid exposures in marine environments that support the Western manatee, but it is possible to use estimated environmental concentrations (EECs) for the large flowing bins (3 and 4) to estimate exposures in freshwater. A semi-quantitative analysis of exposure in drinking water is presented in **Section 6.5**.

The killer whale (*Orcinus orca*, Southern resident DPS), is found in the Strait of Georgia, Strait of Juan de Fuca, and Puget Sound, and has an obligate relationship with Pacific salmon (which are anadromous), including several species (Chinook, Chum, and Coho) that are themselves considered threatened or endangered.

Acetamiprid exposures are reasonably expected to be reduced due to dilution and the fate characteristics (i.e., not expected to bioaccumulate); therefore, exposures to killer whales are not expected. The obligate relationship of salmon with the killer whale is unique as species of salmon are also listed and are assessed in this BE, which allows for a more detailed analysis of the obligate species. As discussed in **Section 6.2**, several listed salmonid populations are likely to be adversely affected; however, a majority of listed salmonids are not predicted to have a potential likelihood of future jeopardy. While there may be some reductions in the salmonid prey base that could adversely affect individuals that are more reliant on those affected salmonid populations, it is unlikely to have a widespread impact on the prey base such that the population of Killer whales will be adversely affected from registered uses of acetamiprid.

In addition, the beluga whale occurs in waters of the United States and terrestrial areas that are in Alaska. Although there are some potential pesticide use sites found in Southcentral Alaska, they are likely limited and/or largely removed from coastal areas. A limited amount of land is used for growing grains and fruits and vegetables, based on USDA's Census of Agriculture data for Alaska (2012). Most of these crops are grown in the interior of the state (e.g., near Fairbanks). Although, there are some potential agricultural use sites found in Southcentral Alaska (e.g., forage crops), they are limited and largely removed from coastal areas. Therefore, pesticide exposure to the critical habitat of this species is not reasonably expected to occur.

TERRESTRIAL SPECIES

There is one species of terrestrial animal, the wood bison, that has extensive portions of its range located outside of the United States (*i.e.*, in Canada). In a quantitative assessment, the overlap analysis assumes that all individuals of the species are in the portion of their range located in the United States, which represents a relatively small fraction of the entire range of the species. Since this artificially inflates the overlap numbers, which would result in low confidence in the potential for exposure, the overlap analysis was not run for these species and they are assessed qualitatively. For the wood bison, the population in the United States consists of a nonessential experimental population (NEP) established in 2015 in Western Alaska. This population is highly managed and tracked extensively. In addition, while there are some potential pesticide use sites found in Southcentral Alaska, they are likely limited and/or largely removed from areas utilized by the wood bison. A limited amount of land is used for growing grains and fruits and vegetables (USDA's Census of Agriculture data for Alaska (2012)). Most of these crops are grown in the interior of the state (e.g., near Fairbanks). Although, there are some potential agricultural use sites found in Southcentral Alaska (e.g., forage crops), they are limited. Therefore, pesticide exposure to the wood bison is not reasonably expected to occur and a NLAA determination is made.

Eidels, R.R., and J.O. Whitaker Jr. 2007. Insecticide Residues in Bats and Guano from Indiana. Proceedings of the Indiana Academy of Science 116(1):50-57.

Eidels, R.R., and J.O. Whitaker Jr. 2013. Screening of Insecticides in Bats from Indiana. Proceedings of the Indiana Academy of Science 121(2):133-142.

Howarth, F.G. 1987. The evolution of non-relictual tropical troglobites. International Journal of Speleology 16: 1-16.

Land, T.A., D.R. Clark Jr., C.E. Pekins, and T.E. Lacher Jr. 2019. Seasonal Emergence and Historical Contaminant Exposure of Cave Myotis (*Myotis velifer*) in Central Texas and Current Status of the Population. Environments; 6: 21.

McFarland, C.A. 1998. Potential Agricultural Insecticide Exposure of Indiana Bats (*Myotis sodalis*) in Missouri. Unpublished Master's thesis.

Appendix J. Percent Crop Treated Information

The attached excel file details the maximum and average percent crop treated values for each UDL and state which is incorporated into the overlap analysis.

Appendix K. Endangered and Threatened Species Effects Determinations and Predictions of Likelihood of Jeopardy and Designated Critical Habitat Effects Determinations and Predictions of Likelihood of Adverse Modification

The attached Excel spreadsheets Appendix K.1 and Appendix K.2 present the effects determinations and predictions of likely J/AM for species and CH, respectively. These spreadsheets provide the lines of evidence considered for each determination and prediction of likely J/AM including species-specific life history modifiers.

Appendix L. Generation of the ESA Agricultural Use Data Layers (UDLs) from the Cropland Data Layer (CDL)

Use Data Layers (UDLs) spatially represent application sites for agricultural and non-agricultural label uses in EPA's Endangered Species Biological Evaluations (BEs). They leverage several different landcover and land use datasets acquired from remote sensing[46] technology to create a spatial footprint for a given label use. EPA uses USDA's Cropland Data Layer[47] (CDL) for the agricultural use sites found in the conterminous United States. Updated annually, this publicly available dataset includes a robust accuracy assessment which is used by EPA to ensure the UDLs used in the BEs are of sufficient accuracy for decision making. This document provides a brief history of how this remotely sensed data is assessed for accuracy, introduces key topics related to assessing remotely sensed data, and outlines the criteria used by EPA when generating the agricultural UDLs and finally outlines the UDLs used in the acetamiprid BE.

Introduction to Accuracy Assessments

When selecting data sources to use to create its UDLs, EPA prefers to use publicly available national level datasets; however, it may use proprietary data if it cannot identify appropriate publicly available data. By using existing datasets, EPA leverages the expertise of other agencies and organizations, rather than becoming a 'data maker'. Generally, the selected datasets follow national standards for the creation of spatial data and, in the case of remotely sensed data, include accuracy assessments. Accuracy assessments provide a measure of correctness for the data layer. Without this measure of understanding in the spatial layers, decisions based on the dataset may lead to unexpected and possibly unacceptable results (Congalton, 2019). The goal of a quantitative accuracy assessment is to identify and measure map errors so that the map can be as useful as possible to the persons making decisions.
Two distinct types of quantitative accuracy assessments exist for spatial data: positional and thematic. Positional accuracy deals with the locational correctness of a map feature by measuring how far a spatial feature on a map is from its true or reference location on the ground (Bolstad, 2005). The Federal Geographic Data Committee (FGDC) produced the U.S. National Cartographic Standards for Spatial Accuracy (NCSSA) (FGDC, 1998) to create positional accuracy standards for medium- and small-scale maps/data. When possible, EPA leverages datasets adhering to these standards. Thematic accuracy deals with the labels or attributes of the features in the resulting GIS product and will be the focus of the discussion in this document. The thematic labels or attributes are the specific cover classes assigned in the landcover dataset. Each landcover dataset targets specific types of landscape features. In the case of the UDLs, and the underlying CDL, the primary goal of the datasets is to identify cover classes that represent agricultural crops. Other remotely sensed products may target but are not limited to non-agricultural features, non-agricultural plant cover, or water features. Each of the remotely sensed products may use the same satellite imagery, but due to the different goal of each project, the end results can differ. Thematic accuracy assessment provides measures of how different the mapped cover classes are from what occurs on the ground at specific reference locations. This is completed by

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[46] Remote sensing is defined as the collection and interpretation of information about an object from a distant vantage point. Remote sensing systems involve the measurement of electromagnetic energy reflected or emitted from an object and include instruments on balloons, aircraft, satellites, and unmanned aerial systems (UAS) (Congalton 2019).
[47] Available at USDA's National Agricultural Statistic Survey website: https://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php

comparing reference data, known/true classification of samples sites, and classified data for the same sample sites.

History of Map Making

Before the invention of aircraft, maps were created from human observations using survey equipment. Today, most map/data makers use remote sensing data rather than collecting data using field observations. To create the spatial data from remotely sensed data, decision trees algorithms use the imagery and information from known sites, referred to as training data, to generate the cover class classifications. These algorithms look for spectral signatures across multiple wavelengths to identify unique cover classes – in the CDL these are crop cover classes. Spectral signatures of various vegetation components include things such as canopy architecture, stem characteristics, leaf orientation, light angle, and shadowing of vegetation (Shah, 2019). Even though advances in technology have provided access to remotely sensed information, field observations are still important and provide information at specific sample locations, used as known data for the decision tree, or as a reference site for the accuracy assessment, rather than providing a complete survey of the project area's map extent. Map/data making has moved to using remotely sensed data to make maps because it:

- is less expensive and more efficient than creating maps from human observations;
- offers a bird eye perspective, improving the understanding of spatial relationships and the context of our observations; and
- captures information in electromagnetic wavelengths that humans cannot see, such as the infrared portions of the electromagnetic spectrum, allowing for characterization of the landscape a human could not achieve.

However, no remotely sensed dataset is perfect. It is not possible to reach a complete one-to-one correlation between variation in remotely sensed data and the true variation found on the landscape. This means no resulting dataset will be error free. Several factors influence errors occurring in remotely sensed data, including but not limited to aircraft movement, topography, lens distortions, and other environmental factors (e.g., shadows, clouds, forest cover, snow morphology). These influences can reduce the strength of the relationships between the remotely sensed data and the landscape.

However, errors are not limited to remotely sense datasets. The historical method of field observation also included errors due to factors such as observer bias, equipment malfunctions, inaccuracies from sampling errors, or goals of the projects.

Regardless of the collection method, no dataset will be error free. The accuracy assessment allows for an understanding of those errors and provides the user the necessary information to decide if the accuracy level meets their decision-making needs. As discussed above, remotely sensed data typically includes two types of accuracy assessment: positional and thematic. The use of remotely sensed data requires an understanding of both.

Positional accuracy is assessed by comparing the coordinates of sample/reference points on a map against the coordinates of the same points derived from a survey or some other independent source. The Federal Geographic Data Committee (FGDC) produced the U.S. National Cartographic Standards for Spatial Accuracy (NCSSA) (FGDC, 1998) to create positional accuracy standards for medium- and small-scale maps/data. When possible, EPA leverages datasets adhering to these standards.
Unlike positional accuracy, there is no government or professional society standard for assessing thematic accuracy. This omission is partially due to the inherent complexity of thematic accuracy but

primarily because historically, thematic accuracy was generally assumed to be at acceptable levels (Congalton 2019). The following sections explores the history of thematic accuracy and the accuracy goals set by EPA for the UDLs in absence of the government or professional society standard.

