# Insecticide Strategy (Final)

# to Reduce Exposure of Federally Listed Endangered and Threatened Species and

# Designated Critical Habitats

# from the Use of Conventional Agricultural Insecticides

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Office of Pesticide Programs
Office of Chemical Safety and Pollution Prevention
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## Table of Contents

**List of Other Documents Included in the Insecticide Strategy Docket (ID: EPA-HQ-OPP-2024-0299)**

- Insecticide Strategy (Final) Species Overlap and Characteristics (Appendix C), dated April 2025
- Ecological Mitigation Support Document to Support Endangered Species Strategies Version 2.0, dated April 2025
- Response to Public Comments Received on the Draft Insecticide Strategy, dated April 2025
- Crosswalk of EPA's Ecological Mitigation Measures with USDA NRCS Conservation Practices in Support of EPA's Endangered Species Strategies Version 1.2, dated April 2025
- Spray Drift Analysis Review Report (Addenda to Data Evaluation Record for MRID 49135901), dated September 2022
- Docket Posting Memorandum for the Insecticide Strategy, dated April 2025

# 1 Executive Summary

## 1.1 Background

When the U.S. Environmental Protection Agency (EPA or Agency) takes an action on a pesticide registration (*i.e.,* registers a pesticide or reevaluates it in registration review) under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), the Agency also has a responsibility under the Endangered Species Act (ESA) to ensure that the pesticide registration is not likely to jeopardize the continued existence of federally threatened or endangered (referred to as "listed") species, or result in the destruction or adverse modification of their designated critical habitats. Chemical stressors, such as pesticides, are one of many factors that can contribute to population declines of listed species. Meeting this ESA responsibility is a formidable task, considering the tens of thousands of pesticide products and registration amendments for which EPA is required to review potential effects for over 1,700 U.S. listed species.

Given these challenges, EPA released a workplan (USEPA, 2022a) and an update (USEPA, 2022b) on how it plans to meet its ESA obligations as part of pesticide registration processes conducted under FIFRA. The update also describes strategies for identifying early mitigation measures to address potential population-level impacts to listed species across groups of chemicals (*e.g.*, herbicides, rodenticides, insecticides) or in certain regions across the U.S (*e.g.*, Hawaii Strategy). These strategies intend to more efficiently determine whether, how much, and where mitigations may be needed to protect federally listed species from many uses of conventional pesticides. This Insecticide Strategy (strategy) is a key step for EPA in increasing the efficiency of meeting its ESA obligations in a sustainable and practical manner. This strategy was finalized with consideration of significant public comments submitted on the Draft Strategy during a 60-day open public comment period ending in September 2024. In this strategy, EPA considered information provided through public comments in multiple ways. EPA has expanded the menu of spray drift, runoff, and erosion mitigation options from which end users can choose, resulting in enhanced flexibility in crop production. The Final Strategy acknowledges many of the practices that growers already use to reduce pesticide movement and protect the surrounding lands. The options included in the mitigation menu incorporate as many of these practices as is feasible, based on EPA's review of the available information. In addition, EPA plans to continue outreach efforts with the farming community and other stakeholders to add practices, where appropriate, to the list of mitigation options. EPA intends to continue developing tools and incorporating input from growers and other insecticide users from outreach efforts and public comment processes to simplify the process for users to the extent it can as EPA begins to apply the strategy. EPA also acknowledges that implementing a process that is flexible and that allows for changes along the way, as EPA's knowledgebase of mitigation practices continues to expand, may result in more complexity. EPA is conscious of this and is committed to continuing to work with growers and other applicators to decrease these complexities.

The Insecticide Strategy is not self-implementing. This strategy provides guidance and clarification to the public, including, but not limited to, farmers, pesticide companies, pesticide applicators, agricultural consultants, and pest management planners for how EPA would consider and apply this strategy to address the potential for population-level impacts for listed species. This strategy will be applied during a FIFRA action (*e.g.*, registration of new active ingredient or registration review) for conventional agricultural insecticides. In contrast to this strategy, the requirements in FIFRA and agency regulations are binding on EPA and pesticide applicants, registrants, and users. When applying the FIFRA standard to an ecological risk evaluation[1], EPA intends to use this strategy to determine whether mitigations are necessary for a FIFRA action. EPA will continue to balance the costs and benefits of all actions taken under FIFRA. As is common practice when EPA seeks public comments on registration actions, where appropriate, EPA would seek public comment on actions that apply the Insecticide Strategy.

EPA may depart from the guidance where circumstances warrant and may amend this strategy or its supporting documents when appropriate. As the EPA continues to implement this strategy, it will continue to engage with stakeholders and federal partners on different aspects of this strategy. Listed below are some of the areas where EPA intends to undertake further engagement:

- EPA is developing a process to qualify individual conservation programs that could achieve 9 mitigation points. Additionally, EPA is developing a process to qualify external parties that would assess a grower's farm and determine the existing mitigation points that could be achieved during the growing season. EPA is continuing to develop this new approach to qualify programs and parties. This approach will be shared with stakeholders before it is implemented by EPA. EPA will also continue discussions with federal partners and other stakeholders concerning these efforts and will also seek comment, through our Paperwork Reduction Act (PRA) obligations, on any necessary information collections.

- EPA is reconsidering using descriptions of protected areas or habitat, as opposed to (or to supplement) the descriptions of managed areas (*e.g.,* what is not a protected area) in the Final Insecticide Strategy. This would help growers and other applicators determine if a field is exempt from runoff or spray drift mitigations because the area intended for a pesticide application is not close to protected areas. Developing a list of what is included in these protected areas, around which spray drift and/or runoff/erosion mitigation measures may be needed, may provide additional clarity to pesticide users.

- EPA is developing refined Pesticide Use Limitation Area (PULA) maps[2] to limit the spatial extent of off-target mitigations to specific areas to protect listed species and to minimize impacts to applicators. EPA intends to implement the Insecticide Strategy using refined species maps. EPA made the process it uses to develop species maps available to the public. Using EPA's process, registrants and other non-government organizations (NGO) may choose to develop refined maps and associated documentation for species that may be of interest to them. EPA plans to continue working with organizations and individuals who choose to develop maps to facilitate their development.

[1] Using the pesticide according to specifications "will not generally cause unreasonable adverse effects on the environment.'' Additional information on FIFRA is available at: https://www.epa.gov/laws-regulations/summary-federal-insecticide-fungicide-and-rodenticide-act

[2] https://www.epa.gov/pesticides/epa-updates-process-developing-maps-protect-endangered-species

- EPA is continuing to work with stakeholders to evaluate drift-reducing adjuvants as a mitigation measure for insecticides. EPA has received data on certain adjuvants during and after the public comment period and is currently evaluating them to determine if and how the information informs using adjuvants as a mitigation measure for insecticides.

- EPA is working with stakeholders to identify additional mitigation options including potential offset opportunities for insecticides and other types of pesticides.

- EPA is developing a mobile-friendly application tool for growers and other applicators that provides efficiencies in compiling the label information and helps pesticide users consider their options and understand how their current practices, location, and field properties relate to any required mitigations.

This Final Insecticide Strategy covers conventional insecticides, insect growth regulators, nematicides and miticides (collectively referred to throughout this document as insecticides, for simplicity) that are used in agriculture in the lower 48 states. Insecticides are important, widely used tools to prevent crop damage from insect and mite pests. This Final Strategy focuses on agricultural uses. More than half of the "land base" in the United States is used for agricultural purposes.[3] In 2022, approximately 83 million acres of cropland were treated with insecticides according to the Census of Agriculture.[4] In addition, there are approximately 1,000 listed species in the conterminous United States. This strategy identifies mitigations that would provide early protections for hundreds of species that are under the purview of U.S. Fish and Wildlife Service (FWS).[5]

EPA has coordinated with FWS and United States Department of Agriculture (USDA) on the development of this strategy. Recently, EPA and FWS entered into a Joint Statement of Coordination that addresses how this strategy, as well as others, could inform future biological evaluations and consultations.[6] The Insecticide Strategy would provide early protections for the listed species most impacted by insecticides even before effects determinations are made or consultations are completed, thereby accelerating EPA's ability to meet its ESA obligations for all conventional insecticides, reducing the legal vulnerability of EPA's pesticide decisions, and ensuring the continued availability of pesticides.

The Insecticide Strategy is intended to create a consistent, reasonable, transparent, and understandable approach to assess potential impacts and identify mitigations to reduce potential population-level impacts to listed species from the use of agricultural insecticides. The strategy does not include ESA effects determinations but is meant to identify mitigations that can be considered and applied in registration and registration review actions to reduce pesticide impacts and exposures to listed species. The strategy is intended to provide similar and consistent mitigations for insecticides with similar

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[3] https://www.ers.usda.gov/topics/farm-economy/land-use-land-value-tenure/.

[4] www.nass.usda.gov/AgCensus.

[5] EPA is separately addressing potential impacts of insecticides to the listed species and their critical habitat under the jurisdiction of the National Marine Fisheries Service (NMFS) through programmatic consultation.

[6] https://www.epa.gov/endangered-species/joint-statement-cooperation-between-epa-and-fws-help-protect-endangered-species.

characteristics (*e.g*., exposure, toxicity, application method) that are used on the same crops. This approach identifies mitigations based on objective criteria that allows for more consistency and more predictability for growers and other stakeholders.

These mitigations would address potential impacts to aquatic and terrestrial listed invertebrates, which are the types of species likely to be most impacted by insecticides. EPA identified mitigations that would reduce exposure to insecticides for listed invertebrates, as well as for listed species that depend on invertebrates. This includes terrestrial plants that depend on insect pollination, and listed vertebrates that rely on invertebrates for food. The Insecticide Strategy, when considered and applied to pesticide regulatory decisions, would reduce population-level impacts to more than 900 listed species in the lower 48 states.

## 1.2 Insecticide Strategy 3-Step Framework

The Insecticide Strategy includes a three-step framework for EPA to use when considering FIFRA actions for insecticides (such as new chemical registrations and registration review), including how to apply mitigations from the strategy. Taken together, the three-step framework in this strategy includes many refinements beyond those in EPA's standard ecological assessment. The refinements consider concepts such as variability in exposure across geography, insecticide usage, and differences in listed species impacts and habitats. Including these refinements improves EPA's confidence when identifying uses of an insecticide that are likely to cause impacts to listed species populations. These refinements minimize the need for pesticide restrictions in situations where listed species do not need them.

**Step 1** establishes the potential for population-level impacts to the listed species as not likely, low, medium, or high. The low, medium, and high categories indicate a potential concern for population-level impacts that may need mitigation. The first step relies on a refined assessment of potential impacts to invertebrates that builds off EPA's longstanding ecological assessment methodology using the typical fate and toxicity data submitted by registrants and EPA's standard models for estimating exposures. This strategy refines that approach by considering more realistic and less conservative[7] toxicity endpoints that represent impacts to populations and communities of invertebrates. The refined assessment considers direct impacts to listed invertebrates in terrestrial and aquatic areas. The assessment also considers indirect impacts on listed animals and plants from loss of their invertebrate diet or pollinators.

EPA begins by considering the proposed and registered uses and use patterns of the insecticide (*e.g.,* application rates, crops, application methods), environmental fate of the insecticide (*e.g.,* major transport routes off-field, degradation information), likely exposures for listed species to the pesticide, and the toxicity of the insecticide to listed species and their habitats. The refined assessment also considers whether EPA's standard exposure models represent a listed species' habitat and adjusts the identified mitigations to address overly conservative assumptions. Therefore, the assessment process brings in several lines of evidence to characterize the potential for population impacts to listed species. EPA acknowledges that the risk assessment process will continue to improve and will continue to evolve along with the state of the science and available data.

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[7] The screening level assessment relies on toxicity endpoints representing individuals or small groups of individuals.

In **Step 2** of the framework, EPA uses the potential of population-level impacts to invertebrates from **Step 1** to identify levels of mitigations that reduce spray drift and runoff/erosion to non-target habitats (*e.g.,* low impacts would be addressed with fewer mitigations than medium or high potential impacts). EPA developed menus that identify mitigations that the Agency has determined to be effective at reducing spray drift and runoff/erosion in different parts of the country. The menus are available on an EPA website.[8] Since the Draft Insecticide Strategy, EPA expanded and refined spray drift and runoff/erosion mitigation options based upon information and feedback received from a variety of stakeholder groups. Furthermore, EPA clarified that mitigations would not be identified under certain types of application (*e.g.*, spot treatment), habitat locations (*e.g.*, mountain tops; beaches), and applications far from the treated field (*i.e*., farther than 1000 feet from a habitat; see **Section 3.2.2.4**).

Generally, when EPA identifies the need to mitigate spray drift exposure, the Agency would determine a spray drift buffer distance to consider for the pesticide action. The strategy includes mitigations that could be incorporated to reduce or eliminate the identified spray drift buffer (*e.g.* employing drift reducing technologies (hooded sprayer, adjuvants, or windbreaks). For the strategy, EPA identified spray drift buffers to address the potential for population-level impacts as a starting point if other spray drift reducing measures are not used. The higher the potential for population-level impacts, the larger the identified starting buffer distance.

When EPA identifies the need to mitigate exposure from runoff/erosion, EPA would identify an amount of mitigation points associated with the level of population-level impacts related to runoff/erosion: up to 3 points of mitigation for low impacts, up to 6 points for medium impacts, and up to 9 points for high impacts. In developing this point system, EPA incorporated several refinements into the mitigation approach, including considering differences in runoff intensity across the United States to account for differences in runoff mitigation needed.[9]

EPA updated the mitigation menus and spray drift buffer distances based on public comment on the Draft Strategy that was released in July 2024. EPA received and considered numerous thoughtful comments on the Draft Insecticide Strategy from growers, commodity groups, industry, environmental Non-Governmental Organizations (NGO), state, local, and federal government agencies, pesticide applicator/user communities, and other groups. Comments included data, analyses, and perspectives from individuals or groups. As a result, five additional spray drift mitigation measures were added to provide additional flexibility for growers and other applicators, particularly for aerial and airblast applications (**Section 3.2.1**). Spray drift buffer distances to address high potential for population-level impacts were also reevaluated based on public comments that included additional scientific literature, analyses, and consideration of additional lines of evidence. EPA also separated spray drift exposures from runoff exposure estimates to better match the type of mitigation (*e.g.*, runoff reduction) to the exposure route used to estimate potential for population-level impacts (**Step 1**). Also, an additional runoff/erosion mitigation measure, anionic polyacrylamide (PAM), a soil amendment that is typically

[8] https://www.epa.gov/pesticides/mitigation-menu

[9] This approach incorporated concepts from EPA's refined assessment methods, such as the Spatial Aquatic Model, to identify areas where lower levels of exposure compared to its conservative screening models would result in less need for mitigation.

used for erosion control was added for additional flexibility for growers (**Section 3.2.2**). EPA also increased the mitigation relief points for fields with very sandy soils, which adds flexibility for farmers who grow crops on very sandy soils (**Section 3.2.2**) with low potential for lateral movement of runoff water. EPA found that some conservation programs are likely to achieve 9 mitigation points, and EPA will be developing processes to identify, evaluate, and communicate qualified programs to the public. Concurrent with the release of the Final Insecticide Strategy, EPA has determined that the USDA-Natural Resources Conservation Service's (NRCS) Environmental Quality Incentives Program (EQIP), when incorporating NRCS Conservation Program Standard (CPS) 595 Pest Management Conservation System for planning runoff/erosion mitigation for agriculture, is designated as an "EPA-Qualified Conservation Program".[10] EPA will continue to work on a process to identify, evaluate, and communicate other qualifying programs. EPA will seek comment on any necessary information collections. Additional changes to the Final Insecticide Strategy from the draft version based on public comments are included in **Section 2**.

For this strategy, EPA has determined that the identified level of mitigation to address potential population-level impacts should be lower (fewer points identified for runoff and erosion and reduced buffer distances for spray drift) for growers who: (1) have already implemented certain measures to reduce pesticide runoff (*e.g.,* installed tailwater return systems), (2) who are in areas less prone to pesticide runoff such as flat lands and regions with less rain to carry pesticides off fields, or (3) who use measures to reduce pesticide drift (*e.g.,* use larger droplet sizes or have drift barriers downwind of the application). For example, EPA assigned two (2) mitigation relief points to counties with medium runoff potential, three (3) mitigation relief points to counties with low runoff potential, and six (6) mitigation relief points to counties with very low runoff potential. Thus, if EPA, in a FIFRA action that implemented the Insecticide Strategy, identified six (6) mitigation points to address population-level impacts for a specific use of an insecticide in a geographic area with very low runoff potential, then the mitigation points would have been achieved based solely on their geographic location without the need for additional mitigation measures because the Insecticide Strategy determined that areas with very low runoff potential have 6 mitigation relief points. **Figure 9** depicts the runoff potential of each county in the conterminous United States.

In **Step 3** of the framework, EPA identified where in the conterminous United States the mitigations identified in **Step 2** would apply. In some cases, EPA expects the mitigations would apply across the full spatial extent of a use pattern (*e.g.,* specific crops) within the conterminous United States. In those cases, EPA would specify the mitigations on the general pesticide product label. In other cases, mitigations may only apply in geographically specific areas (referred to as Pesticide Use Limitation Areas or PULAs). For geographically specific mitigations, the pesticide labeling would include a direction for the user to access EPA's Bulletins Live! Two (BLT) website to determine whether they are in an area that requires mitigation.