History of Thematic Accuracy

The history of assessing thematic accuracy of maps derived from remotely sensed data is relatively brief, beginning around 1975 and was divided into four parts or epochs by Congalton in '*Assessing the Accuracy of Remotely Sensed Data'* (2019). Initially, no real accuracy assessment was performed on maps; rather, a "it looks good" mentality prevailed. This approach is typical of a new, emerging technology in which everything is changing so quickly that there is no time to assess how well you are doing. Despite the maturing of the technology over the last half century or so, some remote sensing analysts and map users still lean heavily on this mentality.

The second epoch is called the age of non-site-specific assessment. During this period, total acreages for each cover class were compared between reference estimates and measured without regard for location. It did not matter whether you knew where it was; only the how similar the total amounts were when compared. While total acreage is useful, it is equally if not more important to know where a specific landcover exists. Therefore, this second epoch was relatively short-lived and quickly led to the age of site-specific assessments.

In a site-specific assessment, reference locations for cover classes are compared with the classified cover class at the same location, and result in a measure of overall accuracy across all cover classes in the form of a 'percent correct'. This method far exceeded the non-site-specific assessment but lacked information on individual landcover categories. Site-specific assessment techniques were the dominant method until the late 1980s.

The fourth and current age of accuracy assessment is called the 'age of the error matrix'. An error matrix compares cover class information for a number of reference sites to the remotely sensed cover class results for the same location, across each cover classes in the data layer. The error matrix is a square array of numbers set out in rows and columns, accounting for each of the cover classes. Generally, the reference data cover classes are represented as the columns and the remotely sense/classified cover classes are represented by the rows. The number in each cell represent the sample sites in the corresponding cover classes from the reference data and the classified data. The major diagonal of this matrix identifies the sites where the reference and classified cover classes match, meaning the classified data correctly identified the cover class. (**Figure L-1**).

Some key terminology when considering these matrices:

- Reference data cover classes: the class label of the accuracy assessment site derived from field or human collected data, assumed to be correct
- Classified data cover classes: the class label of the accuracy assessment site derived from the remotely sensed data.

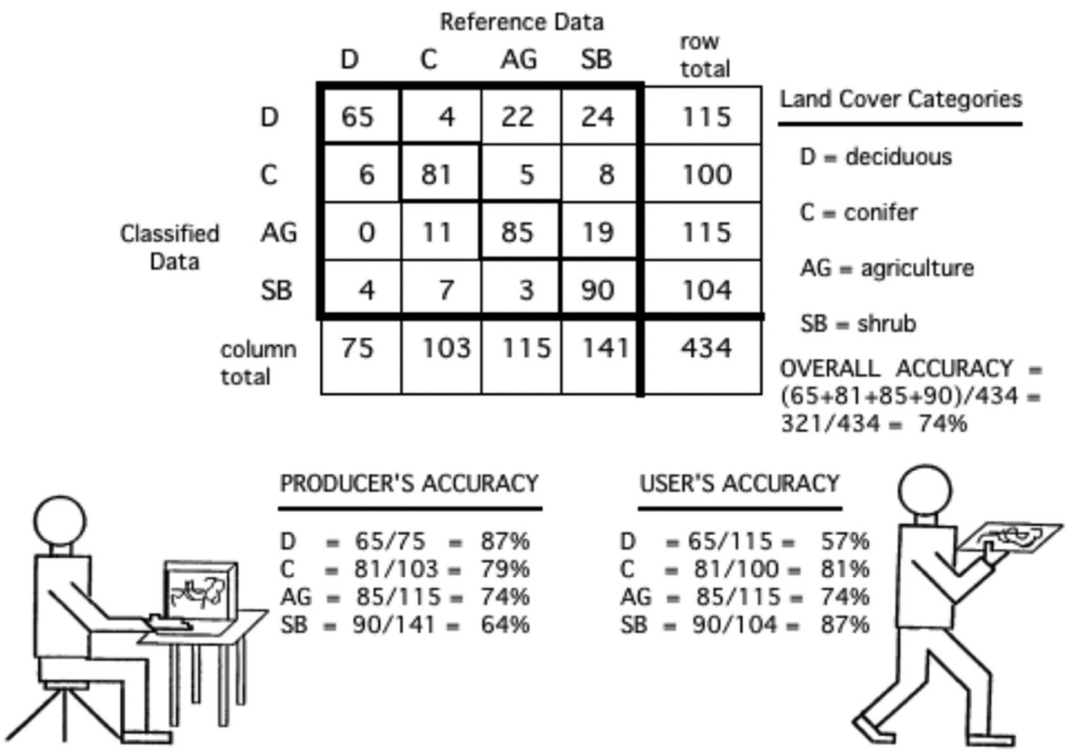

Figure L-1. Example Error Matrix and Accuracy Values (Congalton, 2019). Numbers within the bolded section of the matrix are the total number of sample sites that were identified for each cover class. In this example there are a total of 434 sample sites. The number in each cell represents the total number of sample sites found with the corresponded reference and classified cover class. For example, the 65 in the top left corner indicates that 65 samples site were identified as “D” for deciduous in both the reference and classified data. However, 65 does not account for all “D” sample sites in either classified or reference data. Moving over once cell to right, there are 4 sample sites identified as “C”, conifer, in the reference data but “D” in the classified data. The classified data misidentified the cover class by including it in the incorrect category – this is an error of commission. Moving down to the cell directly below 65, there 6 sites known to be “D” from the reference data but “C” in the classified data -- here the misidentified cover class results in the exclusion from a category or an error of omission. The diagonal of the error matrix represents the number of sample sites matching in the reference and classified data. The column total provides the number of sample sites found each cover classes based on the reference data, and the row total provided the number of sample sites found in each cover class based on the classified data.

With each annual release of the CDL, USDA provides error matrices for their thematic classification of cultivated land at both the national and state level. The next sections provide additional details on the types of reported accuracy metrics provided with the error matrices, how the matrices are collapsed, and accuracy metrics are recalculated to represent the agricultural UDLs. Along with these descriptions is an example of the use of these metrics as outlined in **Figure L-1**.

Error Matrices, Overall, Producer’s, and User’s Accuracies, Kappa Statistic

Error matrices are effective representations of map accuracy, because the individual accuracies of each map cover class are plainly described on the major diagonal (*i.e.*, classified data that matches the reference data), along with both the errors of inclusion (also referred to as “commission errors”) and the

errors of exclusion (also referred to as “omission errors”) when the classified and reference data cover classes do not match. An omission error occurs when a sample site is left out, or omitted, from the correct classes in the classified dataset. This is considered a false positive of the classified data or Type 1 error. A commission error occurs when a sample site is included in an incorrect class in the classified dataset. This is considered a false negative/false match of the classified data or Type 2 error.
In addition to clearly showing errors of omission and commission, the error matrix can be used to compute overall accuracy, producer’s accuracy, and user’s accuracy, which were introduced to the remote sensing community by Story and Congalton (1986). Overall accuracy is simply the sum of the major diagonal divided by the total number of sample units, providing a ‘percent correct’ across all cover classes. In the example error matrix found in **Figure L-1**, the overall accuracy is the sum of the values on the major diagonal, where the classified and reference data match, divided by the total number of sample sites or 321/435; resulting in an overall accuracy of 74%. This value is the most commonly reported accuracy assessment statistic. In addition to the overall accuracy, the reporting of producer’s and user’s accuracies allow for additional considerations, specifically of individual cover classes.

Computed to determine individual cover class accuracies, producer’s and user’s accuracies provide important information related to error within the individual cover class from different perspectives. The producer of the map may want to know how well a class matched the reference data, referred to the producer’s accuracy. This value is computed by dividing the value from the major diagonal (the agreement between the reference and classified data) for the class of interest, by the total number of reference data points for the class. Looking at **Figure L-1**, the map producer identified 65 sites as deciduous, while the reference data indicate there were a total of 75 deciduous sites. So, 65 of 75 samples were correctly identified, resulting in a producer’s accuracy of 87%, which is quite good. However, this is only half of the story. If you now view the map from the user’s perspective, a user wants to know how many classified data points matched the reference data. In Figure 1, you see once again that 65 sites were classified as deciduous on the map that were actually deciduous, but the map shows a total of 115 site classified as deciduous, resulting in a user accuracy of 57%. In evaluating the accuracy of an individual map class, it is important to consider both the producer’s and the user’s accuracies.

The kappa statistic or coefficient is used as another measure of agreement for the resulting remotely sensed data (Cohen, 1960). This measure of agreement is based on the difference between the actual agreement in the error matrix (i.e., the agreement between the remotely sensed classification and the reference data as indicated by the major diagonal) and the chance agreement, which is indicated by the row and column totals (i.e., marginals). The kappa reflects agreement between the classified cover classes and the reference cover classes, and ranges from 0 to 1. If the kappa equals 0 than there is no agreement between the classified and references label. The closer to 1 the kappa, the closer the agreement is, and if it reaches 1 then the classified and reference data match perfectly. Ultimately, a Kappa of 0.85 means there is an 85% or better agreement than chance alone.

$$\widehat{K} = \frac{observed\ accuracy - chance\ agreement}{1 - chance\ agreement}$$

The power of kappa is in its ability to test whether one error matrix is statistically significantly different from another and not in simply reporting this value as another measure of accuracy.

Use of Accuracy Values in Understanding Thematic Errors

In the past, an overall accuracy level of 85% was often adopted as representing the cutoff between acceptable and unacceptable data. This standard was first proposed in Anderson *et al.* (1976) despite the lack of any research being performed to establish this standard. Accuracy depends on many factors, including the amount of effort, level of landscape or classification detail, and variability of the classes. In some instances, an overall accuracy of 85% is more than sufficient; in others it would not be accurate enough; and in others, such an accuracy would be way too expensive to ever achieve (Congalton, 2019).

In the example described above and presented in **Figure L-1**, the error matrix has an overall map accuracy of 74%. This value tells about how accurate the map is, in general or across all classes, but provides no information within individual classes. For additional information on the deciduous cover class, the producer's and user's accuracies can be considered. The producer's accuracy for this class of 87% is quite good and even higher the overall accuracy of the dataset. However, if we stopped there, one might conclude that although the dataset appears to be average overall (*i.e.*, 74%), it is more than adequate for the deciduous class. Making such a conclusion could be a serious mistake because the user's accuracy of 57% tells a different story. In other words, although 87% of the deciduous areas have been correctly identified as deciduous, only 57% of the areas called deciduous on the map are actually deciduous based on the reference data. This lower user accuracy tells us that there are errors of commission in the map related to the deciduous classes, meaning there are sample sites that were classified as deciduous that based on the reference belong to a different class. The result of this is more area in the map classified as deciduous than actually occurs on the ground.

A more careful look at the error matrix reveals significant confusion in discriminating deciduous from barren and shrub. Therefore, although the producer of this map can claim that 87% of the time an area that was deciduous on the ground was identified as such on the map, a user of this map will find that only 57% of the time that the map says an area is deciduous will it actually be deciduous on the ground, and may often be barren/scrub.

The intended use of the data/map can drive the need to address some of the error. For example, the lower user accuracy in the example above often resulted from the confusion between discriminating deciduous from barren/shrub. Collapsing these two classes together into a deciduous/barren/shrub class increase the user's accuracy to 83% but lowers the producer's accuracy to 85% (**Figure L-2**). The higher user's accuracy means when the map identifies this grouped cover class it matches what is found on the ground more often than the two individual classes. Under certain situations it may be worth the slightly lower producer accuracy and sacrificing one of the cover classes, meaning the map will no longer distinguish between deciduous and shrub/barren.

	D/SB	C	AG	Row total
D/SB	183 (65+4 +114)	11	25	219
C	14 (6+8)	81	5	100
AG	19 (0+19)	11	85	115
Column total	216	103	115	434

Producer's accuracy = $\frac{183}{216} = 85\%$ User's accuracy = $\frac{183}{219} = 83\%$

Figure L-2. Example collapsing cover class to address error of commission, building off the error matrix in **Figure L-1** here the deciduous and barren/shrub are combined and accuracy metric recalculated.

For the purposes of the UDL, EPA's targets at least 85% in both the producer's and user's accuracy and at least 90% for an overall accuracy when combining individual crops from the CDL into the UDL cover classes.

EPA's Accuracy Value Goals for Use Data Layers Used in BEs

The native CDL landcover dataset includes over 100 cultivated cover classes in its thematic classification. The error matrices released with the CDL data provide overall, producer and user measures of accuracy at both the state and national level as well as the associated Kappas. In recent years, the overall accuracy of the CDL dataset has been in the low to mid-80% with Kappa just over 0.80. The producer's and user's accuracy for the individual cultivated classes range from less than 5% to 98%, and less than 15%-97%, respectively (Boryan 2011). When considering the individual cultivated classes of the CDL, the user's accuracy is slightly better than producer's accuracy, resulting in a lower commission error, or false negative/Type 2 error. However, when considering these BEs, reducing the false positive/Type 1 error is equally or more important. Improving all accuracy metrics as well as leveling out the producer and user accuracies is an overall goal when grouping crops into the UDLs cover classes.

To improve the overall, user and producer accuracies for the UDLs, the 100+ thematic cultivated classes found in CDL are reclassified into 13 crop groupings. Consolidating CDL into aggregated categories is a documented way to significantly improve the accuracy of assessments by eliminating misclassification errors within the combined classes (Johnson 2013a, Johnson 2013b, Wright 2013 and Lark 2017). Each of the 100+ thematic cultivated classes from the original CDL, are found in at least one state but not every state will include all 100+ classes. For this reason, while the focus is on the accuracy at the national level, there are instances when the state accuracy for a UDL would be higher than observed at the national level.

When deciding how to group crops from the CDL, EPA refers to the grouping used by the U.S. Geological Survey (Baker and Capel, 2011) and the Generic Endangered Species Task Force (Amos et al 2010). This information considers environmental factors that influence the location of crops and the error matrices provided by USDA with the original CDL data. By considering these agronomic factors in addition to the error matrices it is possible to improve the accuracy for these UDLs while retaining agronomic similarities. There is an infinite number of ways to group the crop cover classes found in the CDL, and each structured grouping can be reviewed in terms of recalculated accuracy compared to the native dataset.

When collapsing the available error matrices provided with the CDL into the 13 UDL groups, the sample site values for each of the CDL crops found in a UDL are summed across both rows and columns in the error matrix. Currently the 13 UDL groups bring the overall accuracy to 90%, increased from 80% for the CDL, with a Kappa of 0.88 (**Table L-1**). As described above, it is important to consider the producer's and user's accuracy of the individual thematic classes in addition to the overall accuracy.

When considering the user's and producer's accuracy, EPA targets at least 85% for each UDL, while retaining at least a 90% overall accuracy. Following the thematic grouping into the 13 UDLs and the recalculation of the user and producer accuracies, by year of the CDL, to help address errors of commission, additional steps to lower the omission errors, are implemented. These include the temporal aggregation of multiple CDL years into the UDL, and expanding the crop area found in the UDL layer to meet or exceed the area for the same suite of crops as reported in the Census of Agriculture.

The goal of each of these steps is to improve the accuracy of the UDLs by minimizing the rate of omission error. However, these steps are not directly related to the existing error matrices provided with the CDL, and therefore new accuracy values are not calculated following the temporal aggregation, and area expansion. By reducing the omission errors, these steps result in a more protective landcover classification for each UDL.

If an individual crop class in the CDL has both the producer and user accuracies that are over 85%, the corresponding UDLs is that same as the CDL crop cover class, for example cotton from the CDL is found in the cotton UDL. These UDLs include corn, cotton, grapes/other vineyards, rice, soybeans and wheat. Five of these UDLs have user and producer accuracies in the low to mid 90%, with Kappas ranging from ~0.89 to 0.97. The user's and producer's accuracy for the remaining cotton UDL falling above 85% with Kappas of ~ 0.85. Due to the geographically limited occurrence of cotton, this crop is only grown in the south, lower national accuracy is expected compared to other crops with a broader geographic range. This is due to the fact that cotton growing states may classify cotton well, however, there is a lower accuracy in identifying cotton in states where cotton doesn't grow and this brings down the national accuracy.

When an individual crop cover class in the CDL is below 85%, grouping multiple crops together and ultimately reducing the number of total thematic crop groups, improves the accuracy of the resulting UDL. When deciding which crops to group, error of omission and commission of the remotely sensed data are considered, in addition to environmental and agronomic practices. EPA targets an accuracy of at least 85%; however, it is not always possible to reach the target without compromising the environmental/agronomic practices. For this reason, some of the UDLs that contain multiple crop classes have slightly lower than 85% accuracy.

The UDLs containing a number of crops include alfalfa/other agricultural grasses, citrus, other crops, other grains, other orchards, other row crops, and vegetables and ground fruit. Two of these UDLs, other crops and other grains, did not meet an 85% accuracy for user's and producer's accuracy. Two additional UDLs, other row crops and vegetables and ground fruit, did not reach 85% for just the producer's accuracy. See **Table L-1** for a complete list of accuracy values across all 13 UDLs. Of the 13 UDLs, ten were used to map the agricultural label uses for acetamiprid. A list of the pertinent UDLs can be found in Figure 3. As mentioned above, the focus of the discussion is on the national accuracies. But due to the variety and regional nature of some crops found in the UDLs, state-based accuracy assessments often reach 85% even though the national level assessment for the same UDL does not.

Additional challenges when identifying some crops include higher frequency of change in agricultural practices (*e.g*., crop rotation), and/or lower total area on the landscape for minor crops. These two challenges are related to errors of omission, rather than errors of commission addressed by grouping crops into the UDL categories a common practice implemented to increase accuracy of remotely sensed data (Johnson 2013a, Johnson 2013b, Wright 2013 and Lark 2017). Two additional steps address some of the uncertainty related to these errors of omission, specifically, the known downward estimates of acres for remotely senses data and changes in crop patterns over time. These steps are implemented on all UDLs, but have the most impact in addressing uncertainty around error of omission for the UDLs containing multiple crops with lower accuracy values. First, a temporal aggregation of multiple years of the CDL into the UDLs is performed to account for changing agricultural practices, for example crop rotation, from year to year. Second, the total area of the temporally aggregated UDL is compared to the reported area found in the Census of Agriculture, accounting for some of the error/difficulty in identifying minor crops. If the area of the UDL is less than the reported area in the Census of Agriculture, the UDL is grown out to meet or exceed the Census of Agriculture. Referred to as region growing, expanding the UDL area to meet or exceed the area reported in the Census of Agriculture is a conservative measure take to minimize the error of omission. However, the Census of Agriculture generated once every 5 years, represents a single year in time. The CDL generated every year may capture agricultural practices, such as rotations, not captured in the Census Agriculture. For this reason, there is uncertainty around the crop area found in the Census of Agriculture being representative across all years of the CDL.

At the end of the whole process, the resulting UDLs provide a more protective landcover estimate for the purposes of the Endangered Species Biological Evaluations, making them the best available spatial agricultural data to use in the ESA BEs.

Figure L-2 provides a summary of the UDLs used to map the agricultural label uses for acetamiprid with a complete crosswalk of the original CDL crops to the UDL class provided in **Appendix C**.

Table L-1. Collapsed national error matrix from the 2018 CDL, example of the 13 national UDLs with associated measures of accuracy

	Alfalfa	Citrus	Corn	Cotton	Grapes	Other Crops	Other Grains	Other Orchards	Other Row Crops	Rice	Soybeans	Vegetables and ground fruit	Wheat	User's Accuracy	Commission	Kappa
Alfalfa	2157632	325	49580	6026	440	38838	45476	4745	4226	131	27170	13039	29148	89%	11%	0.87
Citrus	147	244865	37	25	12	185	112	103	1	0	0	164	3	99%	1%	1.00
Corn	39172	26	4222089	6598	241	18927	32759	1636	6212	1454	124498	20895	13154	94%	6%	0.92
Cotton	5368	12	9800	974234	51	9753	17664	1405	43844	509	36809	5983	15474	87%	13%	0.86
Grapes	426	30	546	35	93320	1372	47	3206	607	0	56	288	92	93%	7%	0.93
Other Crops	26196	385	12842	7554	581	729904	37343	6695	4335	2888	11038	9363	32155	82%	18%	0.82
Other Grains	16615	23	14503	7531	20	18118	597678	312	3603	210	8702	7707	34988	84%	16%	0.83
Other Orchards	2870	234	1305	1717	1862	3680	521	353321	950	26	524	1424	412	96%	4%	0.96
Other Row Crops	2528	0	3208	13781	208	2860	4999	466	315797	165	3933	2981	782	90%	10%	0.89
Rice	150	0	1061	154	1	3158	340	5	36	275819	2509	190	106	97%	3%	0.97
Soybeans	28675	0	139339	54449	101	29702	25116	427	10953	15386	4754850	16137	27339	93%	7%	0.90
Vegetables and ground fruit	5221	83	6822	1587	289	6397	7439	1209	3009	106	3263	361780	5496	90%	10%	0.90
Wheat	22383	0	11027	18183	99	44103	81911	525	1618	10	22050	13228	1833412	89%	11%	0.88
Producer's Accuracy	85%	99%	93%	89%	95%	78%	68%	93%	79%	93%	94%	79%	90%			
Omission	15%	1%	7%	11%	5%	22%	32%	7%	21%	7%	6%	21%	10%			
Kappa	0.82	0.99	0.91	0.88	0.95	0.77	0.67	0.93	0.79	0.93	0.91	0.79	0.89			
	Overall Accuracy	90%														
	Overall Kappa	0.88														

Table L-2. Summary of Use Data Layer Classes for Acetamiprid

Summary of Use Data Layers (UDL) Classes	
Reclass Value	UDL General Classes
20	Cotton
40	Soybeans
60	Vegetables and ground fruit
70	Other Orchards
71	Vineyards
72	Citrus
80	Other grains
90	Other row crops
100	Other crops
110	Alfalfa

These classes are not mutually exclusive to one another and are further reclassified into 13 national agricultural UDL classes. 10 UDLs are used to map acetamiprid labelled agricultural uses. The complete crosswalk for all 13 UDL classes can be found in ***Appendix C.***

The attached **Table L.3** presents information about the crops covered by each agricultural UDL evaluated in this BE.