[10] "EPA-Qualified Conservation Program" - EPA evaluated these programs using the qualifying characteristics described in **Section 3.2.2.6.2**. These characteristics are intended to show how a qualified program, when mitigations are in place before or at the time of application, can achieve at least nine points of mitigation, thereby addressing any potential for potential population-level impacts to listed species from runoff/erosion.

### 1.3 Reducing Impacts and Complexity for Pesticide Applicators and Growers

Between the Draft and Final Insecticide Strategy, EPA continued engagement with stakeholders (such as grower groups, federal and state partners) through meetings and webinars to discuss mitigation measures, and implementation (see **Section 4.3** for more details). Based on this engagement and public comments, EPA incorporated changes to the Final Insecticide Strategy and the Ecological Mitigation Support Document (v2.0), including adding new or revising existing mitigation measures to address spray drift and runoff/erosion and clarification of certain mitigation measures (*e.g.* subsurface chemigation) that commenters noted were confusing. These updates are intended to reduce impacts on growers and other applicators while still addressing the potential impacts of pesticide applications to populations of listed species within the scope of the Insecticide Strategy. **Section 2.3** contains a list of substantive changes incorporated in the strategy between the draft and final versions.

This strategy suggests that, when appropriate, EPA may identify label language as part of a proposed FIFRA action. The Agency may propose label language that requires mitigation measures irrespective of where the pesticide is applied. EPA may also propose label language that requires a specific level of mitigation and directs the user to EPA's Mitigation Menu website. EPA may propose one or more of these for FIFRA actions.

Using a website allows EPA to update the menu over time with additional mitigation options, which allows applicators to use the most up-to-date and comprehensive set of mitigation options without requiring pesticide product labels to be amended each time new measures become available. Further, EPA may determine that some mitigation options (or levels of mitigation) would be appropriate for some listed species beyond what is specified on the general pesticide product label. To minimize the areas that may be impacted, those additional mitigations would be identified on Bulletins accessed through EPA's Bulletins Live! Two (BLT) website. Thus, mitigation measures may appear in up to three places: on a product label, on a mitigation menu website, and in Bulletins.

EPA understands that some pesticide users may find the spray drift and runoff/erosion mitigation described in this strategy to be an added complexity. EPA attempted to maximize flexibility for pesticide users as well as identify a comprehensive set of mitigation options. By increasing flexibility for growers and other applicators, the strategy and its supporting documents include more complex information. To help applicators consider their options, EPA has developed tools and education materials[11] (and will continue to do so) that applicators could use to help them determine what mitigations are already in place and what further actions they may take.[12]

To help pesticide users properly employ any necessary runoff/erosion measures identified in this strategy, EPA has identified mitigation relief points for those who seek assistance from technical experts or are participating in a soil and water conservation program that can help implement those measures.

[11] This includes EPA's Mitigation Menu website (https://www.epa.gov/pesticides/mitigation-menu) which also houses a runoff points calculator to assist growers in determining the number of points earned for practices they already have in place on the field.

[12] EPA may also apply other strategies, including the Vulnerable Species Action Plan to an insecticide FIFRA action as appropriate.

The strategy includes one (1) mitigation relief point for those who use an expert that meets the three characteristics specified in this strategy (see **Section 3.2.2.6.1**). Additionally, when EPA evaluated conservation programs that were submitted during the comment period on the Draft Strategy (see **Section 3.2.2.6.2**) the Agency determined that many programs would put farms at or near the maximum of nine (9) mitigation points with the strategy's goal of reducing potential impacts to populations of listed species. EPA has amended the identified characteristics of programs to include additional characteristics that would allow EPA to determine that the program qualifies for nine (9) relief points. Growers who participate in a qualified program would effectively be able to meet the maximum of nine (9) mitigation points for EPA's runoff/erosion mitigation needs for all pesticides used. Concurrent with the release of the Final Insecticide Strategy, EPA has determined that the USDA-Natural Resources Conservation Service's (NRCS) Environmental Quality Incentives Program (EQIP), when incorporating NRCS Conservation Program Standard (CPS) 595 Pest Management Conservation System for planning runoff/erosion mitigation for agriculture, is designated as an "EPA-Qualified Conservation Program". EPA will continue to work on a process to identify, evaluate, and communicate other qualifying programs.

EPA provides two (2) mitigation relief points for participation in programs that are not able to achieve nine (9) points as a program, as well as for growers who no longer participate in the programs but maintain the mitigations that were advised by the program. Additionally, the strategy includes one (1) mitigation relief point for those who keep a written record of the measures they implement under this strategy. Growers and applicators will still need to adhere to any spray drift requirements on pesticide labels and visit Bulletins Live Two! within 6 months of application.

In December 2024, EPA released a process[13] that it uses to create refined maps that identify those portions within a species range that need to be conserved for a listed species and/or designated critical habitat and are specific areas that may require pesticide mitigations when necessary (and exclude areas that do not). These maps will be used to develop pesticide use limitation areas (PULA) in the BLT system. EPA uses this process to develop maps; however, pesticide registrants, NGOs, trade associations, or any other member of the public can also use this process to develop refined maps. Importantly, EPA intends to implement the Insecticide Strategy only for species that that have refined maps.

There are a small number of listed terrestrial invertebrates in PULAs that EPA, in consultation with FWS, determined may be on the field to the extent that population-level impacts may occur, even after off-field exposures are mitigated. Therefore, in the spatially limited areas where these species are present and for a limited subset of agricultural use sites (as discussed in **Section 3.2.3**), EPA identified that under certain conditions and for specific crops, on-field mitigations such as timing or restrictions on applications during bloom may be identified. EPA recognizes that in some circumstances (*e.g.* systemic and persistent insecticides or when pest pressures are high during blooming periods), on-field mitigations may be very difficult to implement. EPA is committed to working with pesticide registrants and growers to develop offsets that may be used instead of on-field mitigations.

[13] https://www.epa.gov/endangered-species/process-epa-uses-develop-core-maps-pesticide-use-limitation-areas

### 1.4 Summary of Runoff and Spray Drift Mitigation Identification Process

Below is an example of how to identify any necessary runoff mitigations for the pesticide application and determine the total number of runoff mitigation points related to the application of the insecticide product. In addition to the example below, **Section 3.2.2.7** includes a Runoff/Erosion Mitigation Decision Tree as an illustrative example of how a pesticide applicator could work through this process.

- Read the pesticide product label, look for use directions pertaining to runoff mitigation that includes runoff mitigation points.

- If the label includes runoff mitigation points, evaluate whether the managed landscape at the application site is more than 1000-ft downslope of application area and would not be subject to runoff mitigations under this strategy. Additionally, evaluate whether the application site is subject to runoff mitigations (*e.g*., some pesticides, use sites, and/or application methods may not require runoff mitigations, some runoff control measures are sufficient by themselves to address any runoff requirements).[14]

- If runoff mitigation points are required for a particular use, the number of runoff mitigation points needed (*i.e.,* 3, 6, or 9 points for a runoff-prone chemical needing mitigation) will be indicated on the pesticide label.

- Subtract the number of mitigation relief points, if any, for farming in geographic areas determined to have limited runoff potential, or other reasons specified in this strategy.

- Subtract the number of mitigation relief points, if any, for working with an expert, participating in a conservation program, and/or tracking mitigation measures.

- Subtract the number of mitigation points, if any, for mitigation measures from EPA's menu that the user has already implemented.

The result is the total number of points that EPA recommends a user achieve to apply the insecticide product. After these subtractions, if runoff/erosion mitigation points are still greater than or equal to 1, the user would need to find enough measures from the mitigation menu to meet or exceed those remaining mitigation points. If the resulting number of points to be achieved is zero or less, a user would not need to employ any additional runoff/erosion mitigation measures to apply the pesticide. However, spray drift mitigation may still be needed. For example, if a grower applies a pesticide that specifies 6 points of runoff/erosion mitigation in a county with very low runoff potential (6 points of mitigation relief), that grower would not need to employ any additional runoff/erosion mitigation measures. EPA has identified 462 counties across 12 states with very low runoff potential that would receive 6 points of mitigation relief, 780 counties across 37 states with low runoff potential that would receive 3 points of

[14] Areas and/or application methods not required to satisfy labeled runoff mitigation points are further described in **Section 3.2.2**.

mitigation relief, and 1536 counties across 44 states with medium runoff potential that would receive 2 points of runoff mitigation relief.[15]

Below is an example of how a user could determine if an ecological spray drift buffer is required for an application and, if so, what reductions to the spray drift buffer could be implemented prior to applying the insecticide product. The exact outcome of some of these steps will vary depending on the wind direction at the time of application (*e.g.* managed areas, windbreaks). In addition to the example below, **Section 3.2.1.6** includes a Spray Drift Mitigation Decision Tree as an illustrative example of how a pesticide applicator could work through this process.

- First, read the insecticide product label(s), look for use directions pertaining to spray drift mitigation.

- Identify whether the type of use or characteristics of the field and downwind areas exclude the need for additional spray drift mitigation.

- If spray drift mitigation is needed, identify the insecticide and use that requires the maximum spray drift buffer. Existing spray drift mitigation measures defined on the label should be considered in this step.

- Next, subtract the total distance of "managed areas" downwind of the application site from this maximum buffer. If the spray drift buffer is greater than ten feet, additional spray drift mitigations are needed.[16]

- Finally, identify the additional spray drift mitigation measures that are needed to reduce the buffer to less than ten feet.

[15] The county-based list of mitigation relief points is available on the mitigation menu website, https://www.epa.gov/pesticides/mitigation-menu.
[16] EPA encourages growers and other applicators to keep track in writing of their reductions.

# 2 Introduction

## 2.1 Background

EPA regulates the sale, distribution, manufacture, and use of pesticides under FIFRA and the Federal Food, Drug, and Cosmetic Act. EPA considers applications for pesticide products containing new active ingredients and new uses of currently registered pesticides and decides whether to register these products. If the application meets the standard for registration under FIFRA Section 3, EPA approves the application with any necessary restrictions on its sale, distribution, or use. FIFRA Section 3(g) requires that EPA periodically reevaluates existing registered pesticides as part of registration review. In addition to EPA's obligations under FIFRA to regulate pesticides, EPA also has obligations under the ESA. Under ESA Section 7(a)(1), all federal agencies shall "utilize their authorities in furtherance of the purposes of this Act by carrying out programs for the conservation of endangered species and threatened species." Under Section 7(a)(2), federal agencies shall insure that their actions are "not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species." Where appropriate for a FIFRA action, EPA may be required to consult with the U.S. Fish and Wildlife Service (USFWS or FWS) and National Marine Fisheries Service (NMFS) (the Services) to ensure that the relevant actions are not likely to jeopardize the continued existence of listed species or adversely modify their designated critical habitats.

In past decades, the Agency has had trouble meeting its Section 7(a)(2) obligations for the thousands of pesticide actions it completes annually under FIFRA. The entire process, including consulting with the Services and implementing any additional measures in any resulting biological opinions determined to be necessary, can take years for a single pesticide. EPA expects that there could be thousands of FIFRA actions that could require an ESA review over the next decade. EPA has been unable to keep pace with its ESA workload, resulting in the need for more efficient approaches for integrating listed species evaluations and protections into pesticide registration activities even before effects determinations are made or necessary consultations with the Services are completed.

In its April 2022 workplan (USEPA, 2022a), "Balancing Wildlife Protection and Responsible Pesticide Use: How EPA's Pesticide Program Will Meet its Endangered Species Act Obligations" (the "workplan"), EPA described several challenges to implementing timely and effective strategies for specifically protecting listed species from possible pesticide impacts. The workplan also described how EPA is working to 1) improve assessment of potential impacts to listed species in its pesticide evaluations, 2) increase efficiency of the consultation processes, and 3) implement through registration and registration review actions, protections for listed species prior to completion of effects determinations or consultations, if necessary. In November 2022, EPA released an update to the workplan (USEPA, 2022b) which described EPA's efforts to reduce pesticide exposure to non-target organisms, including listed species, during the FIFRA registration and registration review processes.

As described in the workplan update, EPA is developing a series of strategies that group mitigations by pesticide type, use site, location, or other consideration. These strategies are intended to inform EPA's registration and registration review decisions to address landscape level exposures and population-level impacts to listed species. The Insecticide Strategy is intended to provide early protections for hundreds of FWS listed species. The protections would substantially improve the efficiency of mitigating and consulting on pesticides, and result in conservation actions being implemented sooner and at a landscape scale. As part of the development of this strategy, EPA worked in cooperation with FWS and continues to do so. This coordination lays a foundation for further efficiencies in the FIFRA-ESA consultation process. The Insecticide Strategy focuses on listed species under the jurisdiction of FWS as they have authority over approximately 95% of the listed species in the conterminous United States. Listed species under the authority of NMFS are not in the scope of the Insecticide Strategy because these are being addressed through a separate process between EPA and NMFS.

The Insecticide Strategy supports EPA's commitment to achieve early protections for more than 900 listed species potentially impacted by conventional insecticides in a manner that is flexible and practical to farmers and is consistent with the cost and benefit balancing required by FIFRA. The Insecticide Strategy incorporates improvements based on public comments received on the Draft Herbicide Strategy and Draft Insecticide Strategy. The Final Insecticide Strategy includes increased flexibility while still protecting federally listed species. Consistent with the Herbicide Strategy, the Insecticide Strategy focuses mitigations on reducing spray drift and runoff/erosion transport to non-target areas. Both strategies focus on agricultural uses in the conterminous United States and on mitigating impacts to species that are similar to the target pests of the pesticides (*i.e.,* for insecticides, mitigations focus on non-target invertebrates; for herbicides, mitigations focus on non-target plants).

Both strategies approach mitigating direct impacts to listed species that are taxonomically similar to the target pests differently from mitigating impacts to listed species that only have a general reliance on plants or invertebrates in the Herbicide and Insecticide Strategies, respectively (**Table 1**). This is consistent with recent EPA biological evaluations and resulting consultations with FWS (*e.g.,* Enlist, methomyl), where less mitigation was determined to be necessary for listed species that depend broadly on directly impacted species (described in this document as 'generalists') compared to the amount of mitigation identified to protect listed species that are taxonomically similar to the target pests or that are "obligate" listed species that rely on one (or a small number) of specific species. The literature may refer to obligate species using different terms, such as 'specialist.' This document refers to these types of species as obligates. Further, the Insecticide Strategy considers habitats or exposure routes relevant to listed invertebrate species on which listed plants do not rely. For example, this Insecticide Strategy considers exposures to listed terrestrial insects, like butterflies, that may eat contaminated food sources or come into direct contact with spray drift, while the Herbicide Strategy focuses on direct contact and root uptake exposures from spray drift and runoff/erosion for terrestrial plants. Both strategies consider aquatic environments. Additionally, in the Herbicide Strategy, EPA determined that listed plants or other non-target plants do not need on-field mitigations because the vast majority of species are not likely to occur on highly managed agricultural areas. In contrast, for the Insecticide Strategy, EPA also considers a small number of listed terrestrial invertebrate species (*e.g.,* adult butterflies) that are likely to occur on treated agriculture fields to the extent that there is concern for population-level impacts from insecticide exposures, such that on-field mitigations may be necessary.

**Table 1. Key Comparisons Between the Insecticide and Herbicide Strategies**

| | Direct Effects | Indirect Effects | On-field Effects |
|---|---|---|---|
| **Insecticide Strategy** | Considers for listed terrestrial and aquatic invertebrate species | Considers for listed animal and listed plant species that rely on invertebrates | Considers for listed terrestrial invertebrate species |
| **Herbicide Strategy** | Considers for listed terrestrial, wetland and aquatic plant species | Considers for listed animal species that depend on plant species | Did not consider for listed plant species |

### 2.2 Scope and Goals of the Insecticide Strategy

This Insecticide Strategy covers conventional insecticides, insect growth regulators, and miticides (referred to as "insecticides" throughout this document) and is focused on agricultural uses[17] of insecticides in the conterminous United States (CONUS). For purposes of the strategy, agricultural uses are described as any land planted with orchards, vineyards, Christmas trees, row crops, specialty crops, sod farms, or flooded crops. Pasture/grass or range land are not considered agricultural uses. The Strategy focuses on mitigating population-level impacts on listed species that may be caused by impacts to invertebrates. The two major mitigation components for listed species are: mitigating direct impacts on listed invertebrates and mitigating impacts on listed plants or vertebrate animals that depend on invertebrates for pollination or diet. Based on this, EPA included in this strategy approximately 250 listed invertebrate species[18,19] (**Figure 1A)**, most of which are mussels, snails, shrimp, and butterflies. There are approximately 700 listed species in the conterminous United States that depend on aquatic or terrestrial invertebrates for prey (also referred to as "food" or "diet") or pollination (**Figure 1B**). Among these, listed plants are most numerous due to their dependency on terrestrial invertebrates for pollination. When implementing the Insecticide Strategy as part of a FIFRA action, EPA will use the most recent status of listed and proposed species.