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Appendix M. Supplemental Overlap Information

Estimating Off-Site Buffer Area from Drift or Runoff Exposure

In addition to the potential pesticide use sites each Use Data Layer (UDL) has an omnidirectional off-site buffer area used to assess impacts by spray drift and/or run-off, collectively referred to as the exposure area. Each UDL includes numerous distance options from the use sites for calculating the exposure area. Generated with the Euclidean distance tool in ArcGIS, areas adjacent to those identified as a potential use site are assigned a distance value based on the shortest distance, to the closest source (*i.e.,* potential use site); from cell center to cell center "as the crow flies".

Figure M-1 depicts a conceptual model of how the distance values are assigned to the area adjacent to a use site. However, in practice use sites are found throughout the landscape, and as you move away from one site you move toward a different use site. The distance value for a given location always represents the minimum distance to the closest use site (see **Figure M-1**). The values increase as distance from the closest use site increases but then starts to decrease when a different use site becomes the closest source (see **Figure M-1**).

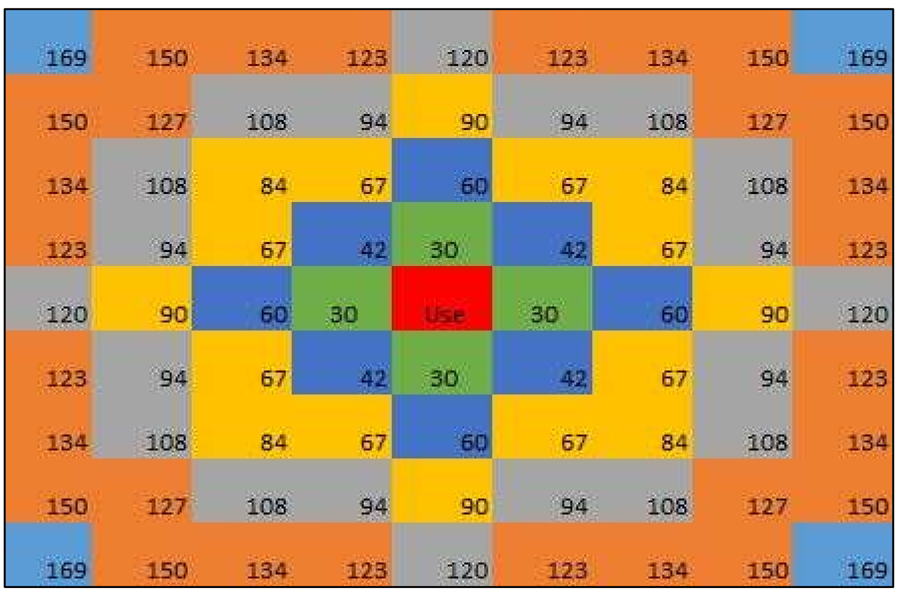

Figure M-1. Conceptual diagram of the Euclidean distance calculation for generating the buffer area from a use site.

The resulting GIS layer represents the potential pesticide use sites and associated off-site area buffered based on the minimum distance to the closest pesticide use site (**Figure M-2**). Inclusive of numerous distance values, the exposure area can be adjusted as part of the assessment based on the distance to effect for a specific aspect of the assessment.

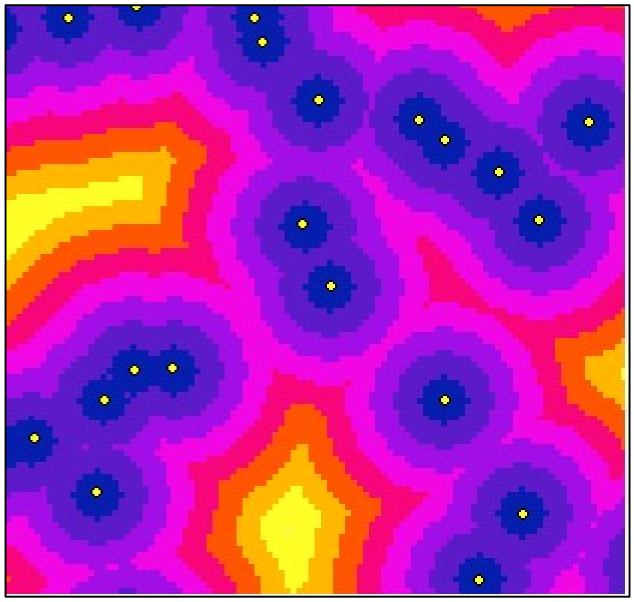

Figure M-2. Example offsite buffered area GIS layer based on the minimum distance to a use site.

A unique overlap metric is reported for each distance, with the use site at distance zero, and off-site area values greater than 0. Chemical specific distance(s) based on label requirements and the results of the AgDrift modeling set the extent of the exposure area for the UDL when evaluating the results of the overlap analysis.

Standardizing Spatial Files

Prior to the overlap calculations, EPA used ARCGIS v. 10.8.1, to standardize all spatial files, UDLs and species locations into the selected regional projections (see **Table M-1**). Regional projections were selected to minimize distortion in area and are based on the most common projection used by the parent GIS sources in the given region. Regional snap rasters are also used to support consistency in the resulting overlap values.

Table M-1. Projected coordinate systems used in the co-occurrence analysis.

Region	Projection
Conterminous United States (ConUS)	Albers_Conical_Equal_Area.prj.
Hawaii (HI)	NAD_1983_UTM_Zone_4N.prj
Alaska (AK)	WGS_1984_Albers.prj
Puerto Rico (PR)	Albers_Conical_Equal_Area.prj
United States Virgin Islands (VI)	WGS_1984_UTM_Zone_20N.prj
American Samoa (AS)	WGS_1984_UTM_Zone_2S.prj
Guam (GU) and Commonwealth of the Northern Mariana (CNMI)	WGS_1984_UTM_Zone_55N.prj

Uncertainties and Conservative Assumptions Associated with the Overlap Analysis

EPA based the overlap analysis on the species locations provided by USFWS and NMFS (USFWS, NMFS 2020). Species range is defined as the geographical area where a species could be found in its lifetime. These data are produced and managed by the species experts in the services responsible for implementing the ESA. EPA uses the Services' range data to estimate the overlap of the species range with potential exposure areas. This represents a likelihood that the species will be exposed; however, there are assumptions related to the range data that influence the likelihood that the species is exposed. The range information is not sub-divided into additional qualifiers such as current/historical locations or temporal information to account for distribution variations relating to timing such as seasons. Without additional distribution information, EPA assumes that the species is present in all sections of the range at all times of the year.

Other commonly known and related sources of uncertainty for GIS data generally relate to accuracy and precision. Accuracy can be defined as how well information on a map matches the values in the real world. Precision relates to how well the description of the data used for mapping matches reality, based on closeness of repeated sets of measurements. The more precise the data, the more likely additional measurement or calculation will show the same result. Some sources of inaccuracy and imprecision in GIS data are obvious while others are difficult to identify. It is important to consider these sources of error as GIS software can make it appear that data are accurate and precise beyond the limits of the data. When conducting this spatial analysis to assess the relationship between the species range and agricultural location, EPA made conservative assumptions related to the accuracy and precision of the available data (*e.g.,* using a 30 m resolution for the overlap process). These assumptions impact the uncertainty of the relationship, and generally overestimate the overlap between species range and agricultural locations.

To address classification accuracy and positional accuracy of the agricultural GIS data used, EPA combined multiple years into a UDL for each crop to represent anywhere the crop could be found. This is likely an overestimate of where a crop is found in any given year due to common agricultural practices such as crop rotation. Data resolution, or the smallest difference between features that could be recorded, is related to accuracy. The raster land cover data used to identify agricultural land, the Cropland data layer (CDL) produced by United States Department of Agriculture (USDA), has a resolution of 30 meters. A raster data set can be re-sampled into smaller increments, but this does not improve the resolution or accuracy of the dataset. For this reason, values cannot be established with a higher level of resolution than 30 meters, values that are not multiples of 30 cannot be determined (*e.g.,* 30, 60, 90 are distances in the dataset; 50 is not).

Precision errors can be introduced when formatting data for processing. Formatting changes can include changes to scale, reprojections of data, and data format conversions (raster to vector or vice versa). Sources of errors that are not as obvious can include those originating from the initial measurements, digitizing of data and using different versions of a dataset. These types of precision error may introduce edge effect, or misaligned dataset when conducting the spatial analysis. Borders following the general shape of the county boundaries but not aligning exactly with range information used could be the result of this type of precision error.

These uncertainties impact the relationship between the agricultural areas and species locations. EPA's spatial analysis makes conservative assumptions to err on the side of overestimating the potential for species exposure when assessing the relationship of the species range to agricultural land. EPA uses five years of crop information in constructing the UDLs representing the agricultural land, so that the UDLs include every location where the crop was grown during those five years. Due to normal agricultural practices (*e.g.,* crop rotations), this is more land than expected in a given year for a given crop. The relationship between the species and the agricultural land may be overestimated when the range is larger than the actual area occupied, and the additional area includes agricultural use or where edge effects were introduced.

When considering the species location data, all areas may be occupied at the time the pesticide is used. County or state boundaries can be used as a conservative estimate for species range but species and natural habitats are not expected to follow man-made boundaries. When the species locations have not been refined beyond these man-made boundaries, underestimates of the relationship between species range and agricultural use can occur. While this underestimation is possible, EPA makes several conservative assumptions for agricultural land and species life history to account for this possibility. For agricultural land, use of the UDLs representing multiple years of agriculture expands the agricultural footprint beyond what is expected in a given year. In addition to these assumptions, EPA uses the best available species location information from the species experts at USFWS and NMFS, minimizing this possibility.

Appendix N. Methods for the Census of Agriculture Overlap Tool (V1.1) Information

Background

This document provides background information and the methods used to develop the Census of Agriculture (CoA) Overlap Tool. This tool was developed to expedite the process for conducting an overlap analysis for federally listed endangered and threatened ("listed") species assessments. The purpose of the overlap analysis is to determine the percent overlap of the proposed labeled use sites and the listed species' ranges and designated critical habitats (CH[48]). The outputs from the Overlap Tool are conservative in nature and intended to maximize efficiency estimating potential overlap. This tool may be used along with the Use Data Layer (UDL) Overlap tool, as both tools provide areas of refinement based on different principles. In cases when a more refined spatial analysis is required, a higher-tier analysis can be conducted.

This tool runs in Python editor and has a Graphical User Interface (GUI) for selecting the key inputs for analysis. Key features that the tool provides from a user perspective are the following:

1. Geographic Information System (GIS) analysis is not required for the user;
2. The GUI uses Individual Crop or Crop-Group nomenclature for ease-of-use site selection;
3. The GUI includes entering geographic restrictions;
4. The overlap is presented as cumulative and by the individual Use Site ;
5. Buffering for offsite transport is included and presented in multiple formats.
6. In addition to the continental United States (ConUS), data for Alaska, Hawaii, and Puerto Rico are included in the tool by crop. Island territories (*i.e.,* Guam, American Samoa, Virgin Islands of US, and Northern Mariana Islands) are included at the Total Agriculture level.
7. The tool utilizes two years of USDA Census of Agriculture (CoA) data and reports the highest acreage value over the two reports. The current scope of the tool is for agricultural uses. Overlaps for non-agricultural uses, such as residential, rangeland, forestry, *etc*. are not included.

Conceptual Model

This section provides a brief overview of the conceptual model for the tool. Details of the method are further described in "General Data/Inputs" and "Methodology" sections below.

There are two inputs to the Overlap tool (*i.e.*, the Census of Agriculture (CoA) county-level crop acreage values and the species range and CH acreage in each county). For deriving the species acreage by county using ArcGIS spatial overlap analysis, the key process is the "intersect" of the CH and species range location with the U.S. County boundaries. Together, with the crop acreage inputs by county, these inputs are used to determine an upper-bound maximum potential percent overlap based on the number of acres of crop within the county. This is considered an "upper-bound percent overlap" as it is assumed that the species location (range or CH) county acres overlap with the crop acres.

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[48] Henceforth in this document, the acronym CH is used to represent designated critical habitat.

For example, in **Figure** N.4**N.4,** the green shape represents the species range. This range can fall anywhere within a county and overlap with county borders. The crop acres are shown with the orange box but the exact location within the county is unknown, and it may be distributed across the county with varying intensity. For the overlap analysis, these two areas (*i.e.,* species range or CH and the crop acreage) are assumed to coexist in space as shown in the overlap where the green shape overlaps with the orange box. This overlap may occur, or it may not occur in the landscape. The overlapping assumption is made to be certain any potential overlap of range and CH is accounted for in the percent overlap for a species.

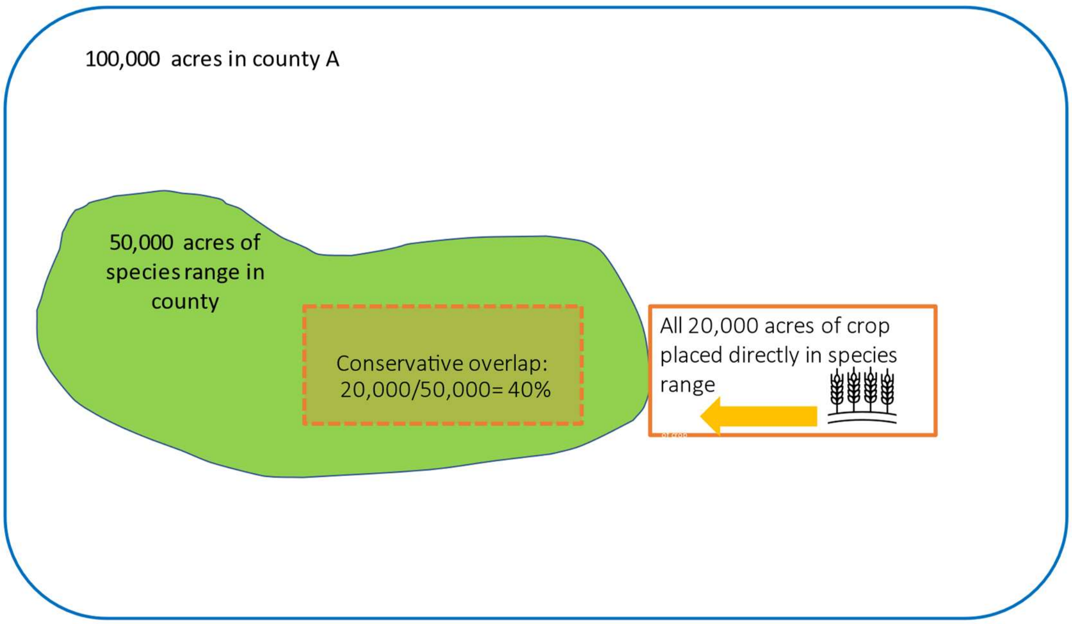

Figure N.4. General Example of Overlap ASSUMPTION with Species Acres

A limitation of working with CoA data is that there is non-disclosed acreage for some crop-county combinations (*e.g.,* acreage is not reported to protect the confidentiality of the growers). For this reason, a conservative proxy is utilized to account for these non-disclosed acres and is described further in methodologies section (see non-disclosed acreage imputation). This is a preprocessing step.
To begin calculating the overlap, for each species, the county crop acres are summed but are capped (*i.e.,* cannot exceed) at the species range/CH for each individual county. For example, **Figure N.2** shows a simple example of three counties and how the acreage may be capped if the crop acreage exceeds the species range. Counties B and C have crop acres (100 and 300 acres, respectively) that exceed the species range for the county, therefore, they are capped at the species range (20 and 200 acres, respectively). County A has less crop acres than the species range and does not require capping. After the crop acres are capped (if needed) at the county level the values for the crop acres and the species range are summed for the state level (**Figure N.2**).

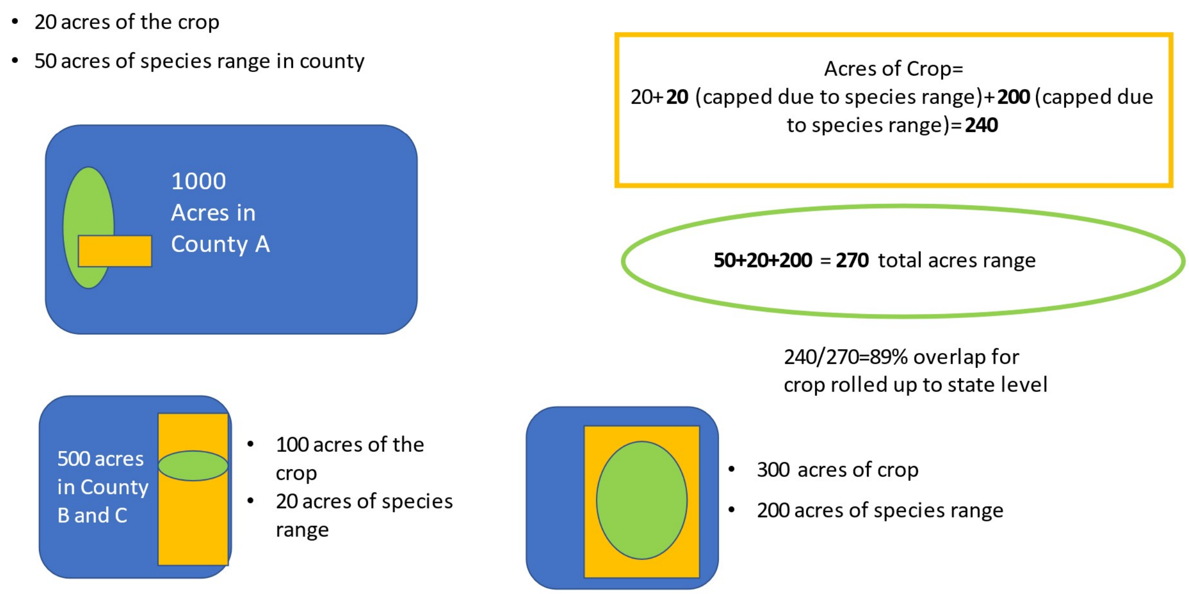

Figure N.5. *Depiction of Capping Using Species Range by County*

Figure N.5 depicts a single crop, however, when there are multiple crops selected, a redundancy step may be used in cases where the sum of overlap from all potential use sites within a county exceeds the county species acreage. In such cases, an adjustment is applied that maintains the ratio of crop overlap areas while reducing the sum of the overlap areas to the total species area (described further in "Methodology" section below).

To check the potential overestimation of the earlier assumptions (*e.g.,* non-disclosed acre proxy, species acres distribution), the county crop acres, when rolled up (*e.g.*, added together) to the state and national level are compared to the state/national acreage for the individual crops and are capped if the sum of the county crop acres for a species exceeds the state or national crop value. The direct overlap value is then calculated by dividing the sum of the crop acres across all states by the total species range or CH acres. **Figure** N.6**N.5** depicts the national level for a species with a multi-state range, thus, as an example, the "rolled up values" depicted in **Figure N.2** would fit into a single state (the blue boxes in **Figure** N.6).