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[17] Agricultural uses include cultivated land (including orchards, vineyards, Christmas trees, row crops, specialty crops, and flooded crops) but not pasture/grass or range lands.

[18] This total reflects the number of unique listed species as of December 2023. **Panel A of Figure 1** includes 3 species that are represented twice due to having both aquatic and terrestrial phase insects. Updated species lists will be used as the Insecticide Strategy is implemented.

[19] Listed species considered under EPA's Vulnerable Species Action Plan were also excluded from consideration in the Insecticide Strategy.

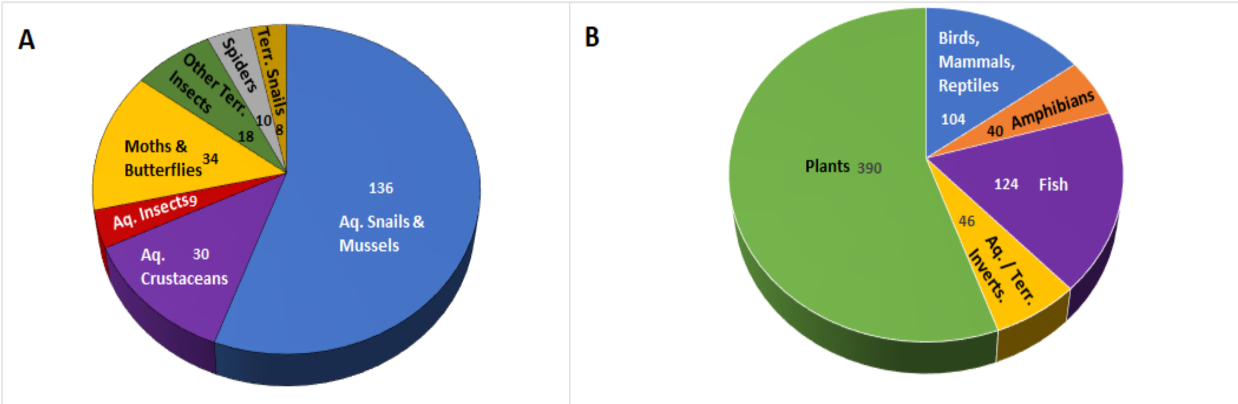


**Figure 1. Number of Listed Aquatic and Terrestrial-phase Invertebrates in CONUS (Panel A) and Listed Species that Broadly Depend on Aquatic or Terrestrial Invertebrates for Survival (Panel B) Within the Scope of the Insecticide Strategy**

The Insecticide Strategy focuses on agricultural uses (*e.g.,* row crops, orchards) given the high degree of insecticide usage in these areas and the similarity of mitigation measures that apply to these uses. In 2022, approximately 83 million acres of cropland were treated with insecticides according to the Census of Agriculture.[20] This Insecticide Strategy focuses on agricultural uses, which account for more than half of the U.S. land base.[21] While covering only agricultural uses, this strategy, when implemented through FIFRA actions, is expected to make great strides in protecting listed species, while providing flexibility to users. The primary goals of the Insecticide Strategy include:

1. Identifying early mitigations for listed species likely impacted at the population-level by the agricultural use of conventional insecticides;

2. Providing flexibility for implementing mitigations through FIFRA actions that would reduce major routes of insecticide exposure to listed species;

3. Improving the efficiency of future ESA consultations on conventional insecticides including considering and applying the strategy to future registration and registration review actions, where appropriate; and

4. Increasing regulatory certainty for growers and other stakeholders regarding the use and availability of conventional insecticides and providing growers and other applicators with flexibility in selecting mitigation that works for their operation(s).

Each of these goals is discussed more below. Goal three is also described in the Implementation section of this document (**Section 4**).

[20] www.nass.usda.gov/AgCensus

[21] https://www.ers.usda.gov/topics/farm-economy/land-use-land-value-tenure/

**Identifying Early Protections.** This strategy focuses on identifying mitigations to protect listed species that can be implemented earlier in the registration and registration review process before ESA effects determinations, or the completion of any necessary consultation with FWS for the approximately 250 listed aquatic and terrestrial invertebrates and over 700 listed species that depend on aquatic or terrestrial invertebrates for diet or pollination. The goal of the identified mitigations is to minimize exposure from the use of conventional agricultural insecticides that EPA registers or reevaluates, and thereby reduce the potential for population-level impacts to listed species, which could reduce the likelihood of future jeopardy or adverse modification and increase efficiency in future consultations with FWS. EPA expects that implementation of the Strategy in FIFRA actions would protect listed species from potential population-level insecticide impacts.

**Reducing Major Routes of Exposure**. EPA identified mitigation measures for conventional agricultural insecticides that have the potential to reduce off-field pesticide exposure via spray drift (pesticide movement as spray droplets at the time of application) and runoff and/or erosion (pesticide movement with water and/or soil) that would likely result in exposure of listed species. EPA focused on measures to reduce spray drift, runoff, and erosion transport because FIFRA risk assessments commonly identify risk concerns for invertebrates in terrestrial, wetland, and/or aquatic habitats due to offsite transport of insecticides via these exposure pathways. This strategy does not cover other potential exposure routes for a chemical or species (*e.g*., volatilization, bioaccumulation in aquatic food webs, consumption of treated seeds by birds or mammals, abraded seed dust-off). These pathways may be addressed in the FIFRA registration or registration review actions with all other non-target exposures excluded from this strategy, as appropriate for the specific pesticide and use. EPA also considered whether on-field mitigation may be appropriate to address population-level impacts to any listed terrestrial invertebrates (*e.g.,* butterflies).

**Improving Efficiency of ESA Consultations.** EPA expects implementation of this strategy would help improve the efficiency of future pesticide consultations with FWS.[22] Currently, the process for assessing and mitigating effects to listed species through ESA consultations takes many years to complete. This process typically starts with EPA conducting a species-specific effects determination that is included in a biological evaluation for the specific pesticide action. The assessment analyzes the potential effects of the FIFRA action (*e.g.,* assessment of all uses for a particular active ingredient) to one or more individuals of all listed species. If EPA finds that effects may occur to one or more individuals of a listed species or to the physical and biological features of designated critical habitat, EPA initiates consultation (informal or formal) with the responsible Service. EPA initiates informal consultation when it concludes that its action may affect but is not likely to adversely affect listed species or their designated critical habitat. At the end of informal consultation, the Service will either provide concurrence with EPA's finding that the effects are not likely to adversely affect a listed species or destroy or adversely modify designated critical habitat and the process ends, or the Service may recommend EPA initiate formal consultation.

[22] Listed species overseen by the National Marine Fisheries Service are currently being address through programmatic consultation.

EPA initiates formal consultation when it concludes that its actions are likely to adversely affect one or more listed species or its designated critical habitat. More recently, consistent with the ESA counterpart regulations,[23] EPA provides to the Service(s) predictions of the potential likelihood of future jeopardy or adverse modification for such species and their designated critical habitat in the biological evaluation or during formal consultation. During formal consultation, the Service(s) determine whether the action is likely to result in jeopardy to the listed species or destruction or adverse modification of designated critical habitat. In addition, during formal consultation, EPA, the Service(s), and the pesticide applicant/registrants discuss needed measures to mitigate likely jeopardy, destruction, or adverse modification determinations made by FWS in the draft Biological Opinion. At the end of formal consultation, the Service will generate a final Biological Opinion where it documents its evaluation, including agreed upon conservation measures, reasonable and prudent measures, and/or reasonable and prudent alternatives as applicable.

Historically, EPA and the Services have completed the consultation process for relatively few conventional insecticides due in part to the complexity of the ESA consultation process. This Insecticide Strategy includes a substantial and necessary change in process to identify and mitigate potential impacts from agricultural uses of conventional insecticides using a streamlined analysis even before EPA makes effects determinations or initiates/completes consultation. To this end, FWS provided input on the development of this strategy and EPA intends to continue to seek and incorporate feedback from them, as well as other stakeholders as it moves forward with the implementation of the strategy.

Informed by coordination with FWS, and input from other stakeholders, EPA expects to implement the Final Insecticide Strategy by considering the appropriate mitigations and applying those to FIFRA actions to mitigate population-level impacts to the listed species most impacted by insecticides, thereby providing for more efficient ESA consultations and implementation of any resulting Biological Opinions while being consistent with the requirements of FIFRA.

**Regulatory Certainty.** The Final Strategy provides greater regulatory certainty about the mitigation measures EPA would consider and may apply in future registration and registration review decisions. EPA further expects these efforts could reduce the likelihood of legal challenge for failure to make effects determinations where the Agency considers and applies the Strategy to FIFRA actions, which in turn could lead to less requests to vacate registrations.

### 2.3 Public and State Input

EPA released the Draft Insecticide Strategy for public comment on July 25, 2024. EPA received more than 26,000 comments from a variety of groups including states, other federal agencies, the pesticide industry (*e.g.,* pesticide companies, applicators), grower groups, environmental groups, academics, and individuals. EPA received approximately 230 unique comments, with the remainder being mail-in campaigns that either supported or opposed the Draft Strategy. In general, commenters agreed with the importance of protecting listed species from insecticides. Commenters identified concerns with specific aspects of the Draft Strategy and suggested revisions. Commenters also identified concerns with

[23] 50 CFR Part 402, subpart D

implementation of the strategy, which is discussed in **Section 4**, including some of the education and outreach that EPA has conducted over the last three years (**Section 4.3**).

EPA considered all comments and information provided. EPA made revisions to the strategy for clarity, to add additional runoff/erosion mitigation measures, and to address spray drift concerns. The "*Response to Public Comments Received on the Draft Insecticide Strategy*" document contains more detail on public comments received and EPA's responses; however, several changes to the Draft Strategy based on public input are summarized below.

- EPA separated spray drift exposures from runoff exposure estimates when deriving the Magnitude of Difference (MoD) so that the level of mitigation is consistent with the exposure calculation used to identify the need for mitigation (**Step 1**). For example, drift exposures would identify a potential need for drift mitigation, and runoff exposure would identify a potential need for runoff mitigations.

- EPA reevaluated and reduced spray drift distances associated with high potential for population-level impacts that could occur from spray drift exposures. EPA's re-evaluation was based on additional scientific literature and analyses submitted in the public comments as well as additional lines of evidence to represent potential for population-level impacts for species and use combinations associated with high potential of population-level impacts (**Step 2; Section 3.2.1**).

- EPA added spray drift reduction measures as options for growers and other pesticide applicators that increased flexibility, particularly for airblast applications (**Step 2; Section 3.2.1** and updated Ecological Mitigation Support Document).

- EPA added anionic polyacrylamide (PAM) as a new runoff/erosion mitigation option (**Step 2;** see updated Ecological Mitigation Support Document).

- EPA increased mitigation relief points for applications in higher sand soils (**Step 2; Section 3.2.2** and updated Ecological Mitigation Support Document).

- EPA clarified some mitigation options identified to address runoff (*i.e.,* subsurface chemigation, soil categories) described in **Step 2** of the Final Insecticide Strategy)**.**

- EPA updated its approach for growers participating in qualified runoff/erosion programs. (**Step 2; Section 3.2.2.6.2** and updated Ecological Mitigation Support Document).
    - EPA reconsidered its approach to conservation programs and determined there is a path forward for EPA to qualify individual conservation programs that meet 9 points.
    - EPA evaluated additional characteristics that give EPA confidence in the ability of some programs to qualify, as further described in the strategy. Additionally, EPA is developing a process whereby external parties that have technical experts and

provide a similar service as a conservation program could also qualify farms for a different number of points.
  - Based on EPA's review of USDA-Natural Resources Conservation Service's (NRCS) Environmental Quality Incentives Program (EQIP), when incorporating NRCS Conservation Program Standard (CPS) 595 Pest Management Conservation System for planning runoff/erosion mitigation for agriculture, EPA has designated this program as an "EPA-Qualified Conservation Program"
  - EPA will continue to develop a process to identify, evaluate, and communicate qualified programs and external parties to the public, including seeking comment on any needed.

- EPA narrowed the list of specific invertebrate species that could occur on agricultural fields with potential population-level impacts and EPA describes the types of potential on-field mitigations (*e.g.,* application timing restrictions relative to bloom for specific crops) that may be identified for these species (**Step 2; Section 3.2.3**).

- EPA updated the overlap analysis to evaluate the potential for population-level impacts to newly listed/proposed and delisted species and considered updated species ranges and critical habitat information (**Step 3, Appendix C**). Species lists will continue to be used as the Insecticide Strategy is implemented in FIFRA actions.

- EPA added a Pesticide Use Limitation Area (PULA) for generalist species (*i.e.* species that rely on invertebrates, as opposed to species that rely on a specific species of insect, for food or pollination) that reside in wetland habitats. Addition of this PULA allows EPA to more appropriately tailor mitigations and levels of mitigation to where they are needed. Wetland species tend to have higher exposure potential compared to other habitats. Therefore, developing a PULA specifically for generalists in wetland habitats allows EPA to reduce the level of mitigation needed outside of these wetland habitats, which reduces the potential impacts and mitigation burden for many growers and other applicators (**Step 3**).

### 2.4 Case Studies from Draft Insecticide Strategy

The Draft Insecticide Strategy was informed by case studies of insecticides representing diverse modes of action, agricultural uses, and impacts to the environment. EPA conducted the case studies for illustrative purposes. Although an individual case study could inform a future assessment, EPA does not intend to use them to support a future FIFRA action for a particular insecticide. Rather, the case studies allowed EPA to develop, evaluate, and revise the Draft Strategy and provided stakeholders with useful examples of the proposed approach. For example, the case studies helped EPA to identify differences in the sensitivity of different taxa (*e.g.,* for some insecticides, mussels were less sensitive to the same chemical compared to shrimp or aquatic insects; for one insecticide, butterflies were more sensitive than bees and beetles).

The case studies also illustrated how these differences in sensitivity relate to the identified level of mitigation based on the sensitivity of a species to the pesticide. This allowed EPA to identify mitigations to address population-level impacts to listed species while minimizing impacts of mitigation on growers and other applicators in areas with less sensitive species. Not all insecticides have the same amount of data for assessing risk, so it was not possible to differentiate sensitivities and mitigation levels for all potential scenarios prior to conducting an assessment for a particular action. However, a refined evaluation of insecticides and species sensitivity in relation to listed species can be conducted where these data are available.

The case studies developed to support the Draft Strategy are available in the docket. Importantly, EPA did not revise the case studies for the Final Strategy because the basic framework did not change; however, the mitigation measures available to growers and applicators have changed. Therefore, the case studies are informative, but they do not represent all aspects of the Final Strategy.

### 2.5 Organization of This Document and Supporting Documents

This Insecticide Strategy document is composed of two major parts: the framework for identifying mitigations and the plan for implementing the strategy through FIFRA actions. **Section 3** explains the three-step framework that EPA developed to identify potential population-level impacts, identify mitigation measures to address these impacts, and determine the geographic extent of the mitigation measures. **Section 4** describes EPA's plan for implementing the strategy and provide further education and outreach on this and other strategies.

This document includes several supporting appendices with more information on the 3-step framework. This strategy is informed by Version 2.0 of the "*Ecological Mitigation Support Document to Support Endangered Species Strategies"* (referred to throughout this document as the "Ecological Mitigation Support Document"). The Ecological Mitigation Support Document contains supporting information on the mitigation measures EPA identified to date and for which EPA has data on their efficacy in reducing exposure. The development of the support document includes consideration of stakeholder feedback and information collected during the development of the Draft Herbicide Strategy. EPA took comment on the earlier version of this document during the proposal of the Draft Herbicide and Insecticide Strategies. Version 1.0 of the Ecological Mitigation Support Document was released with the Final Herbicide Strategy in August 2024. EPA is releasing version 2.0 of the Ecological Mitigation Support Document concurrently with this Final Insecticide Strategy. This updated version reflects changes made to ensure consistency with this Final Insecticide Strategy. EPA expects these strategies to continue to evolve as the Agency obtains additional information on potential mitigations to add to the strategies and expects to provide updated versions of the Ecological Mitigation Support Document as necessary in the future. At this point in time, version 2.0 is the most current support document for the strategies and should be used by all stakeholders.

# 3 Insecticide Strategy Framework for Identifying Mitigation Measures

The decision framework in the Insecticide Strategy provides EPA with a tool to use when considering conventional agricultural insecticide FIFRA actions. The framework can be used to identify the potential for population-level impacts, the type and level of mitigation to address these impacts, and the geographic extent of the identified mitigation. EPA developed this framework to identify mitigation measures backed by scientific information that shows employing these measures would decrease pesticide exposure, and thereby reduce the potential for population-level impacts to listed species from the use of conventional agricultural insecticides.

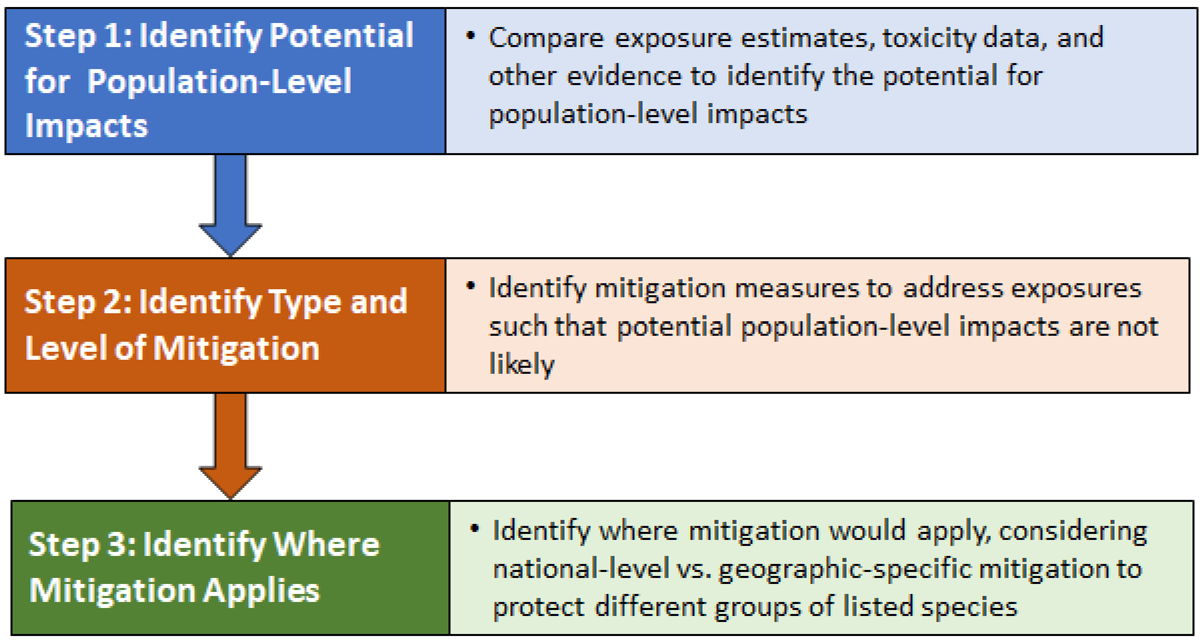


**Figure 2. Overview of the Insecticide Strategy Framework**

**Step 1** establishes the process for assessing the potential for population-level impacts to listed species. This step is based on long standing FIFRA risk assessment approaches EPA uses to identify potential ecological risk to non-target species, with additional considerations to refine the typical FIFRA risk assessment. In **Step 1**, EPA considers the use pattern and environmental fate characteristics of an insecticide to estimate exposures in aquatic and terrestrial environments. EPA then compares these exposure estimates to toxicity data that are most relevant to the insecticide and relevant listed species. This comparison of exposure to toxicity is considered by EPA for determining the potential for population-level impacts to occur to listed species from an insecticide's registered or proposed use(s). EPA supplements this analysis with other information including available incident and monitoring data in addition to how well exposure and toxicity estimates reflect important characteristics of the listed species. This process results in the designation of not likely, low,[24] medium, or high potential for population-level impacts to the grouped listed species, which would then be used to determine a level

[24] A low potential for population-level impacts is a concern because there is a potential for impacts. Only a low level of mitigation is identified for this concern.

of mitigation (**Step 2**). In both steps, EPA incorporates important sources of variability that are considered in refined assessments, including exposures across different locations and distributions in species sensitivities to pesticides. EPA also considers precision and accuracy of available exposure, toxicity, and mitigation data to establish potential population-level impact levels. These refinements to the assessments provide EPA with the ability to consider determinative aspects with a consistent and efficient approach.

**In Step 2**, EPA would identify the level of mitigation to reduce exposure via drift or runoff/erosion that addresses the potential for any population-level impacts. EPA would identify a greater level of mitigation where the potential for population-level impacts is higher, and less mitigation where there is a lower potential for population-level impacts. For reducing exposure from spray drift transport, EPA typically identifies a spray buffer. The distance associated with that buffer increases with the level of mitigation (low, medium, and high). If a buffer is identified, EPA could identify other mitigation measures that a pesticide applicator could use to reduce or eliminate the buffer distance as long as the pesticide labeling allows for this reduction.

For reducing exposure from insecticide runoff and erosion, EPA would identify a level of mitigation (none, low, medium, and high) as points, up to 9 points of mitigation. The point system provides regulatory certainty for the level of mitigation to be achieved, while the use of the mitigation menu website provides greater flexibility to achieve the level of mitigation stated on the pesticide labeling, as long as the labeling is clear that the menu can be used. The identified mitigation measures have different levels of efficacy to address pesticides with different levels of potential impacts to different species, and therefore different point values associated with them. With few exceptions, the mitigations available on EPA's Mitigation Menu website or those that could be on the pesticide labeling for insecticide applications are expected to be the same as those that would be available for herbicide applications because the application methods and approaches for reducing off-site transport are similar for both types of pesticides. The goal for spray drift and runoff/erosion mitigations is the same: to identify a level of mitigation to address potential population-level impacts. The difference between the spray drift mitigation approach (spray drift buffer and reductions in distance of the buffer) compared to the runoff/erosion mitigation approach (mitigation points) is due to differences in the types of mitigations available, effectiveness of practices, and the nature of exposure.

**In Step 3**, EPA identifies where in the conterminous United States mitigations for listed species identified in **Step 2** would apply. In some cases, EPA expects the mitigations would apply across the full spatial extent of a use pattern (*e.g.,* specific crops) within the conterminous United States, specifying the mitigations on the general pesticide product label. In other cases, EPA may identify geographically specific areas for mitigation (referred to as Pesticide Use Limitation Areas or PULAs) through the use of Bulletins using its web-based system, Bulletins Live! Two (BLT). If Bulletins apply, a statement on the pesticide labeling would direct the user to access BLT and comply with the associated bulletins.

After considering the information from **Step 1** (integrating exposure and toxicity information to determine the potential for population-level impacts) and **Step 2** (identifying the type and level of mitigation to reduce the potential for population-level impacts), in **Step 3**, EPA uses three major sets of information that are impactful for identifying what species to include in a PULA, including: (1) amount of range/critical habitat overlap with cultivated lands, (2) amount of range overlap with insecticide usage data, and (3) species habitat modifiers. Those species that have low (<5%) overlap between their ranges/critical habitats and cultivated land areas (after taking into account the potential for insecticide usage) were not identified in a PULA in the Insecticide Strategy. Also, those species that inhabit areas with limited insecticide exposures (*e.g.*, forests, caves) do not need PULAs.

Taken together, the 3-step framework includes many refinements to EPA's standard process for assessing potential impacts at the taxa level and to identify mitigations to protect listed species from potential population-level impacts. The framework considers higher tier concepts such as variability in exposure across geography and differences in listed species impacts and habitats beyond the typical FIFRA ecological assessment for non-target organisms. This framework is intended as a process for EPA to confidently identify when the uses of an insecticide have the potential for population-level impacts to listed species and to identify effective and reasonable mitigations that are flexible and practical for growers of different crops in different parts of the country. Additional information on each step is provided below.

EPA incorporated elements of FWS's approach to developing Biological Opinions for pesticides and identifying mitigations (*e.g.,* USFWS 2022a, USFWS 2024) into the 3-step framework. For example, FWS assesses potential population-level effects by considering multiple factors such as pesticide exposures and impacts from direct toxicity and loss of prey or pollinators, overlap with potential use sites, and usage of pesticides. In its Biological Opinions, FWS typically includes conservation measures that are implemented by applicants and registrants requesting pesticide label amendments that include directing the user to access EPA's BLT system and comply with associated Bulletins as well as general label mitigations also effectuated through requesting label amendments. EPA incorporated elements from FWS's approaches so this strategy is consistent with the Service's approach where there is a potential for population-level impacts and in the identification of early mitigations that could be applied to address those impacts, thereby resulting in more efficient ESA consultations, regulatory certainty of how much and where mitigations may be needed, and providing flexibility to achieve the necessary level of mitigation.

### 3.1 Step 1. Identify Potential for Population-level Impacts

The first step in the Insecticide Strategy framework is to identify potential population-level impacts to listed invertebrates (*i.e.,* direct impacts) and to listed species that depend on invertebrates (*i.e.,* indirect impacts) from agricultural use of a conventional insecticide. The population-level refined analysis in this strategy builds on EPA's standard FIFRA ecological risk assessment process for pesticides. Similar to the FIFRA ecological risk assessment the analysis for this strategy includes calculations of ratios of exposure to toxicity estimates for species grouped by toxicity and different exposures by habitat for population-level impacts.

A key component of this step is calculating the Magnitude of Difference (MoD) for each of the assessed insecticide uses. The MoD is the ratio of the insecticide exposure, known as the estimated environmental concentration (EEC), to its corresponding toxicity threshold value. MoDs are calculated for different types of exposures (spray drift, runoff/erosion), different environmental media (*e.g.,* as water or sediment concentrations for aquatic species, concentrations in the diet of terrestrial species), different types of habitats (*e.g.,* small vernal pools, wetlands, ponds, terrestrial areas), and different groupings of species (referred to as "taxa", grouped based on taxonomic categories such as order or phylum) when they differ substantially in their sensitivity to an insecticide. MoDs are also typically calculated for each labeled use (or groups of uses) of a pesticide, which may consider different application methods.

MoDs for assessing direct impacts to listed invertebrates are based on toxicity thresholds for population-level impacts to a single species. Examples of listed invertebrate species relevant to the strategy include mussels; snails and shrimp in pools, ponds, streams and rivers; and butterflies and beetles in grasslands near agricultural areas (**Figure 3**). MoDs for assessing indirect impacts to listed species which obligately depend on one or a few species of invertebrates for survival (*i.e.,* "obligates") are also based on the same population-level toxicity thresholds as those for assessing direct impacts, since the survival of obligates depends on one or a few populations of invertebrates. An example of an obligate species is the Everglade snail kite, a bird that eats only one type of aquatic invertebrate: the apple snail (**Figure 3**).

**Key Definitions for Step 1 of the Insecticide Strategy Framework**

**Magnitude of Difference (MoD):** The MoD is the ratio of pesticide exposure to toxicity. Higher MoDs indicate greater potential for species/population-level impacts. For listed invertebrates with direct impacts from insecticides (and listed obligate species), the denominator reflects the relevant population-level toxicity threshold. The MoD informs the potential for population-level impacts. For species that are generalists, the denominator reflects the relevant community-level impact threshold (*i.e.,* multiple species populations) since generalists depend on a community of species.

**Direct Impacts:** Adverse impacts to listed aquatic or terrestrial invertebrates that may occur from direct exposure to insecticides. Examples include contact with insecticide spray droplets on their bodies, eating contaminated food and respiring contaminated water for aquatic species.

**Indirect Impacts to Obligates:** In this analysis, obligate listed species are those that depend exclusively on an aquatic or terrestrial invertebrate species or genus to survive. For example, the Furbish lousewort (*Pedicularis furbishiae*) depends exclusively on the half black bumble bee (*Bombus vagans*) for pollination and is considered an obligate listed species to the half black bumble bee.

**Indirect Impacts/Generalists:** In this analysis, generalist listed species are those that depend broadly on aquatic or terrestrial invertebrates for their survival. For example, the Indiana bat (*Myotis sodalis*) relies on many different types of flying insects in its diet and is considered to have a generalist relationship with terrestrial insects.

**Figure 3. Examples of Listed Species of Invertebrates or Obligates for which EPA Identified Potential Population-level Concerns from Insecticides. Upper left: Karner Blue Butterfly.[25] Upper right: Purple Bankclimber (Mussel).[26] Lower: Everglade Snail Kite[27] (Obligate to Apple Snail, Which Is in the Talon of Pictured Bird). Images from FWS.**

Listed species of animals or plants that generally depend on many different invertebrate species for prey/diet or pollination are referred to as "generalists" (**Figure 4**). MoDs for assessing indirect impacts of insecticides on generalists are based on toxicity thresholds for community-level impacts for invertebrates. Typically, as EPA moves from protecting populations to communities (*e.g.,* protecting terrestrial insects, broadly, that the Florida scrub jay relies on generally for diet), the relevant toxicity endpoints increase in concentration (*i.e.,* are less sensitive), and MoDs decrease; however, sometimes the population- and community-level toxicity thresholds (and associated MoDs) are similar due to factors such as high toxicity across multiple invertebrate species.

[25] https://www.fws.gov/media/karner-blue-butterfly-female
[26] https://ecos.fws.gov/docs/species_images/doc6801.jpg
[27] https://ecos.fws.gov/docs/species_images/doc5039.jpg

**Figure 4. Examples of Listed Species of Generalists that Depend on Invertebrate Communities for Diet or Pollination. Left: Florida Scrub Jay[28] is a Listed Bird Species that Eats Many Species of Terrestrial Insects. Right: Western Prairie Fringed Orchid[29] is a Listed Plant Species Pollinated by Hawkmoths. Images from FWS.**

The MoD is comparable to the risk quotients (RQ) that EPA calculates and compares to regulatory Levels of Concern (LOC) in FIFRA assessments. RQs and MoDs are similar in that they both are a ratio of exposure to toxicity; however, they differ by the toxicity endpoint, estimated exposures, and how they are interpreted. RQs typically rely upon toxicity information more representative of potential effects to an individual organism. RQs also include exposure estimates in terrestrial environments that represent agricultural fields with upper-bound pesticide exposures compared to other treated fields. EPA's standard listed species LOCs also are relative to potential effects to an individual of a species (USEPA, 2004). When interpreting RQs, if the LOC is exceeded, EPA concludes that there is a potential risk and additional refinement is needed to determine the potential that adverse effects will occur. The RQ approach is conservative, deterministic, and intended to be used as a screen, where additional refinements can be done if appropriate.

MoDs and their interpretation for identifying mitigations (in **Step 2**) represent a more refined approach. MoDs use toxicity information, such as endpoints from a species sensitivity distribution as described later in this document, to represent potential population- or community-level impacts. Interpretation of MoDs considers concepts relevant to variability in exposures and responses, and to where the EPA standard FIFRA models may overpredict exposures (bias of the models' parameters in representing exposures to small ponds and wetlands when applied to other habitats, such as fast-moving streams and large rivers used by listed species). This refined approach is intended to help EPA confidently identify

[28] https://www.fws.gov/media/banded-florida-scrub-jay
[29] https://www.fws.gov/media/western-prairie-fringed-orchid

pesticide uses that have the potential for population-level impacts to a listed species. This refined approach also establishes the potential level of impacts (not likely, low, medium, and high) to listed species' populations. That way, EPA can adjust the levels of mitigations to address the potential levels of impacts associated with the specific pesticide use.

EPA investigated the degree of variability of various data and analyses (*e.g.,* variability in laboratory testing, exposure estimates). Based on these sources of variability, when levels of potential population-level impacts are more than an order of magnitude (10x) different from each other, EPA has higher confidence that the impacts are actually different. Ultimately, EPA uses the MoD and other information to determine the potential population-level (or community-level) impacts according to **Table 2**.

**Table 2. Relationship Between the Magnitude of Difference and Potential for Population-Level Impacts**

| Magnitude of Difference (MoD)[1] | Potential for Population-Level Impacts[2] |
|---|---|
| <1 | Not Likely |
| 1 to <10 | Low |
| 10 to <100 | Medium |
| ≥100 | High |

[1] The MoD is the ratio of the exposure estimate to the relevant toxicity threshold value for population-level impacts (listed invertebrates and listed obligates) or community-level impacts (listed generalists).
[2] Other evidence being considered in the analysis may alter the assignment of categories of population- or community-level impacts to the MoD ranges shown here. In some cases, bias in exposure or toxicity estimates, typically due to modeling assumptions, may increase the categories by 10X. In rare cases, the categories may be lowered by 10X.

MoDs that are >1 but less than 10 are classified as 'low' potential for population-level impacts to species. The term "low" can be misleading in this context because the MoD is based on refined endpoints, and population-level impacts may still occur. EPA considers other factors such as how EPA's standard modeling approach relates to species' habitats as described in the following paragraph when determining if a low level of mitigation is appropriate for a 'low' MoD.

In addition to the MoD ranges, EPA considers other information such as the level of confidence and bias in exposure or toxicity threshold estimates when assigning the potential for population- or community-level impact to a listed species. For example, EPA's EECs for the standard farm pond are used as a proxy to represent exposure of listed species in rivers and streams since EPA currently lacks a reliable exposure model for these flowing water systems. Previous analyses indicate that EPA's pond-based EECs tend to overestimate exposures in rivers and streams by an order of magnitude or more (USEPA 2016). Similarly, the models used to estimate spray drift also tend to overestimate exposure for some habitats where substantial interception of spray droplets is expected (*e.g.,* forests, shrubland). Therefore, for listed species that live in such habitats, the potential for population-level impact categories shown in **Table 2** are assigned higher MoD ranges by one category (*i.e.,* an MoD range of 10 to <100 would equate to low potential for population-level impacts, representing the lower exposure and potential for population-level impacts in these habitats).

### 3.1.1 Determining Exposure Estimates for the MoD

The first step in estimating exposures for MoD ratios is to estimate the exposure level or EEC for a particular exposure route. EPA starts its exposure analysis by considering the currently registered or proposed uses of an insecticide. This includes the relevant crops, application rates, and methods of application. EPA also considers any existing or proposed mitigations that the registrant(s) or applicant(s) included on the pesticide product label or committed to in writing to amend their registration or application.