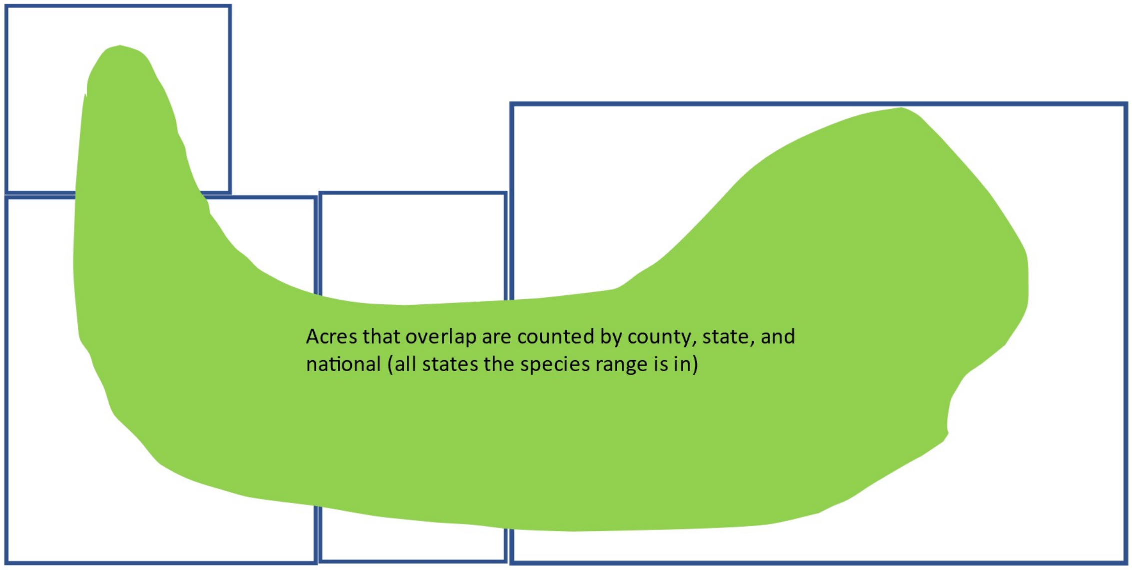

Figure N.6 Species Range- across multiple states

The overlap tool also accounts for offsite transport by buffering out the use area. To account for spray drift this is done by using 30 m increments, 305 m and 792m buffer distances (based on the AgDRIFT™ maximum/model limits for aerial and ground). To account for runoff, the tool includes a 1,500m buffer for assessments that require maximum 'runoff' buffering (US EPA, 2022).

For the buffering, the method assumes that the acreage within a county is divided up into multiple fields. Because there can be differences in field size by crop, the crops from the CoA are binned into two size categories for the spray drift calculations. In general, the row crops (*e.g.*, corn, soybean, and wheat) have larger field sizes and the specialty crops (*e.g.*, strawberries, apples, cucumbers, *etc.*) have a smaller field size. Data are available from USDA Census of Agriculture (USDA, 2017- Tables 35-38) to inform on the breakdown of crop acres grown/harvested by field size. Based on a review of the available data, the specialty crops are assigned a field size of 25 acres and row crops are assigned a field size of 500 acres. These field size acreages are used to adjust the spray drift by assuming that the crop acreage in the county is divided into multiple fields (*i.e.*, divided by the field size of either 25 or 500 acres) and then the drift is calculated for each field before summing up. Using this model, the buffer extends from all four sides of the modeled field to the various buffer distances (Error! Reference source not found. for further details).

General Data /Inputs

1. Census of Agriculture (2017 and 2012)- national, state and county acreage (preprocessed by BEAD[49])- The CoA is a complete count of agricultural activity on U.S. farms and ranches. This analysis utilizes the crop acreage data. The CoA census is published every 5 years (2012 and 2017 being the most recent two surveys conducted) and the two most recent surveys are used to account for temporal variability in crop patterns and ensure conservatism. Data are available for all states.
2. Census of Agriculture-2017[50]- For Puerto Rico and the Island Territories of Guam, American Samoa, Virgin Islands of US, and Northern Mariana Islands, data were not available in a preprocessed format. Data were extracted from the USDA National Agricultural Statistics Service (NASS) Quick Stats database. For Puerto Rico, the crop acres were extracted for the territory as a whole. For the other islands, the data resolution was at the total acres in agriculture level (*i.e.*, not available by crop).

3. Location files for listed species- (range and designated critical habitat) and the U.S. County boundary shapefile. All files were provided by EFED/EISB with the requisite data preparation. Originally, the source files of the species location files were provided by the Services. For EPA's endangered species biological evaluation, these source files were standardized and organized by taxonomic group in file geodatabases (referred to as species libraries)[51].

4. Master Species List-Species subject to Section 7 under the Endangered Species Act are obtained from the US Fish and Wildlife Threatened and Endangered Species System (TESS[52]). The resulting table is filtered to include listing statuses[53] currently subject to Section 7 or potentially subject to Section 7 during the registration period. Information from TESS for species under the jurisdiction of the National Marine Fisheries Service (NMFS) is supplemented with information from the NMFS website[54], deferring to the NMFS website if conflicts exist between the sources. The master species list was *provided by EFED/EISB* (file version generated- 09_2022).

Methodology

There are three main sections for the methods descriptions:

- Preprocessing the CoA Data

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[49] Census Acreage Data (USDA NASS 2012, 2017) Processed by the Biological and Economic Assessment Division (BEAD)- 2012 version 111/15/2018; 2017 version 1- 11-23-2020.
[50] USDA, NASS. 2017. Census of Agriculture for Outlying Areas
https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Census_for_Outlying_Areas/index.php
https://www.nass.usda.gov/Surveys/Guide_to_NASS_Surveys/Census_for_Outlying_Areas/index.php
[51] More details about the location files preparation can be found in the EISB document titled "Tool Documentation – Processed GIS Data – Listed Species Spatial Files"-Updated 2020 Ver 1.2.
[52] https://ecos.fws.gov/ecp/
[53] Statuses included: Threatened, Endangered, Experimental Population Non-Essential, Proposed Threatened, Proposed Endangered, and Candidate
[54] https://www.fisheries.noaa.gov/national/endangered-species-conservation/esa-threatened-endangered-species

- ArcGIS Species Range and CH County Projection and Processing
- Overlap Calculations

Preprocessing of Census of Agriculture Crop Acreage Data

Crop acreages at the county-, state-/territory-, and national-level are sourced from the CoA. To account for temporal variability in crop patterns, crop acreage values from both the 2012 and 2017 CoA are used to generate the input values used in the overlap analysis. Due to the presence of non-disclosed acreage values (assigned as D values in CoA) for specific crop/location combinations in the two CoA datasets a preprocessing step is conducted prior to overlap analysis to fill missing values.

Non-Disclosed Acreage Imputation[55]

The imputation method for missing acreage values requires that all crops have national-level acreage values. In limited cases where national-level acreage values are unavailable[56], estimates are obtained from other datasets (*i.e.*, alternate CoA years). Once a complete set of national-level crop acreage estimates are obtained, the missing state acreage values are imputed. To generate the most conservative crop acreage estimates, each state/crop combination with a non-disclosed acreage value is filled with the difference between the national-level crop acreage values and the sum of available state acreage values. An example of this approach is described below.

Before Imputation:

State 1 Acres	State 2 Acres	State 3 Acres	State 4 Acres	State 5 Acres	National Acres
100	300	200	(D)	(D)	1000

D=acreage non-disclosed

After Imputation (Imputed values in Red):

State 1 Acres	State 2 Acres	State 3 Acres	State 4 Acres	State 5 Acres	National Acres
100	300	200	400	400	1000

In this example shown in the Before Imputation table there are 3 states (*i.e.*, State 1, State 2, and State 3) with disclosed crop acreage values totaling 600 (100+300+200) acres, a national crop acreage value of 1000 acres, and 2 states with non-disclosed acreage values. Because the distribution of the non-disclosed acres is unknown, each state is assumed to have acreage equal to the difference (1000 acres – 600 acres = 400 acres), which represents the maximum possible acreage in each non-disclosed state given all known acreage values. This is shown in the After Imputation table (assumed acres shown in red).

[55] Imputation refers to the process of replacing missing data with substituted values.
[56] Guar, jojoba, ginger root, birdsfoot trefoil-seed, miscanthus and sugarcane, sugar all were national "D" values in 2012. 2017 values were subbed as a proxy. Sugarcane had similar values in the 2007 and 2017 census.

Following the state-level non-disclosed acreage imputation, the county-level non-disclosed acreage values are imputed. This county-level imputation is performed using a similar approach to the state-level imputation; each non-disclosed county/crop combo is filled with the difference between the state-level acreage total for the crop and the sum of disclosed county-level acreage values for that crop.

In addition to the non-disclosed acreage values (indicated by a "(D)" in the CoA tables), some crop/location combinations entries are labeled as "(Z)", which indicates that the value corresponds to half an acre or less of the crop in the location. Once the non-disclosed (D) values have been filled using the approach described above, all crop/location combinations with (Z) values in the CoA tables are filled with 0.5 acres (the maximum possible value). The filling of (Z)-values occurs after the imputation of (D) values to ensure that (D) maximum estimates (*i.e*., each (Z)-value reflects an acreage value between 0 and 0.5 acres, so the program first estimates (D) values assuming that (Z) values are 0 to obtain the highest possible acreage for both sets of unknown values).

Once the imputation steps are complete, tables of county- state- and national- level crop acreage values with numeric values for all crop/location combinations are available.

Merging multiple CoA Years

To capture the potential difference (*e.g*., crop rotation) in cropping overtime both the 2012 CoA and 2017 CoA values are used in the final crop acreage input table that is used for overlap calculations. Both CoA datasets are first processed using the imputation approach described in the previous section to fill missing values. Following the imputation steps, acreages from the two datasets for each location/crop combination are compared at the county, state, and national level. For each combination, if both or neither crop area was imputed (*i.e*., estimated because of a non-disclosed acreage entry in the raw CoA table), the maximum acreage value was selected from the two years. If one dataset contains an imputed value and the other contains a value that did not require imputation, then the non-imputed value was retained in the final crop area table. This approach assumes that non-imputed values will introduce less uncertainty into the final overlap estimates compared with imputed values.

ArcGIS Overlap Analysis of Species Locations and U.S. Counties

This section provides information on how the ArcGIS analysis was done for the spatial overlap of listed species locations and the U.S. Counties. The described overlap analysis was conducted in ArcMap/ArcGIS Pro and ArcGIS version of Python 2.7, with ArcPy and ArcPy.sa modules imported. The goal of this spatial overlap analysis is to generate chemical-independent species acreage in each county of the United States. The output tables of this analysis are used as the inputs by the overlap tool (written in Python).