EPA uses its models to calculate EECs to which listed species may be exposed. EPA uses different models to calculate EECs depending on the exposure route and whether the species resides in an aquatic or terrestrial habitat. More specifically, EPA evaluates exposures for listed species using established standardized exposure models[30] to calculate aquatic and terrestrial EECs based on:

- Relevant application parameters (*e.g.,* application rates, application method, equipment) for the chemical;
- Chemical-specific environmental fate characteristics (*e.g.,* ability to bind to soil particles or remain in aqueous solution, half lives in soil and water);
- Ecological scenario (based on soil, climatic, and agronomic practices to determine runoff);
- Modeled habitat where the listed species lives (*e.g.,* vernal pool, stream, forest); and
- Degree to which the habitat for a given listed species reflects EPA's modeling assumptions.

A list of exposure models that EPA typically uses is provided in **Table 3.** When this Strategy is used to inform a particular registration or registration review decision, EPA will use the most recent version of each exposure model. Additional details on the exposure modeling approaches included in the Insecticide Strategy can be found in **Appendix A**.

[30] Current models and their user guides can be found at https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment and https://www.epa.gov/endangered-species/models-and-tools-national-level-listed-species-biological-evaluations

**Table 3. EPA's Standard Models Currently Used to Assess Exposure to Insecticides**

| Environment | Exposure/Transport Pathway (Relevant Habitat) | Models or Assumption |
|---|---|---|
| Terrestrial | Off-field spray drift exposure (point deposition to terrestrial habitat off the field) | AgDRIFT®<br>T-REX<br>Bee-REX |
| Aquatic | Runoff and erosion for EPA farm pond or larger waterbody (includes low flow waters, medium/fast flowing waters, lakes, reservoirs, karst systems) | PWC[1] |
| | Runoff and erosion for waterbody smaller than EPA farm pond (includes vernal pools and other wetlands) | PWC with PAT[1]<br>Edge of Field Calculator |
| | Spray drift only to waterbody (farm pond, wetland, vernal pool) | AgDRIFT® |
| | Runoff and erosion in rice paddy/cranberry bogs (flooded agricultural fields) | PFAM |

[1] Although PWC and PAT can be used to consider spray drift contribution to waterbodies, spray drift is set to zero when estimating exposure just from runoff and erosion because these models are used to estimate exposures and resulting mitigation levels for runoff and erosion.

In the Insecticide Strategy, EPA aims to rely on standard EECs to calculate MoDs. Variability associated with exposures and the conservative bias of the model estimates are all considered when interpreting the MoDs. EPA also considers cases where the habitat of a listed species is likely overestimated due to the type of habitat of the species and lower expected exposures compared to the exposure estimates of EPA's standard models. So, although the MoD includes conservative exposure estimates, EPA includes refinements when it interprets the MoDs as overly conservative. EPA also accounts for assumptions necessitated with evaluating label directions when conducting an assessment at a national scale that may not apply to all users across the country. For example, EPA assumes that a user applies a pesticide at the maximum application rate. EPA understands that a user may apply a pesticide at a rate that is less than the maximum allowed on the label for reasons such as pest pressure or target pest species sensitivity (but may not exceed the maximum rate on the label). Therefore, users that apply a pesticide at lower rates or fewer number of times per season may need less mitigation to protect against population-level impacts. EPA accounts for these and some other localized practices and environments through EPA's mitigation menus that allow growers to select among efficacious mitigation options that achieve the desired protection for listed species while minimizing impacts to their pest management objectives. These factors are described in **Sections 3.2.1.3** and **3.2.2.2** of this document and in greater detail in the Ecological Mitigation Support Document. For example, if a grower or other applicator, following the label instructions, can manage their pest pressures using an application that is 50% of the maximum application rate, they would be able to reduce the identified spray drift buffer by 50% (before any other spray drift mitigations to reduce the buffer) and they would also have two points of runoff mitigation.

For listed invertebrate species in terrestrial habitats (and listed species that have an obligate relationship to a terrestrial invertebrate), EPA assumes the primary route of exposure is from spray drift off a field. EPA estimates dietary exposure through consumption of contaminated food sources such as pollen, nectar, plants, and invertebrates. EPA also estimates contact exposure (*e.g.*, direct deposition of a pesticide onto an invertebrate). EPA uses the AgDrift® model to estimate deposition of pesticides via spray drift onto downwind areas to allow for a calculation of dietary and contact exposure estimates at various distances from the application site. Dietary and contact exposures are estimated using the T-REX and Bee-REX models. For the MoD, EECs represent exposures at the edge of the treated area.

EPA currently uses the Pesticide in Water Calculator (PWC) and the Wetland Plant Exposure Zone (WPEZ) module of the Plant Assessment Tool (PAT) to estimate insecticide concentrations in aquatic habitats. Exposure estimates from runoff/erosion alone are used in deriving MoDs. PWC couples agricultural crop scenarios with weather information to assess runoff/erosion potential from vulnerable agricultural use sites. The PWC model generates 1-in-10-year EECs associated with a particular pesticide, aquatic habitat, and use pattern within a specific geographic region. Each scenario is specific to an area where the use occurs (*i.e.*, where a crop is commonly grown). The EECs generated represent maximum annual concentrations that occur once every 10 years and consider the runoff/erosion pathway of exposure. For listed aquatic invertebrates inhabiting small vernal pools, EPA estimates runoff exposure based on edge-of-field concentrations from the PWC. For species living in larger vernal pools and wetlands, EPA uses the wetland module from PAT. EPA also uses AgDRIFT® to model spray drift exposures into each aquatic habitat from the spray drift route of exposure alone. EPA considered the habitat requirements of currently listed aquatic invertebrates and any listed species with an obligate relationship with aquatic invertebrates and identified which of EPA's standard model waterbodies is most representative of the expected exposures for that species. In some cases, the standard model is a reasonably good fit for the habitat of the species (*e.g.,* standard wetland is a good fit for vernal pools and wetlands) and in other cases, EPA expects that the model will overestimate exposures to the species' habitat (*e.g.,* the standard pond will likely have much higher exposures than rivers with larger volumes, dilution, and flow). When interpreting MoDs, EPA considers how well or how poorly the models estimate exposures for listed aquatic invertebrates.

Similarly, the AgDRIFT® model for spray drift assumes a bare field with no interception, which will overestimate site-specific exposures if the landscape contains features that would intercept spray drift. For example, spray drift exposure from a treated field to a listed species located in interior forest habitats is unlikely because the trees would intercept the spray drift. Therefore, before deciding on the potential for population-level impacts, EPA would consider the habitat of the species (and the representativeness of the exposure estimates from its models).

The scope of the Insecticide Strategy includes insecticide applications via broadcast spray made with ground or aerial equipment, soil treatment, treated seeds, and granular formulations. Runoff/erosion transport pathways are a potential concern for most application methods, with exceptions (*e.g.* tree injection) as described in **Section 3.2.2.5.** For spray drift, as described in the Ecological Mitigation Support Document, several application methods would not likely result in population-level impacts irrespective of the characteristics of a particular insecticide. Therefore, EPA would not evaluate the potential for population-level impacts for these application methods (**Table 4**).

**Table 4. Insecticide Application Methods and Relevant Exposure Pathways for this Strategy**

| Application Method | Spray Drift | Runoff |
|---|---|---|
| Foliar Applications[1] | Yes | Yes |
| Soil Treatment | Yes[2] | Yes |
| Treated Seed | No | Yes[3] |
| Granular formulations | No | Yes |

[1] Foliar applications include those made by aerial broadcast spray, ground broadcast spray, airblast, and chemigation.
[2] As described in the Ecological Mitigation Support Document, soil treatment with certain equipment (*e.g.,* drip tape, in-furrow sprays) are not expected to result in meaningful exposures of spray drift that would have the potential to result in population-level impacts.
[3] The reduced potential for transport in runoff of treated seeds (and any incorporated/buried application method) is currently assessed in EPA aquatic exposure modeling by accounting for burial depth of treated seeds and reduced availability of residues in runoff at the soil surface. Runoff MoDs for foliar and soil treatments will typically be greater than those for treated seeds. However, EPA may identify mitigation needs for these uses when MoDs indicate the need for at least low levels of mitigation.

### 3.1.2 Determining Toxicity Thresholds for the MoD

The toxicity values selected for MoD calculations are intended to represent either potential impacts to (1) a population for direct toxicity or impacts to a species with an obligate relationship to an invertebrate or (2) a community (*i.e.,* multiple species' populations) for species with a general relationship with invertebrates. In general, different toxicity thresholds are used to represent population- and community-level impacts, where population-level impacts are assumed to occur at lower levels of exposure.

EPA relies on standardized toxicity data that are submitted to the Agency during the registration (or registration review) process for deriving its toxicity threshold values used to calculate an MoD.[31] EPA may also supplement these submitted toxicity data with data obtained from the scientific (open) literature.[32] For invertebrates, a variety of toxicity data are available from submitted data and the open literature. These studies involve different types of species habitats (aquatic and terrestrial), exposure routes (water, sediment, contact, diet), durations (short term[33] or long term[34]), life stages (larvae and adults) and species (crustaceans, mollusks, insects).

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[31] EPA's standard ecological toxicity data requirements are defined in 40 CFR Part 158 subpart G (https://www.ecfr.gov/current/title-40/chapter-I/subchapter-E/part-158/subpart-G)
[32] Toxicity data obtained from the open literature are reviewed according to OPP's open literature guidelines and classified as to whether they are of sufficient quality to be used in deriving toxicity thresholds in regulatory risk assessment (https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/evaluation-guidelines-ecological-toxicity-data-open).
[33] Shorter term exposures are referred to as "acute." These studies typically include 2-4 days exposure and observation.
[34] Longer term exposures are referred to as "chronic." These studies typically include one or more weeks of exposure and observation.

EPA matches up the available toxicity data to represent different types of listed species. For example, available honey bee toxicity data (which are typically available for insecticides) are used to represent the sensitivities of larval and adult life stages of listed species of bees. Honey bee toxicity data account for contact exposures to adults and dietary exposures of both larvae and adults. If toxicity data are not available for other types of terrestrial invertebrates, EPA will use the honey bee toxicity data to represent the sensitivities of other listed terrestrial invertebrates (*e.g.,* butterflies and beetles). If robust toxicity data are available for butterflies and/or beetles, and they differ in sensitivity compared to the honey bee, EPA will use available butterfly and/or beetle toxicity data to represent these types of listed species.

A similar approach is used for aquatic invertebrates, where available insect, crustacean and mollusk toxicity data are considered and matched to these types of listed species. In some cases, larger amounts of data are available to represent the toxicity of an insecticide to multiple species within a taxon. In that case, EPA will consider the full set of data in a species sensitivity distribution (SSD; a ranking of the different species' toxicities), which is more commonly used when considering aquatic invertebrates as test data are typically available for more of those species (from studies submitted by applicants/registrants and published studies in the scientific literature) than species of terrestrial invertebrates. While there can be toxicity information available in the open literature for multiple terrestrial invertebrate species, they may not be used in an SSD because of the differences in in test design (*e.g.*, duration, life stage) and exposure route (*e.g.*, contact, oral), which complicates the ability to compare results across species. When SSDs are available, they are helpful in selecting population-level endpoints that represent more sensitive species and community-level endpoints that represent levels where multiple species need to be impacted to represent an impact to a generalist.

The following sections summarize the process for deriving toxicity thresholds for calculating MoD values.

#### *3.1.2.1 Assessing Species Sensitivity Differences*

EPA relates the sensitivity of particular groups of listed invertebrates to species that have toxicity test data available if those data show meaningful differences in sensitivity to an insecticide. As summarized in **Section 2.2**, the listed aquatic and terrestrial invertebrates in the conterminous United States consist of a wide range of species types, including beetles, crustaceans, snails, mussels, butterflies, dragonflies, bees, and others. Because closely related species have more similar physiology compared to species that are more distantly related, it is reasonable to expect that some groups of listed invertebrates may differ in their sensitivity to a given insecticide compared to other invertebrate groups. Furthermore, some insecticides are developed to target specific groups of pests (*e.g.,* mites, flies, butterflies), which supports the notion that differences in sensitivity of different invertebrate groups may occur. Given this expectation of broad sensitivity differences among listed invertebrate groups for some insecticides, it is prudent to ensure that any identified mitigations for an insecticide also reflect such differences in sensitivity (*i.e.,* for the same exposure, greater mitigation would generally be appropriate for more sensitive species types vs. less sensitive species types).

When deriving toxicity thresholds for MoD ratios, EPA determines whether the toxicity data for various groups of species (*e.g.,* butterflies, beetles, and bees) suggest different sensitivity to the pesticide, or if they could be lumped together (*e.g.,* all terrestrial invertebrate species). The extent to which EPA is able to assess potential different sensitivities to a pesticide is limited by the available data. EPA considers available information to identify if differences in sensitivity likely exist across taxonomic groups of listed invertebrates. These differences are particularly impactful if an insecticide's mode of action (MoA) targets certain groups of invertebrates. In some cases, additional information may be used to supplement available toxicity data. Additional details are provided in **Appendix A**.

Based on the available dataset, EPA determines whether it is appropriate to derive separate toxicity thresholds (and MoDs) for different invertebrate groups, which allows the level of mitigation to be tailored to the sensitivity of the group. Aquatic and terrestrial invertebrates are distinguished here because the exposure routes for these types of habitats are different and so are the toxicity data. Different toxicity thresholds and MoDs may be calculated for the following groups:

- Aquatic/Wetland
    - Insects (*e.g.,* dragonfly larvae)
    - Crustaceans (*e.g.,* shrimp)
    - Mollusks (mussels and snails)
    - Generalist species dependent on invertebrate prey/pollinators in aquatic/wetland habitat
- Terrestrial
    - Butterflies
    - Beetles
    - Bees
    - Generalist species dependent on prey/pollinators in terrestrial habitat

EPA may calculate MoDs for additional groups in the future as data allow. Such MoDs may be informed by ongoing work with EPA's Office of Research and Development, which is investigating sensitivity differences among different types of terrestrial invertebrates. With some case study insecticides, EPA combined toxicity data for different invertebrate groups (*e.g.,* butterflies/moths and other terrestrial invertebrates) because of a lack of difference in sensitivity or limited available toxicity data. Therefore, the toxicity thresholds and MoDs for these groups are equivalent.

#### *3.1.2.2 Toxicity Thresholds Supporting MoDs for Assessing Impacts to Listed Invertebrates and Obligates*

Once EPA determines whether the toxicity data support calculating distinct toxicity thresholds for different listed invertebrate groups, EPA then calculates toxicity thresholds for supporting MoDs for direct population-level impacts to listed invertebrates. The approach for setting these toxicity thresholds depends on how much toxicity data are available for the invertebrate species within each group. These toxicity thresholds are also calculated separately for acute (short-term) and chronic (long-term) exposures and their corresponding MoDs. They are also calculated separately for different types of exposures (*i.e.,* aquatic – water column, aquatic – sediment, terrestrial – contact, terrestrial – diet). MoDs generated for aquatic organisms are used in **Step 2** to consider runoff/erosion and spray drift mitigations. MoDs generated for terrestrial invertebrates are used to consider spray drift mitigations in **Step 2**.

When toxicity data are available for enough species within a group for a given insecticide, EPA uses a species sensitivity distribution (SSD)[35] to set the toxicity threshold used in the MoD for evaluating direct population-level impacts on listed invertebrates. SSDs reflect a ranking of species by their sensitivity from most sensitive to least sensitive. A statistical procedure is used to describe this ranking such that a concentration can be identified which corresponds to a desired percentile of the SSD. For example, a concentration corresponding to the 5$^{th}$ percentile of an SSD means that 5% of the tested species are equally or more sensitive than this concentration and 95% are less sensitive. Therefore, setting a toxicity threshold at the 5$^{th}$ percentile of an SSD would be protective of 95% of tested species. SSDs require toxicity data from a relatively large number of species to be scientifically robust (*e.g.,* generally 8 or more species within a group). As a result, SSDs are almost always limited to acute toxicity data because chronic toxicity data are rarely plentiful enough to develop SSDs. For acute SSDs, EPA uses standard toxicity endpoints such as the acute $LD_{50}$ and $LC_{50}$ values[36] and sets the acute toxicity threshold at the 5$^{th}$ percentile of the SSD which is also called the $HC_{05}$ (*i.e.,* hazard concentration corresponding to the 5$^{th}$ percentile of sensitivity). Since species can vary widely in their sensitivity to chemicals and toxicity data are mostly available for standard test species rather than listed species themselves, the $HC_{05}$ is considered protective in that it assumes the listed species are highly sensitive with respect to most of the tested species.

In the absence of an SSD, EPA sets its toxicity threshold for population-level impacts at the 10% effect level for mortality. The 10% effect threshold is considered appropriate for evaluating population-level impacts since it is reasonably low and corresponds to the acceptable amount of mortality in controls of acute toxicity tests (*i.e.,* is representative of background mortality). EPA intends to estimate the 10% effect threshold by multiplying the aquatic invertebrate $LD_{50}$ or $LC_{50}$ value by 0.5 and the terrestrial invertebrate $LD_{50}$ or $LC_{50}$ by 0.4. These values represent the ratio of the $LD_{10}$ to $LD_{50}$ or $LC_{10}$ to $LC_{50}$ when considering a central estimate of slope (USEPA 2004 and 2014).

For chronic toxicity thresholds for the population, EPA bases toxicity thresholds used to support the chronic MoD on the Maximum Acceptable Toxicant Concentration (MATC) obtained from the most sensitive species for which reliable chronic toxicity data are available. The MATC is the geometric mean between the No Observed Adverse Effect Concentration (NOAEC) and the Lowest Observed Adverse Effect Concentration (LOAEC) from a chronic toxicity test. The NOAEC represents the highest concentration in a chronic toxicity test where statistically significant effects do not occur while the LOAEC represents the lowest concentration where statistically significant effects occurred in the test. Biological effects begin to occur between these two endpoints. Thus, the MATC is intended to reflect the onset of adverse effects from chronic exposure to a chemical.

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[35] Species Sensitivity Distributions (SSD) are a common tool used for setting limits on exposure to a chemical or stressor. SSDs model the variation in the sensitivity of different species to a chemical and fit equations to understand the distribution of species sensitivity to a chemical. EPA uses the SSD Toolbox to generate SSDs. The Toolbox is available at: https://www.epa.gov/chemical-research/species-sensitivity-distribution-ssd-toolbox.

[36] $LD_{50}$ is the lethal dose (*e.g.,* mg a.i./kg-body weight) that results in 50% mortality of the tested individuals (usually with terrestrial species). The $LC_{50}$ is the lethal concentration (*e.g.,* mg a.i./L water) that results in 50% mortality of the tested individuals (usually with aquatic species).

The same toxicity thresholds used for assessing direct impacts to populations of listed invertebrates are also used for listed species that obligately depend on one or a few species of invertebrates. The rationale for using the same toxicity endpoints determined for assessing direct impacts to populations reflects the expectation that population-level impacts to obligate listed species only requires impacts to one or a few invertebrate species. Therefore, assessing direct impacts to populations of listed invertebrates and listed obligate species are the same.

#### *3.1.2.3 Toxicity Thresholds Supporting MoDs for Assessing Impacts to Listed Generalists*

Toxicity thresholds used to assess indirect population-level impacts to listed generalists that depend on invertebrates broadly (rather than a specific invertebrate species) are intended to be protective of impacts to the invertebrate community as a whole since listed generalists depend on many different invertebrate species for survival. When sufficient data are available to develop an SSD, EPA uses the 25$^{th}$ percentile (also called the $HC_{25}$) to set this toxicity threshold. A higher percentile (lower sensitivity) of the SSD is used to evaluate potential population-level impacts to listed generalists compared to direct impacts described in **Section 3.1.2.2** because such impacts are presumed to occur at the community level, rather than for a population of a single species. As indicated previously, SSDs are almost always limited to acute toxicity data and are not typically available for chronic toxicity data.

If available toxicity data are not sufficient to derive an SSD, EPA sets the toxicity threshold for listed generalists at a level that most closely approximates the expected lower quartile of species sensitivity. In many cases, this represents the most sensitive $LC_{50}$ or $LD_{50}$ value when very few species have been tested. However, EPA considers other information (*e.g.,* ECOTOX data and SSDs published in the scientific literature) when selecting the most appropriate $LC_{50}$ or $LD_{50}$ value to represent a threshold for community-level impacts. Where possible, EPA selects a species that can reasonably represent the lower quartile of the acute SSD ($HC_{25}$) to account for potential population impacts to generalists.

### 3.1.3 Determining Potential for Population-Level Impacts

MoDs represent numerical comparisons of estimated exposure levels to population-level toxicity thresholds. A list of exposure estimates and toxicity thresholds used to calculate MoD values in this Insecticide Strategy framework is shown in **Table 5.** EPA is using MoDs to inform the potential for population-level impacts to listed invertebrate species and community-level impacts to species that rely on multiple invertebrate species for food. When considering this strategy in FIFRA actions, EPA would calculate MoDs for each labeled use (or groups of labeled uses) as well as for the major exposure routes associated with mitigation (spray drift, runoff/soil erosion). MoDs are categorized into 4 levels associated with the potential for population-level impacts to a listed species. The levels range from “not likely” to “high” (**Table 2**). Before deciding on the potential for population-level impacts, EPA also considers several lines of evidence, including the habitat of the species (and the representativeness of the exposure estimates).

**Table 5. Exposure Estimates and Toxicity Thresholds Used to Calculate MoD Values for Listed Aquatic and Terrestrial Invertebrates**

| Exposure Source | Exposure Estimates (Model) | MoD Toxicity Thresholds |
|---|---|---|
| **Listed Terrestrial Invertebrates** | | |
| Spray Drift | **Dietary Exposure:**[1]<br>• Residues on arthropods and foliage (T-REX)<br>• Residues in pollen and nectar (Bee-REX)<br><br>**Direct Contact Exposure:**[1]<br>• Residues on arthropods (T-REX)<br><br>**Soil Exposure:**<br>• Residues in soil (screening model)<br><br>Note: spray drift deposition at the edge of the treated area is estimated using AgDRIFT®. | **Direct Impacts & Listed Obligates:**<br>**Acute:**<br>• 5th percentile of SSD of species $LD_{50}$ or $LC_{50}$ values, or<br>• 0.4*$LC_{50}$ (or $LD_{50}$) from most sensitive terrestrial invertebrate [2]<br><br>**Chronic:**<br>• MATC (geometric mean of NOAEC and LOAEC)<br><br>**Listed Generalists:**<br>• 25th percentile of SSD of acute $LD_{50}$ or $LC_{50}$ values, or<br>• Most appropriate surrogate $LD_{50}$ or $LC_{50}$ for terrestrial invertebrates [2] |
| **Aquatic Invertebrates** | | |
| Runoff/ Erosion<br><br>and<br><br>Spray Drift | **Small Vernal Pools:**<br>• Edge of Field concentrations (PWC)[3]<br><br>**Wetlands:**<br>• Concentrations in water and sediment (PAT wetland) [3]<br><br>**Ponds/Larger Waterbodies:**<br>• Concentrations in water and sediment (PWC farm pond) [3] | **Direct Impacts & Listed Obligates:**<br>**Acute:**<br>• 5th percentile of SSD of species $LD_{50}$ or $LC_{50}$ values, or<br>• 0.5*$LC_{50}$ (or $LD_{50}$) from most sensitive aquatic invertebrate species[2]<br><br>**Chronic:**<br>• MATC (geometric mean of NOAEC and LOAEC)<br><br>**Listed Generalists:**<br>• 25th percentile of SSD of acute $LD_{50}$ or $LC_{50}$ values, or<br>• Most appropriate $LD_{50}$ or $LC_{50}$ for aquatic invertebrates[2] |

[1] Based on estimated exposure concentrations (EEC) from mean Kenaga residues in T-REX.

[2] Used when sufficient data are not available to develop an SSD.

[3] Acute and chronic EECs are based on the yearly maximum daily average and 21-day average concentration, respectively, with a 1-in-10-year occurrence frequency.

SSD = species sensitivity distribution; $LD_{50}$ = lethal dose to 50% of tested individuals; $LC_{50}$ = lethal concentration to 50% of tested individuals, respectively; MATC = maximum acceptable toxicant concentration; NOAEC = no observed adverse effect concentration; LOAEC = lowest observed adverse effect concentration

As EPA considered the listed invertebrate species within the scope of the Insecticide Strategy, the Agency found a large diversity of habitats where these listed species can occur. For example, aquatic species can be found in small vernal pools that seasonally dry up, prairie potholes that are interspersed with agriculture, small and large wetlands, streams and rivers, ponds, and lakes. Terrestrial species can be found in meadows adjacent to agriculture, at high elevation mountainous regions, remote areas like cliff faces and waterfalls, and in nearby forests. Since EPA has a finite set of exposure models to represent such a large diversity of aquatic and terrestrial habitats of listed invertebrates, an important consideration when assigning the potential for population-level impacts is how well its exposure models represent these habitats. For example, EPA's previous analyses indicate that its exposure estimates for the farm pond tend to overestimate concentrations in streams and rivers with moderate to fast flow regimes by an order of magnitude or more (USEPA 2016). Since exposure estimates for the farm pond are used as a proxy for other larger aquatic waterbodies including rivers and streams with moderate to fast flow regimes, EPA is using an MoD of 10 as the threshold for when the potential for population-level impacts may occur in these environments rather than 1 as shown previously in **Table 2.** This increase in the MoD/potential population-level impacts threshold from 1 to 10 recognizes the likely overestimation of EECs in the farm pond relative to these habitats. In other words, a MoD of 10 in this situation would equate to a low likelihood of population-level impacts, instead of a medium likelihood. A similar situation exists when considering estimates of spray drift for species that live in areas where pesticide sprays may be intercepted by trees, shrubs, and other obstacles to direct contact with spray droplets. EPA's spray drift estimates assume relatively little or no interception of spray droplets as they move from the treated field. In such cases, EPA also would consider higher thresholds of MoDs to the various categories for assigning the potential for population-level impacts due to the increased likelihood for spray drift interception in these habitats.

With respect to toxicity, EPA also considers the uncertainty and potential bias in toxicity data when determining the potential for population-level impacts. The MoD ranges shown in **Table 2** could conceivably be lowered when other information indicates the available toxicity test data do not adequately capture the expected sensitivity of one or more types of listed invertebrates. For example, if EPA has data that suggest a listed species is expected to be substantially more sensitive than the surrogate species used in the available toxicity testing, EPA could use a value below 1 to indicate the potential for low population-level impacts. Conversely, the MoD ranges may be increased if information suggests the opposite situation is likely to occur. In other words, if EPA has data that suggests a listed species is an order of magnitude less sensitive than the surrogate tested species, then an MoD of 10 in this situation would equate to a low likelihood of population-level impacts for that species, instead of a medium likelihood.

Finally, EPA considers information such as data on pesticide residues in environmental media (*i.e.,* monitoring data) in conjunction with model-based estimates of exposure. Generally, monitoring data can support the model-based exposure estimates when concentrations are reasonably similar; however, monitoring data often are not targeted to when and where insecticides are applied, so lack of agreement does not usually impact the MoD ranges associated with the potential for population-level impacts. Ecological incident data reported to EPA also represent a similar confirmatory line of evidence as monitoring data. However, if substantial numbers of ecological incidents are associated with relevant labeled application practices that would be unexpected based on the MoD analysis, then EPA may choose to re-evaluate its MoD and underlying data.

In summary, EPA determines the potential for population-level impacts by considering multiple factors, including:

- MoDs

- Representativeness (or lack thereof) of exposure estimates with respect to species habitat
- Representativeness of toxicity estimates of surrogate test species
- Monitoring and incident data

Therefore, the MoD approach and associated appropriate level of mitigation require some judgement by EPA's assessors. The potential for population-level impacts is used to identify the level of mitigation in **Step 2** of the framework, which is discussed in the next section.

### 3.2 Step 2. Identify Type and Level of Mitigation Measures

**Step 2** of the Insecticide Strategy framework involves relating the MoD to the appropriate level and type of mitigation measures. Based on scientific information, EPA has identified mitigations that are expected to reduce spray drift, erosion, and runoff exposure such that population-level impacts are not likely. In this step, as described earlier, EPA also considers any existing or proposed mitigations that the registrant(s) included on the pesticide product label or committed to in writing. When EPA identifies the potential for population-level impacts for a FIFRA action that includes a particular exposure pathway to be low, medium, or high, it similarly identifies specific mitigations or a level of mitigation to address those impacts as shown in **Table 6**. If for a particular use (or action) EPA identifies the potential for population-level impacts to be unlikely, then EPA would not identify mitigations to be associated with that use or action. The mitigations associated with a low, medium, or high level of identified mitigation depend on the exposure route and are described below in **Sections 3.2.1** and **3.2.2**.

**Table 6. Relationship Between the Potential for Population-Level Impacts and Mitigation Identified**

| Potential for Population-Level Impacts[2] | Level of Mitigation Identified | Magnitude of Reduction in Exposure to Result in a Not Likely for Population-Level Impact Conclusion |
|---|---|---|
| Not Likely | None | None |
| Low | Low | 10x |
| Medium | Medium | 100x |
| High | High | 1000x |

When EPA identified the type of mitigations to reduce the off-field transport of insecticides in spray drift, runoff, and erosion, the Agency considered whether the mitigation measures would be effective at reducing exposure and would not in themselves be so burdensome as to prevent the intended use. For this and other strategies, EPA identified mitigations that are already used by various applicators and growers and included as many measures as possible (meaning EPA had enough information to evaluate its efficacy for potential inclusion here) to ensure flexibility and allow growers to use mitigations that are intended to be economically and technologically feasible to them. The mitigations identified in this strategy represent additional improvements based on stakeholder input and further analysis by EPA (*e.g.* public comments received on the Herbicide and Insecticide Strategies).

As detailed in the Ecological Mitigation Support Document, for each of these mitigation measures, EPA evaluated their effectiveness at reducing offsite transport. EPA relied upon multiple sources of information about mitigations that are commonly utilized in agriculture to reduce spray drift, runoff and erosion. EPA also included information about other landscape management practices that may effectively achieve similar reductions in exposure. While runoff/erosion mitigation practices may have previously been installed to reduce transport of nutrients and/or soil, they would also be effective in reducing transport of pesticides. This also applies to mitigation measures such as windbreaks which can be installed to protect wind-sensitive crops and control soil-wind erosion, but they can also be effective in reducing pesticide spray drift. The process EPA followed for considering the inclusion of a mitigation in this strategy was based on the following:

- Scientific principles that showed the mitigation is likely to result in meaningful reductions in pesticide spray drift, runoff, or erosion based upon the design, placement, and characteristics of the mitigation;

- Existing EPA exposure models that indicated a potential reduction in environmental exposure if the mitigation were in place;

- Empirical studies that described the reductions in pesticide concentration as a result of the mitigation; and

- Similarity to other mitigations such that they are functionally equivalent.

**Sections 3.2.1** and **3.2.2** discuss the spray drift mitigation measures and runoff/erosion mitigation measures that EPA identified in this strategy to address potential population-level impacts to listed species.

As described in the Ecological Mitigation Support Document, given the low potential for spray drift from applications using treated seeds, EPA did not identify any spray drift mitigations for use as a seed treatment. EPA is not addressing potential exposures via drift from abraded seed (*i.e.,* dust-off) from seed treatments in this strategy. Instead, EPA has taken other actions[37] outside of the Strategy including stewardship efforts and recommending fluency agents to address this potential exposure pathway. However, since exposures from seed treatment via runoff/erosion are analogous to other insecticide formulations (*e.g.,* granular, liquid sprays), EPA identified the mitigations discussed in the runoff/erosion section below to address potential runoff/erosion for insecticide seed treatments. When identifying mitigations to address population-level impacts related to treated seeds, EPA considered whether there could be a potential for population-level impacts through runoff/erosion when seed treated with a registered pesticide is planted at the farm level. Any mitigations identified related to planting treated seed can be implemented through instructions from seed treaters to put them on the seed bag. These considerations would be applied when considering a FIFRA action for a pesticide for which a new seed treatment use is being sought, or for reevaluating a pesticide already registered for treating seed.

[37] https://www.epa.gov/pesticides/epa-issues-advanced-notice-proposed-rulemaking-public-comment-seek-additional

In addition, as described in the scope in **Section 2.2**, this strategy also considered listed species that may be exposed via direct contact with an insecticide application on the field. EPA is continuing to evaluate (with input from the FWS) the potential and extent to which some species of listed terrestrial invertebrates may be exposed on the treated field (*e.g.,* adult butterflies foraging for nectar in a nectar-producing crop). If such exposures are considered to have the potential to cause population-level impacts, then mitigations to address such 'on-field' exposure may be identified. Such mitigations may include restrictions on timing of application relative to the bloom period of the crop, limitations on the time of day in which applications are made, creation of pollinator habitat adjacent to fields, and conditions for airblast applications of insecticides to orchard trees (*e.g.,* dormant vs. full canopy applications).

Even though the Insecticide Strategy has been finalized, the Agency continues to welcome input on the efficacy of additional measures that growers and other applicators may be using that the Agency did not include. EPA acknowledges that the mitigation options will continue to evolve over time and the Agency plans to update the mitigation menus for spray drift and runoff with additional measures or refinements to those identified to date as new information becomes available. EPA will also determine if updates to the Insecticide Strategy are needed as supported by the best available data or information.

### 3.2.1 Spray Drift Mitigation Measures

Spray drift exposures from pesticide applications made via broadcast spray (aerial and ground equipment), airblast, and some chemigation methods (overhead sprayers such as center pivot and traveler sprayers) are a potential concern for population-level impacts. This section first describes a suite of baseline mitigation measures that EPA generally includes on pesticide product labels to reduce spray drift exposure to non-target species. The remainder of this section discusses the use of a combination of identified buffers and/or other mitigations to reduce the identified low, medium, or high potential for population-level impacts associated with spray drift identified in **Step 1**. The spray drift mitigations identified to address potential population-level impacts are expressed as a distance from the edge of the application site (*e.g.,* field) where exposures have been identified and there are potential population-level impacts. **Section 3.2.1.2** explains how EPA identified that distance based on the MoDs calculated in **Step 1**, and **Section 3.2.1.3** discusses mitigation measures for reducing exposures that can be used to reduce or eliminate the spray drift buffer while still addressing the potential for population-level impacts to listed species. **Section 3.2.1.4** also explains how, if a buffer is identified to represent that distance, what types of areas can represent that buffer. **Section 3.2.1.5** discusses spray drift mitigations for overhead sprinkler/chemigation methods.