In this spatial analysis, the key process is the "intersect" of CH and range files of species with U.S. County boundaries. Intersect is a ArGIS intersect tool that calculates the geometric intersection of any number of feature classes and feature layers. Prior to this key step, all input files (*i.e*., species location files and U.S. County boundary files) were projected to the appropriate projection (*i.e*., Albers Equal-area Conic) for the projected coordinate system (PCS). Following the intersect analysis, the acreage of species per county was calculated and, together with the other identifiers (*i.e.*, entity ID, GEOID, state, *etc.*), exported to output tables. **Figure M.4** illustrates the conceptual model for this spatial analysis. A more detailed explanation is described below.

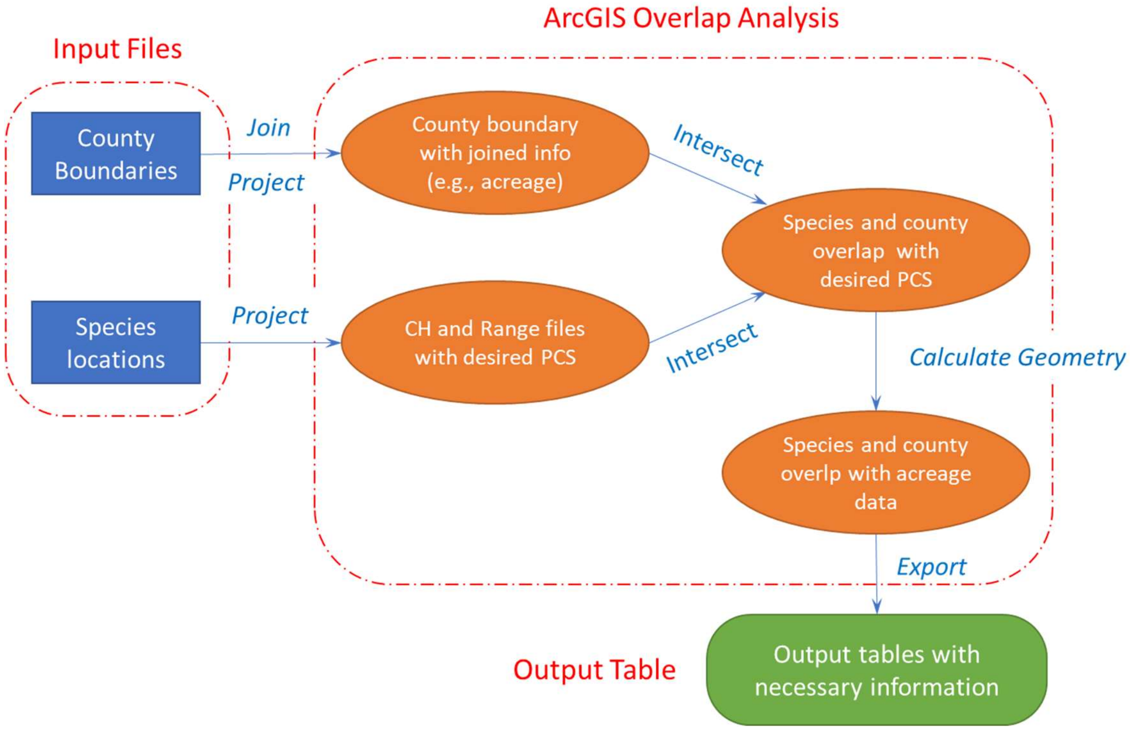

Figure N.7. Conceptual Model for the Spatial Overlap Analysis for the Listed Species and US Counties

Input files

The input files of this overlap analysis included location files for list species (range and CH) and U.S. County boundary shapefile. All these files were provided by the Environmental Fate and Effect Division Environmental Information Services Branch (EFED/EISB) with the requisite data preparation. Originally, the source files of the species location files were provided by the Services. For EPA's endangered species biological evaluation, these source files were standardized and organized by taxonomic group in file geodatabases (referred to as species libraries). More details about the location file preparation can be found in the EISB document titled "Tool Documentation – Processed GIS Data – Listed Species Spatial Files" -Updated 2020 Ver 1.2.

Approach

Integrating county acreage info into county boundary shapefile

A set of county boundary shapefiles were provided by EISB containing slightly different aspects of information of the counties in each file. To integrate all essential information into one shapefile, especially the acreage of the counties, the 'join' tool in ArcGIS was used to combine attribute tables together and generate a new county boundary shapefile based on the "COUNTYNS" (a common attribute contained in each county shapefile). The newly generated county boundary shapefile contained all the essential information and was used as an input file of the overlap analysis.

Projecting species location and county boundary shapefiles
Prior to being used as inputs in the spatial overlap analysis, both species location and county boundary shapefiles were projected to the appropriate projected coordinate systems (PCS). For the 48 ConUS states, the Albers Equal-area Conic projection was used because it is suitable for land masses that extend in an east-to-west orientation (*e.g.*, the ConUS) to minimize the distortion of the shape and linear scale, therefore increasing the accuracy of the geometry calculation (*e.g.*, areas and distance). For the states/regions outside the ConUS, the following selected PCSs were used in projecting species location and county boundary shapefiles (**Table M.1**). Projecting analysis was conducted by using the "projection" tool in ArcGIS or "arcpy.Project_managment" function in ArcPy.

Table N.1. Projected coordinate system used for U.S. regions.

Region	Projected Coordinate System
Conterminous United States (ConUS)	Albers_Conical_Equal_Area.prj.
Hawaii (HI)	NAD_1983_UTM_Zone_4N.prj
Alaska (AK)	WGS_1984_Albers.prj
Puerto Rico (PR)	Albers_Conical_Equal_Area.prj
United States Virgin Islands (VI)	WGS_1984_UTM_Zone_20N.prj
American Samoa (AS)	WGS_1984_UTM_Zone_2S.prj
Guam (GU	WGS_1984_UTM_Zone_55N.prj
Commonwealth of the Northern Mariana (CNMI)	WGS_1984_UTM_Zone_55N.prj

- Intersection of species location and county shapefiles

As mentioned above, the "intersect" process was the key step of the overlap analysis. The "intersect" tool in ArcGIS or "arcpy.Intersect_analysis" function in ArcPy was used to calculate the geometric intersection of species locations and U.S. Counties. The projected species spatial files (CH and range files) and county shapefile were used as input files in this step. The output features were species locations per county, only including the areas where a polygon from species critical habitat or range file intersected from the county boundary file. See **Figure** N.8**N.8** for an illustration of the result of intersecting two polygon feature classes.[57]

In the intersect analysis, the acreage of each intersected polygon in square meters was calculated using the intersect tool. This analysis used the default shape area from the attribute table and the units were confirmed as square meters. This information tells the acreage of a species in a specific county (*i.e.*, species acreage per county, in square meters).

[57] Figure 5 was cited from ArcGIS online help document (https://pro.arcgis.com/en/pro-app/latest/tool-reference/analysis/intersect.htm)

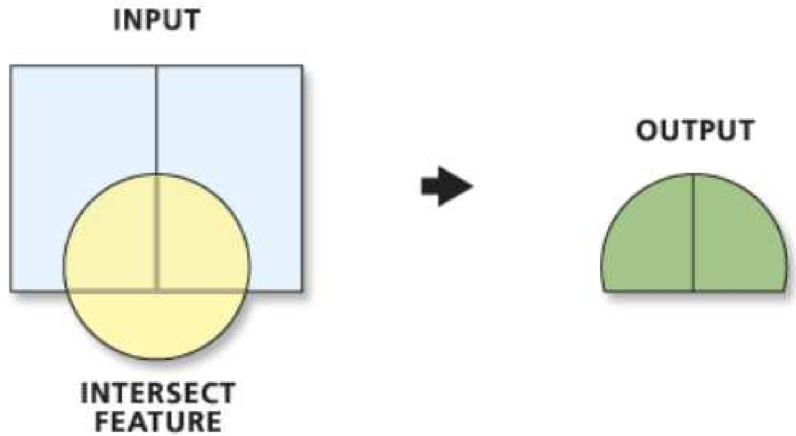

Figure N.8. Illustration of intersect of polygons

Exporting attribute table

Once the intersect was completed, the attribute table was exported as a .csv file. This was done by using the "table to table" tool in ArcGIS or "arcpy.TableToTable_conversion" function in ArcPy. The intersect output tables contained all the attributes from species location files and county boundary files. In addition, the intersect output table also included species by county acreage which was calculated in the intersect process. Once exported to the .csv files, all the intersect output tables were combined into two separate all-in-one tables (one for range and the other for critical habitat) and used as the input data for the overlap Python tool.

Use of Python and ArcPy

As mentioned above, the species location files were organized by taxonomic group in file geodatabases (referred to as species libraries). One location shapefile was designated for each individual species range and critical habitat. Each location file was processed following the same approach (*i.e.*, projected to Albers project) intersected with the county boundary file, and exported the interest output attributes to a .csv file.

Due to the large number of location files and the same process for each file, Python scripts were developed to employ ArcPy functions to run files in a batch for each step described above where spatial files were involved.

The key ArcPy functions used in the Python scripts and their corresponding ArcGIS tools were listed in the **Table N.2** and mentioned above in each step as well.

Table N.2. Key ArcPy functions used and their corresponding ArcGIS tools

Process	ArcPy function	ArcGIS tool
Project	arcpy.Project_management	Project
Intersect feature classes	arcpy.Intersect_analysis	Intersect
Export attribute table	arcpy.TableToTable_conversion	Table to table

Output tables
The final output generated from this spatial overlap analysis includes two all-in-one tables with all species included in each table. One is for the species range, and the other is for designated critical habitat. Each row of the tables represents one species in one county, i.e., single species per county. The attributes/columns of the two tables are slightly different from each other depending on the attribute tables in the source files. However, both output tables contain the essential attributes (but not limited to) that are utilized in the overlap Python tool or further analysis. **Table M.3** listed the essential attributes and the corresponding aspect that each attribute represents.

Table N.3. Output Attribute Tables for Species' Ranges and Critical Habitats

Attribute	Note
EntityID	The unique integer value of the species entity within the database
STATEFP	State FIPS code – the unique two digits value for the state
GEOID	Geographic identifiers – the unique codes identify all administrative/legal and statistical geographic areas i.e., counties.
NAME	Common name of the species
State	The name of the state
Shape_Area	The acreage of the species in the county in square meters
Area*	The acreage of the county in square meters

Note: * This attribute was not used as a filter in the overlap tool but may be needed for other analysis.

Overlap Calculations

Direct Overlap

Calculations of direct overlap percentages begin with tables of county-level acreage values for both listed species and crops of interest. The analysis uses GEOIDs as unique identifiers for counties, allowing assessors to match up entries in the species and CoA input tables. For each county/crop/species combination, the minimum of the county/species area and county/crop area is extracted and stored in a table as an overlap area. For this calculation, it was assumed that each additional marginal unit of cropped area within a county will overlap any available species range/critical habitat within that county until 100% of the species area is overlapped. By taking the minima of the two area values it ensures that county-level overlap area cannot exceed the species acreage (i.e., overlap cannot exceed 100%).

Redundancy Adjustment
While individual crop overlap in each county is capped at 100% of the county species area, the initial overlap calculation described above may result in cases where the sum of overlap from all crops of interest within a county exceeds the county species acreage when multiple crops are considered. In such cases, a redundancy adjustment is applied that maintains the ratio of crop overlap areas while reducing the sum of the overlap areas to the total species area. An example of this redundancy adjustment is provided below:

Unadjusted Overlap Acreage:

Crop 1 Overlap Area (Acres)	Crop 2 Overlap Area (Acres)	Crop 3 Overlap Area (Acres)	Species Range in County (Acres)

30	20	50	50

Overlap Acreage after Redundancy Adjustment (Adjusted values in Red):

Crop 1 Overlap Area (Acres)	Crop 2 Overlap Area (Acres)	Crop 3 Overlap Area (Acres)	Species Range in County (Acres)
15	10	25	50

In the example, the first step is to calculate overlap areas for each crop independently and compares the sum of overlap areas with the species range area. Because the sum of overlap areas for the three crops in the example (100 acres) exceeds the species range (50 acres), each overlap area was multiplied by a factor that represents the species range divided by the sum of individual overlap areas (in this case the factor equals ½). The adjusted overlap areas are consequently reduced in such a way that they sum to the species range area but maintain their original proportions relative to one another.

State-Level Rollup/Capping

Once the redundancy adjustment factor to applicable county-level overlap values was applied, the process of rolling up county-level overlap values to obtain state-level overlap values begins. This process initially involves summing county-level overlap values from the same state for each crop/species combination. Once the initial sums have been obtained, the resulting state-level overlap areas was compared with the state-level crop acreage values from the CoA input tables. The minimum of these two values was then taken as the state-level overlap area. The primary function of this capping procedure is to correct for the highly conservative county-level crop acreage estimates introduced by the non-disclosed acreage imputation procedure. In the imputation all county-level non-disclosed acreage values were assigned with the difference between state acreage values and sum of disclosed county acreage values within that state. While this procedure produces maximum possible acreage estimates in each county (due to the uncertainty regarding the distribution of the acres), it has the potential to result in state-level overlap values that exceed the (known) maximum acreage of crop within the state. The capping procedure enforces this maximum value and corrects state-level overlap estimates downward where necessary.

National-Level Rollup/Capping

The rollup of state-level overlap acreages to national-level overlap acreage values follows a similar procedure to the county-to-state rollup. Rollup of state-level overlap areas to national-level overlap areas is accomplished by first taking the all state-level overlap areas for each crop/species combination and then taking the minimum of the sum and national-level CoA acreage value for that crop (like the state-level capping described in the previous section).

Conversion of National Overlap Areas to Percentages

Once national-level overlap areas have been obtained for each crop/species combination, the overlap areas are divided by the total area of range for the corresponding species to generate percentage values. These final percentage values represent an estimate of the portion of species range or critical habitat that overlapped with each selected crop.

Overlap Calculations – Drift

The process for calculating drift overlap areas differs from direct overlap calculations in a few key aspects. As in the direct overlap procedure, we begin with tables of county-level acreage values for both species and crops of interest. For "all ag" estimates of drift overlap, we first take the sum of acreages for all crops of interest within each county (this allows for more straightforward subsequent calculations that do not require redundancy considerations). A list of buffer distances (*i.e*., distances from the original field over which we might expect drift to occur under different application scenarios) is also specified for drift calculations.

The area impacted by drift for each county/buffer distance combination is estimated by dividing the total crop area in a county into square 25-acre fields, and modeling the areas impacted by drift as the difference between the area of a square determined by extending each side of the original field by the buffer distance and the area of the original 25-acre field as shown in **Figure N.6.**

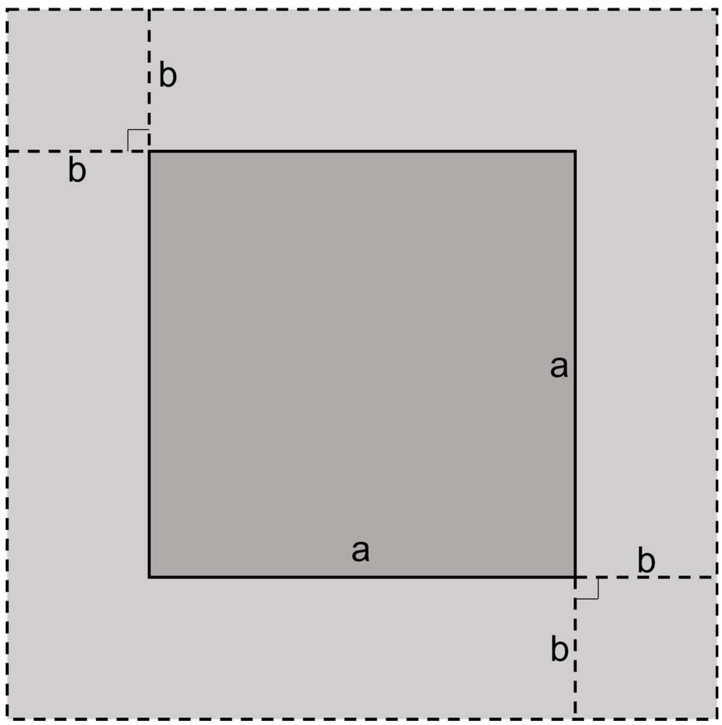

Figure N.6. Illustration of drift model: light gray represents area affected by drift extending distance b (buffer length) from a square field of area a2 (shown in dark gray).

Each 25-acre field in a county has an "a" value of ~318 meters, with specified buffer distance "b" values. The calculation of drift for all crops within a county is shown in **Equation 1**:

$$DriftArea = \frac{Total\ Crop\ Area}{25\ Acres} \cdot \left(\left(\sqrt{25\ Acres} + 2 \cdot Buffer\ Dis\tan c\, e \right)^2 - 25\ Acres \right)$$

Equation 1. Calculation of county-level drift area for all ag columns and specialty crops.

Estimates produced by **Equation 1** thus reflect the conservative assumption that drift areas produced by different 25-acre fields do not overlap one another.

In the "all ag" calculation of drift for a given buffer distance, drift areas are first calculated using **Equation 1** for each county/crop/species combination. Then the overlap area is capped so that the direct overlap of the crop area + drift zone cannot exceed the species range in the county. The drift overlap areas can be summed for each crop/state/species combination to roll up to state-level overlap or sum all drift overlap areas for a given crop/species combination to roll up to national-level overlap areas. Unlike in the direct overlap calculations, state- or national-level crop area caps do not apply to the estimated drift overlap areas. Once the national overlap areas have been obtained, the values are divided by the sums of range/critical habitat areas for the corresponding species to arrive at an overlap percentage.

The overlap tool output tables contain two types of "all ag" drift overlap columns. One group consists of total overlap percentages, which represent all overlap due to drift up to the specified buffer distances of 305 meters, 792 meters, and 1500 meters and these columns require no further calculations besides those already described. Another set of columns output marginal increases in percent overlap over a specified buffer interval (*e.g.*, 60 meters to 90 meters). Marginal drift overlap increase values are obtained by subtracting the national percent overlap value at the start of the buffer interval from the national percent overlap value at the end of the interval. The overlap tool output provides these marginal drift values at 30-meter intervals over the range of 0 to 810 meters (810 selected to complete the last 30m interval). The 30-m increments are presented in the output individually and marginal increases to drift areas will become zero once the maximum number of available acres has been reached.

In addition to the "all ag" drift overlap columns, the tool also outputs a series of crop-specific overlap direct overlap and drift columns. These columns are generated on a per-crop basis by first applying a slightly modified version of Equation 1 to county-level crop acreage values using buffer distances of 0, 30, 305, 792 and 1500 meters to obtain drift areas. The crop-specific drift calculation differs slightly from the "all ag" drift calculations in that row crops (*e.g.,* corn, soybean, *etc*.) are modeled as 500-acre fields while specialty crops (*e.g*., strawberries, apples, cucumbers, *etc.*) are modeled as 25-acre fields. Thus, specialty crop calculations use **Equation 1**, while row crops calculations make use of **Equation 2**, as shown below:

$$Drift\ Area = \frac{Total\ Crop\ Area}{500\ Acres} \cdot \left(\left(\sqrt{500\ Acres} + 2 \cdot Buffer\ Dis\tan c\,e\right)^2 - 500\ Acres\right)$$

Equation 2. Calculation of county-level drift area for row crops.

Once the drift area calculation employing the appropriate field size has been performed, the original crop area is then added to the drift areas to obtain a total affected area for each county/crop/buffer distance combination. The minimum of county-level direct + drift areas and county-level species areas are then taken to produce an overlap area for each county/crop/buffer distance/species combination. County-level overlap values for each crop/buffer distance/species combination to produce a national overlap area value. The national overlap areas are then divided by national-level species areas and multiplied by 100 to produce overlap percentage values for each crop/buffer distance/species combination. In contrast with calculations described in previous sections, no redundancy factor or state/national-level crop-acreage caps are applied in the calculation of these overlap values.

Version Updates: This document accompanies the October 31, 2022, version update from V1.0 to V1.1. Changes to the tool in this version reflect the latest updates to the species range and critical habitat files (Master list-09_2022) as Inputs. This update incorporates new projection methods for regions outside of the conterminous United States. Additionally, this version also includes two additional output tabs [Overlap by Use (Direct and buffered) and Overlap by use in 30 m increments].

Tool Update Cycle: Crop Acreage Inputs may be updated on a 5-year cycle as inputs are available every 5 years from the Census of Agriculture. Species ranges and critical habitats are often updated more frequently, and updates will be scheduled depending on data availability from the Services.

References

US EPA, 2022. 2,4-D Choline Salt and Glyphosate Dimethylammonium Salt: 2022 Ecological Risk and Endangered Species Assessment for Use on Genetically-Modified Herbicide-Tolerant Corn, Soybean, and Cotton in Support of Registration Renewal Decision for Enlist One and Enlist Duo Products. DP Barcodes 462084, 462086