There are insecticide application methods in addition to ground, aerial, airblast, and overhead/traveler sprayer chemigation. EPA's evaluation described in the Ecological Mitigation Support Document indicates that spray drift exposure from these application methods would be limited and thus the potential for population-level impacts is unlikely. These application methods include:

- Non-overhead chemigation methods, including: micro-sprinklers, drip-tape, drip emitters, subsurface or flood chemigation, and chemigation under non-permeable plastic surfaces;

- In-furrow sprays when nozzle height is $\leq$8 inches above soil surface;

- Tree trunk drench, tree trunk paint, tree injection;

- Soil injection;

- Solid formulations that are used as a solid; and

- Less than 1/10 acre (<4356 square feet) treated and spot treatment: <1000 sq ft treated (*e.g.,* when applied with backpack or handheld sprayers) on a per field or management unit basis[38].

#### *3.2.1.1 Baseline Spray Drift Mitigations*

EPA identified several measures that it generally includes on pesticide product labels to reduce spray drift exposure to non-target species. Because these measures are common mitigations included on pesticide product labels, EPA's evaluation for the potential for population-level impacts incorporates and reflects these mitigations. These mitigations typically include:

- restricting the maximum windspeed to 10 or 15 miles per hour;

- prohibiting applications during temperature inversions;

- boom length restrictions and swath displacements for aerial applications;

- maximum release heights for ground and aerial applications; and

- directing sprays into the canopy for airblast and turning off the outer nozzles at the last row.

#### *3.2.1.2 Spray Drift Mitigation Distances*

When considering a FIFRA action, if EPA identifies a potential for population-level impacts (MoD category) associated with spray drift exposure to be low, medium, or high, then the Agency identifies the level of mitigation to address the potential for population-level impacts. EPA may identify a spray drift buffer from protected areas to address concerns related to spray drift. For this strategy, for aerial, ground, and airblast sprays, EPA identified buffers, located on the downwind edge of the application site (*e.g.,* field), to address the potential for population-level impacts. The distance associated with that buffer increases with the level of mitigation (low, medium, and high). EPA also identified mitigation measures (described in **Section 3.2.1.3**) that a pesticide applicator may be able to employ to reduce or

[38] A field or management unit is defined as the single contiguous piece of land that is managed as a single unit in production or in preparation for production of a single crop. A uniform field may be sub-divided based upon different crops (*e.g.*, vegetables and leafy greens) or sub-divided based upon different features (*e.g.*, flat portion and contoured portion).

eliminate the buffer distance (if the pesticide labeling allows) because these mitigation measures also reduce exposure within that buffer distance. The Ecological Mitigation Support Document describes how EPA determined the efficacy of the mitigation measures, which EPA expresses as a percentage decrease for an identified buffer distance. As described below, because spray drift exposure from the overhead chemigation application method is demonstrably lower than other application methods, EPA determined that population-level impacts can be addressed either from using a lower limit spray drift buffer or using non-buffer mitigations that may be more feasible for growers and other applicators to implement (described in **Section 3.2.1.5**).

When considering a FIFRA action, EPA would address a low potential for population-level impacts for aerial, airblast, and ground applications with lower limit buffers, which are smaller spray drift buffer distances that reduce exposures by approximately an order of magnitude. For medium potential for population-level impacts for aerial, airblast, and ground applications, EPA would identify a buffer distance by calculating a chemical-specific distance based on the toxicity of the pesticide and estimated deposition. If EPA identifies a high potential for population-level impacts from aerial, airblast, and ground applications, the Agency would identify a maximum buffer distance by calculating a maximum buffer that varies depending on the application method (see **Table 7**), but with the goal of achieving a reduction in exposures by approximately two orders of magnitude.

EPA evaluated supporting scientific information from a variety of sources including submissions from applicants and registrants, the public comment period, and relevant information in public literature. After review, EPA determined that for a pesticide application, droplet size can impact the distance that spray drift travels, with smaller droplets generally traveling further than larger droplets. As shown in **Table 7**, EPA identified a single spray drift distance based on how pesticides are typically applied for each type of application method. If a smaller droplet size is needed for a particular pesticide, EPA may identify a larger buffer distance. If a pesticide applicator can use a larger droplet size or a low boom, as described in **Section 3.2.1.3**, they would be able to decrease the identified buffer distance (if allowed on the pesticide labeling). The text below and the Ecological Mitigation Support Document provide more discussion and details about the distances identified to mitigate potential low, medium and high population-level impacts.

**Table 7. Potential for Population-Level Impacts Identified in Step 1 and Corresponding Spray Drift Distance to Reduce Impacts (Assuming No Spray Drift Reducing Measures Are in Use).**

| Potential for Population-Level Impacts from Step 1 | Distance from edge of treated area (in feet) | | |
|---|---|---|---|
| | **Aerial Spray**[1] | **Ground Spray**[2] | **Airblast** |
| Not Likely | None | None | None |
| Low | 50 | 10 | 25 |
| Medium | Calculated for specific chemical[3] | | |
| High | 300[4] | 100 | 85 |

[1] EPA based aerial distances on the assumption that most aerial applications will use a medium droplet size distribution. If very fine or fine applications are needed for a pesticide, EPA may increase the distance. There are mitigation measures for reducing this distance when using droplets larger than medium.
[2] EPA based these distances on the assumption that ground applications are made using a high boom and very fine to fine droplet size distribution. Where allowed by the pesticide labeling, there could be mitigation measures available to reduce this distance when using larger droplets and a low boom.
[3] EPA anticipates that chemical specific buffers will be between the lower limit (used for low potential population-level impacts) and at or lower than the maximum (used for high impacts) buffer distances.
[4] Reported value is for aerial application with Medium droplet size distribution. Aerial applicators are expected to apply with Medium or coarser droplets, but increased buffers are indicated for if smaller droplets than Medium are needed.

Where there is a low potential for population-level impacts for a FIFRA action, EPA identifies a low level of mitigation for aerial, airblast, and ground applications using a lower limit distance. EPA based the identified distances in **Table 7** on the distance where the deposition fraction is estimated to be 10% of the application rate for the different application methods. This equates to 50, 25, and 10 feet, for aerial, airblast, and ground applications, respectively. EPA based these distances on the common droplet size distribution for aerial (medium), the common droplet size distribution for ground (fine) and high boom, and on the sparse orchard setting for airblast applications.

Where EPA identifies medium potential for population-level impacts for a FIFRA action, for aerial, airblast, and ground applications, the Agency plans to use AgDRIFT® to calculate the chemical-specific buffer distance when considering a registration or registration review action. This calculation would be the distance to where the deposition exposure is equal to the toxicity threshold (discussed above for **Step 1**, **Section 3.1.3**). This distance is anticipated to be between the lower limit distance and at or lower than the maximum buffer distance.

Where EPA identifies high potential for population-level impacts for a FIFRA action, the Agency would identify a maximum spray drift distance at a distance beyond which exposure does not substantially change and that reduces exposures by approximately two orders of magnitude. The main reasons for determining a maximum buffer distance include: 1) the impact of the buffer in reducing exposure decreases with distance, such that at distances far offsite, there is only a small change in the spray drift deposition, 2) the uncertainty that exposure will be similar to what is predicted by the model increases with distance, and 3) the larger a buffer is, the less feasible it is for many applicators. In many cases, the likelihood that spray drift will be partially intercepted by a drift barrier (*e.g.,* trees, crop canopy or other vegetation, buildings) increases with distance, and as such, the model may over-estimate the maximum spray drift buffer because the model assumes a bare treated area with no obstructions to intercept spray droplets that drift off-field.

Where EPA identifies high potential for population-level impacts, the Agency would identify a maximum spray drift distance used for mitigation. The maximum spray drift buffer is a starting point that can be reduced or eliminated by using drift reducing measures or other features that can count towards a reduced buffer (*e.g.*, windbreaks). EPA considered multiple qualitative and quantitative factors to set the maximum buffers (without other mitigation) of 300, 85, and 100 ft for aerial, airblast, and ground applications, respectively. These maximum buffers represent specific application parameters (*e.g.*, high boom vs low boom) and very fine to fine droplets. Other factors such as using a larger droplet size reduce these maximum buffers considerably; therefore, maximum buffers for larger droplet sizes were also established (the Ecological Mitigation Support Document provides more discussion on these other maximum buffer distances). These distances are intended to represent a balance between where exposure reduction is optimized with feasibility to implement. The basis for the selection of the maximum buffer distances includes several lines of evidence:

1. Consideration of the inherent bias in the conceptual model and conditions of the AgDRIFT® model and how that relates to different environments across the agricultural landscape. For example, AgDRIFT® assumes a flat field with no vegetation and a constant wind speed. However, many fields have vegetation present near the field (*e.g.,* tall grass, shrubs) that will intercept spray drift; the topography of most fields and adjacent areas is not flat (*e.g.,* they have hills and valleys); and wind speed varies over time.

2. Taking into consideration the variability in the underlying data used to generate the AgDRIFT® model curves and interpreting the results (approximately a 3X variability).

3. Recognizing that there is not a substantial reduction in potential exposure beyond the maximum buffers as deposition further from the field is low (<1%). Model estimated drift deposition is highest near the field. The maximum buffers cover the near-field areas where drift deposition is highest.

4. Incorporating open literature studies that evaluated real-world spray drift scenarios, their relationship to the conceptual model (*e.g.,* tallgrass prairie vs. bare ground), comparison of study results as compared to the AgDRIFT® predicted results, and the pattern of conclusions close to the field and for farther distances. More discussion of these open literature studies and how they support the chosen maximum buffers is provided in the Ecological Mitigation Support Document.

#### *3.2.1.3 Spray Drift Mitigation Measures for Reducing Buffer Distance*

EPA reviewed available mitigation measures that could be employed to reduce the distance of any identified spray drift buffer on a site-specific basis (as allowed by the pesticide label). Mitigation measures that could be available (as permitted by the label) or reduce the buffer distance include application parameters (such as specific equipment, application rate, droplet size distribution), the width of the treated area, use of a windbreak/hedgerow or forested/shrubland area as a physical barrier, or the relative humidity. The decrease in the spray drift buffer distance is represented in the mitigations as a percentage decrease (*e.g.,* an aerial application conducted with a basic windbreak mitigation on the downwind side of the field would result in a 50% decrease in the spray drift buffer distance). While many of these measures apply to all spray drift application methods, some application parameters are specific to the type of application. For example, the applicator could choose larger droplet size distributions to reduce the aerial or ground spray drift buffer distances. For ground applications, the applicator may be able to reduce the distance by using hooded sprayers or drop nozzles that result in applications under the crop canopy. For all types of applications, the buffer distance may be reduced by using a lower application rate than the maximum single rate on the label or by using a windbreak or hedgerow on the downwind side of the application area. **Tables 8-10** summarize the spray drift mitigation measures for reducing the distances associated with aerial, ground, and airblast applications to reduce exposure. The Ecological Mitigation Support Document (Version 2.0) has detailed information describing the basis for each percent reduction in distance. For those mitigation measures that have been identified since the publication of the Ecological Mitigation Support Document (Version 1.0) in July 2024, information describing the basis for their inclusion is in the applicable sections below with greater detail available in Version 2.0 of the Ecological Mitigation Support Document. In the Draft Insecticide Strategy, EPA noted that it anticipated receiving data on drift-reducing adjuvants and insecticide formulations. EPA did receive additional information during the comment period and from further communications with stakeholders. EPA is continuing to evaluate these data. Upon completion of this review, EPA anticipates incorporating this information and updating future iterations of the Ecological Mitigation Support Document and the mitigation menu website.

For each of these application methods (aerial, ground, and airblast), EPA based the spray drift buffer distances (**Table 7**) on representative[39] swath widths and the number of passes, flight lines, or rows treated. EPA assumes the size and number of pesticide application equipment passes for the airplane/helicopter, tractor, and airblast sprayer influence the amount of spray drift that deposits on the downwind side of the field or orchard. On a site-specific basis for a broadcast application, if the number of rows treated for an orchard is fewer than EPA's assumptions, there will be less spray drift deposition in the non-target area on the downwind side of the field. For aerial, ground, and airblast applications, the applicator may be able to reduce any identified spray drift buffer by the percent shown in **Tables 8-10** depending on the acres treated or number of passes (for ground and aerial applications) or treated rows (for airblast applications parallel to the wind direction, perpendicular to the downwind side of the treated field/non-target area). **Figure 5** illustrates such an example. **Tables 8-10** include the percent spray drift buffer reductions associated with different areas treated or numbers of passes/treated rows of the treated field/orchard.

[39] Data from typical aircraft used in agriculture (FAA airplane registry and submissions by NAAA), swath width used in Spray Drift Task Force (SDTF) data.

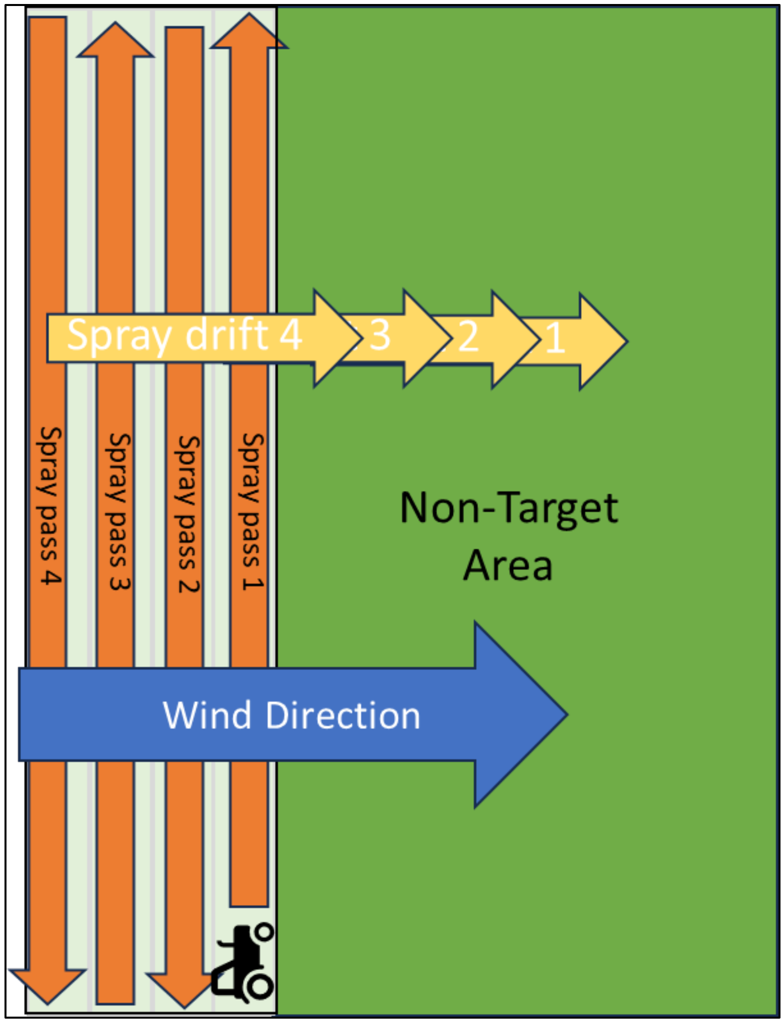


**Figure 5. Cumulative Spray Drift in Non-target Area from Tractor Passes on 4 Parallel Rows on Treated Area. (For example, if this was a ground application and the applicator only made 4 passes of their field, then they could reduce identified spray drift buffer distance by 35%.)**

To use mitigation measures to reduce the spray drift buffer distance (**Tables 8-10**), the applicator should first determine if the pesticide label allows for reductions, then consider the application equipment that they plan to use for the application. With this information and the pesticide label, the applicator could identify the appropriate spray drift buffer distance for the pesticide and use (determined by EPA as either lower limit, chemical specific, or maximum; **Table 7**). The applicator could then select from any of the appropriate mitigation measures relevant to the application type (either aerial, airblast, or ground). The applicator could add up the corresponding percent reductions for all the mitigation measures selected. This total percent could be applied to the spray drift buffer distance. If the percent is 100% or more, the applicator would not need a buffer as the mitigations put in place already address the potential for population-level impacts. If the percent is above zero and less than 100%, the applicator would need a buffer, but the distance would be reduced from that specified on the pesticide product label. For example, if the pesticide product label specifies a 100-foot buffer (and allows for reductions) and there is a downwind windbreak (50% reduction) and the field is 4 to 10 acres (15% reduction), the distance that was identified on the product label could be reduced by 65% (50%+15%). The remaining spray drift distance would be 35 feet (100%-65% = 35% * 100 ft). If the applicator used a low boom instead of a high boom, an additional 50-75% (based on droplet spectra) reduction in distance could be used and no buffer distance would be identified (50%+15%+50% = >100%).

*Aerial applications*

EPA identified multiple measures that could be used to reduce the buffer distance when making aerial applications. Those include application parameters (*e.g.,* reducing the application rate, applying using a larger droplet size distribution), reducing the number of passes on a field, presence of a windbreak and higher humidity. Since the Draft Strategy was released, EPA added a measure to reduce the spray drift buffer distance when an application uses a reduced boom length relative to wingspan. This measure is associated with a 50-65% decrease in the spray drift buffer distance, dependent on the wind speed at the time of application (**Table 8**).

**Table 8. Mitigation Measures Identified When Making Broadcast Aerial Applications**

| Mitigation Measure | Percent Reduction in Distance |
|---|---|
| **Application Parameters** | |
| Reduced single application rate | % reduction corresponds to application rate reduction from maximum on pesticide product label |
| Coarse DSD[1] | 40% |
| Very coarse DSD[1] | 60% |
| Spray drift reducing adjuvants | Under evaluation[2] |
| Reduce boom length to 50% of wingspan, wind speed is <10 mph | 65% |
| Reduce boom length to 50% of wingspan, wind speed is 10-15 mph | 50% |
| **Reduced Proportion of Field Treated (Number of Airplane/Helicopter Passes or Acres[3])** | |
| 1 pass or <1.5 acres | 55% |
| 2-4 passes or 1.5 to <6 acres | 20% |
| 5-8 passes or 6 to <12 acres | 10% |
| **Other Mitigation Measures** | |
| Downwind windbreak/ hedgerow/riparian/forest/ woodlots/shrubland | 50% for basic windbreak/hedgerow/artificial screen<br>75% for advanced windbreak/hedgerow/artificial screen<br>100% for riparian/forests/woodlots/shrubland ≥60ft width |
| Relative humidity is 60% or more at time of application | 10% |

DSD = droplet size distribution

[1]This % reduction assumes baseline of using medium droplet size for aerial.

[2] EPA received spray drift reduction adjuvant data for insecticide formulations after the public comment period closed and will be evaluating this as a potential future mitigation measure for insecticides.

[3] A spray drift buffer applies to downwind non-target areas. The reduced number of passes or acres applies to the upwind part of the treated field. If the passes are not on the downwind edge of the field, the untreated downwind area of the field can be counted as spray drift buffer.

*Ground applications*

EPA identified multiple mitigation measures that could be used to reduce the buffer distance when making ground applications. The ground spray mitigation measures include application parameters (*e.g.,* reducing the application rate, going to a larger droplet size distribution), reducing the number of passes on a field, presence of a windbreak and higher humidity. Many of these measures are similar to those for aerial applications; however, the ground spray measures include boom height, drop/layby nozzles and hooded sprayers. Other than the expansion of basic and advanced windbreaks to include artificial screens, no new ground boom mitigations were included between the Draft and Final Insecticide Strategies based on the information provided during the public comment period. However, EPA did receive additional data subsequent to the comment period closing (*i.e.*, drift reducing adjuvants), and is continuing to evaluate that information. **Table 9** summarizes all ground mitigation measures for reducing spray drift buffers.

<u>Mitigation Measure Expanding Definition of Windbreaks to include Artificial Screens</u>

EPA included basic and advanced windbreaks as mitigation measures resulting in 50 to 75% reduction in the spray drift buffer in the Draft Insecticide Strategy. In this Final Strategy, based on public comment and literature submitted, EPA also included artificial screens, which are an established drift mitigation in orchards and vineyards (see **Section 4.3.9** of the Ecological Mitigation Support Document). EPA determined that artificial screens (semi-permeable curtain or netting) of equal height as the target crop or application release height (whichever is higher) should receive the same level of mitigation reduction in the spray drift buffer as a basic windbreak (50%) and these are now included in the description of windbreaks.

**Table 9. Mitigation Measures Identified When Making Broadcast Ground Applications**

| Mitigation Measure | Percent Reduction in Distance |
|---|---|
| **Application Parameters** | |
| Reduced single application rate | % reduction corresponds to application rate reduction from maximum on pesticide product label |
| High boom, fine to medium-coarse DSD[1] | 75% |
| High boom, coarse DSD[2] | 85% |
| Low boom, very fine to fine DSD[1] | 50% |
| Low boom, fine to medium-coarse DSD[1] | 75% |
| Low boom, coarse DSD[2] | 85% |
| Over-the-top Hooded Sprayer | 50% |
| Row-middle Hooded Sprayer | 75% |
| Sprays below crop using drop nozzles or layby nozzles | 50% |
| Spray drift reducing adjuvants | Under evaluation[3] |
| **Reduced Proportion of Field Treated (Number of Ground Application Equipment Passes[4])** | |
| Field border application (or 1/10 acre to 1 acre) | 75% |
| 2-4 passes (or >1 acre to 4 acres) | 35% |
| 5-10 passes (or 4 acres to 10 acres) | 15% |
| **Other Mitigation Measures** | |
| Downwind windbreak / hedgerow / riparian / forest / shrubland/woodlots | 50% for basic windbreak/hedgerow/artificial screen<br>75% for advanced windbreak/hedgerow/artificial screen<br>100% for riparian/forests/woodlots/shrubland ≥60ft width |
| Relative humidity is 60% or more at time of application | 10% |

DSD = droplet size distribution
Low boom height=release height is less than 2 feet above the ground
high boom=release height is greater than 2 feet above the ground
[1]This % reduction assumes a baseline of using high boom, very fine to fine droplet size for ground.
[2] Based on evaluation of additional ground spray drift data for an additional 10% reduction in distance beyond fine/medium DSDs.
[3] EPA received spray drift reduction adjuvant data for insecticide formulations after the public comment period closed and will be evaluating this as a potential future mitigation measure for insecticides.
[4] A spray drift buffer applies to downwind non-target areas. The reduced number of passes applies to the upwind part of the treated field.

*Airblast applications*

There are similar options for airblast (*e.g.,* application parameters, reduced proportion of treated orchard). EPA added four new mitigation options to the mitigation menu for airblast application based on public comments received on the Draft Insecticide Strategy and additional analysis conducted by the Agency. These new mitigation options include targeted application rate reductions, turning off canopy nozzles, and using axial deflectors and expanding what qualifies under the description of wind breaks. An overview of these new available mitigation measures and associated points is provided below and described in more detail in the Ecological Mitigation Support Document (Version 2.0). The full menu of mitigation measures available for airblast applications is presented in **Table 10**.

Targeted Application Rate Reduction Equivalency

Based on public comments received on the Draft Insecticide Strategy, EPA identified mitigations that could be employed to reduce spray drift buffers (when allowed by the pesticide label). The reductions in buffer size could be 10-90% for using targeted application equipment. Targeted application equipment includes airblast equipment with pulse-width modulated (PWM) nozzles with canopy sensing equipment that turns nozzles off when crop canopy is not present. The amount of buffer reduction that may be available depends on how much pesticide reduction occurs. In other words, if the application rate is 2 lbs a.i./A, but with the targeted application equipment only 1 lb ai/A is used, this corresponds to a 50% reduction in the spray drift buffer distance. This buffer reduction is greater than the reduction from using reduced application rates in the Draft Strategy for growers and other applicators who are not using targeted applications (*i.e.,* divide % reduction in application rate by 2). Additional details and rationale are available in **Section 4.3.11** of the Ecological Mitigation Support Document (Version 2.0).

Turning Above Canopy Nozzles Off and Using Axial Deflector

Based on evaluation of public comments on the Draft Insecticide Strategy, EPA determined that a buffer reduction in the size of the spray drift buffer of 10% would be reasonable when an applicator turns above canopy nozzles off and uses an axial deflector.

Expanding Definition of Windbreaks to include Artificial Screens

EPA included basic and advanced windbreaks as mitigation measures resulting in 50 to 75% reduction in the spray drift buffer in the Draft Insecticide Strategy. In this Final Strategy, based on public comment and literature submitted, EPA also included artificial screens, which are an established drift mitigation in orchards and vineyards (see **Section 4.3.9** of the Ecological Mitigation Support Document). EPA determined that artificial screens (semi-permeable curtain or netting) of equal height as the target crop or application release height (whichever is higher), should receive the same level of mitigation reduction in the spray drift buffer distance as a basic windbreak (50%) and these are now included in the description of windbreaks.

Skipping Last Downwind Row

Based on public comments received following the Draft Insecticide Strategy and additional analysis of the dataset underlying AgDRIFT®, EPA determined that a 50% reduction in the spray drift buffer distance could be available when there is no application to the last orchard/vineyard row, as the resulting deposition is equivalent to the basic windbreak (which EPA previously determined receives a 50% reduction in buffer distance). More details can be found in the windbreak section (**Section 4.3.9**) of the Ecological Mitigation Support Document (Version 2.0).

**Table 10. Mitigation Measures Identified When Making Airblast Applications**

| Mitigation Measure | Percent Reduction in Distance |
|---|---|
| **Application Parameters** | |
| Reduced single application rate using non-targeted application equipment[1] | Divide % reduction in application rate by 2 (*e.g.*, 50% reduction in application rate corresponds to 25% reduction in buffer size) |
| Reduced single application rate with targeted application equipment[1,2] | % reduction corresponds to application rate[1] (*e.g.*, 50% reduction in application rate corresponds with a 50% reduction in buffer size) |
| Targeting application by turning off nozzles spraying above crop canopy combined with use of deflectors[1] | 10%[1] |
| **Reduced Proportion of Orchard Treated (Number of Treated Rows[3])** | |
| 1 row | 70% |
| 2-4 rows | 30% |
| 5-10 rows | 15% |
| **Other Mitigation Measures** | |
| Downwind windbreak/hedgerow/riparian/forest/woodlots/ shrubland | 50% for basic windbreak/hedgerow, or use of artificial screen[1] ≥height of orchard<br>75% for advanced windbreak/hedgerow<br>100% for riparian/forests/shrubland/woodlots >60ft width |
| Skipping last downwind row of orchard/vineyard[1] | 50% |

[1]New airblast buffer reduction mitigation

[2] Targeted application equipment includes airblast equipment with pulse-width modulated (PWM) nozzles with canopy sensing equipment that turns nozzles off when crop canopy is not present.

[3] A spray drift buffer applies to downwind non-target areas. The reduced number of treated rows applies to the upwind part of the treated field.

#### *3.2.1.4 Description of Managed Areas that can be Subtracted from Spray Drift Distances*

As described above, EPA relies upon the AgDRIFT® model for ground and aerial spray drift estimations. The models for ground and aerial drift were developed based on several underlying assumptions, including drift depositing onto a bare field, no obstructions to intercept spray droplets that drift off-field, and a prevailing wind direction. In practice, farms may have managed lands in areas adjacent to a pesticide application. While these managed practices may not be intentionally created for the purpose of mitigating pesticides, their composition and size on the landscape could act like a buffer (*e.g.,* roads) or intercept spray drift (which the model does not take into account) and reduce the distance spray drift may travel. Additionally, EPA's use of the term "managed" is inclusive of all active management (*e.g.*, mowing, planting, thinning, logging) as well as passive management (*e.g.*, set aside lands such as riparian buffers that may have little to no active management). To the extent that such managed areas are downwind and immediately adjacent to a pesticide application, EPA has included information about areas that can be considered within the drift buffer distance. In other words, growers and other applicators could subtract managed areas immediately adjacent to the treated field from their identified buffer distance (see **Table 11**).

**Table 11. Downwind Managed Areas that Can Represent Spray Drift Buffers**

| |
|---|
| When spray drift buffers are identified as mitigations, the following managed areas can be included in the buffer if they are immediately adjacent/contiguous to the treated field in the downwind direction and people are not present in those areas (including inside closed buildings/structures). If the pesticide product label or bulletin, or the state or local government in which the application area is located, has a requirement that prohibits or restricts spray drift in any area, including these specific managed areas, that prohibition/restriction must be followed.<br>a. Agricultural fields, pastures, forage fields, and private rangelands, including untreated portions of the treated field;<br>b. Roads, paved or gravel surfaces, mowed grassy/fallowed areas adjacent to field, and areas of bare ground from recent plowing or grading that are contiguous with the treated area;<br>c. Buildings and their perimeters, silos, or other man-made structures with walls and/or roof;<br>d. Areas present and/or maintained as a runoff/erosion measure as listed on EPA's Mitigation Menu website. Examples include vegetative filter strips (VFS), field borders, grassed waterways, vegetated ditches, riparian areas, managed/constructed wetlands, or other areas of intentional habitat improvement;<br>e. Areas present and/or maintained as a drift buffer reduction measure as listed on EPA's Mitigation Menu website. Examples include vegetative windbreaks, hedgerows, shelterbelts, riparian areas, private forests, woodlots, and shrublands;<br>f. Conservation Reserve Program (CRP)[1] and Agricultural Conservation Easement Program (ACEP) lands;<br>g. On-farm contained irrigation water resources that are not connected to adjacent water bodies, including on-farm irrigation canals and ditches, water conveyances, managed irrigation/runoff retention basins, farm ponds, and tailwater collection ponds. |

[1] Applicators may need to ensure that pesticide use does not cause degradation of the CRP habitat.

In some cases, areas maintained as a mitigation measure for drift or runoff/erosion control, managed areas, and CRP lands could potentially represent habitat for listed species. There can be significant benefits of these habitats to listed species, with a net gain to the species when considering benefits vs. impacts of pesticides. Not all of these areas represent high quality habitat for listed species (*e.g.,* listed plants are not expected to occur within these areas). In some cases, individuals of a species may be attracted to an area that represents habitat (*e.g.,* insects may be attracted to habitat created for pollinators); however, not enough individuals are expected to be impacted within the portion of the exposed area of the habitat such that there would be an impact on the population that would outweigh the overall benefit provided by creation of the habitat. EPA does not want to disincentivize growers and other applicators from providing such habitats, which may have considerable benefits to species, their environment, and pesticide use reductions. Therefore, managed areas that include habitat may be part or all of the spray drift buffer.

**Figure 6** and **Figure 7** represent examples of how spray drift buffers can be reduced where a pesticide product label identifies a 50-foot downwind spray drift buffer. The applicator could subtract the 10-foot off-field area downwind where the grower or other applicator has CRP land and the 20-foot-wide downwind windbreak, leaving only a 20-foot in-field buffer to meet the identified buffer distance (**Figure 6**). In contrast, if the off-field downwind areas of the CRP land and windbreak totaled 50 feet or more this would equal the identified spray drift buffer distance (as shown in **Figure 7**).

EPA is continuing to explore the possibility of describing areas to buffer from (*i.e.*, “protected areas”), as opposed (or in addition) to describing areas that can be included in the buffer. This is based on multiple inquiries EPA received requesting guidance on what could be included in the buffer based on the attributes of the grower’s landscape on or around their farm. This indicates that the “managed area” language may be unclear for some users and would need to have a much longer list of landscape attributes. EPA also received comments indicating concern that the language allows for chemical trespass which can conflict with local and state drift restrictions, as well as best practices to ensure the pesticide product stays on-target. Labeling language listing areas to protect instead of listing areas to include in a buffer may help simplify the label compliance process for growers. EPA plans to continue to improve upon and clarify this language along with soliciting feedback through its public comment processes and through the registration and registration review process.

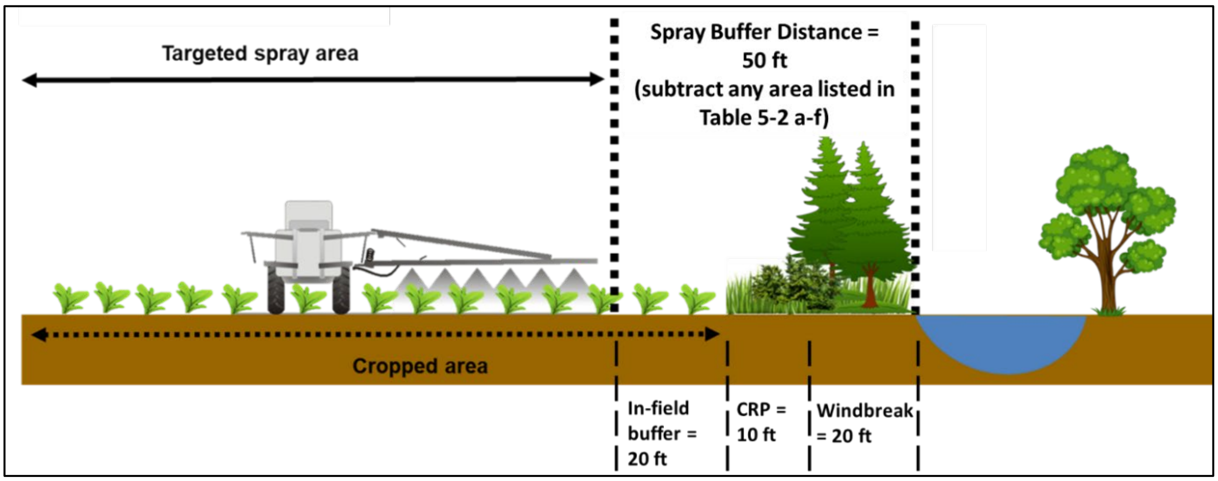

**Figure 6. Diagram of the Field (Cropped Area) with a Downwind Spray Drift Buffer[40] that Includes a Portion of the Cropped Area Because the Adjacent Managed Areas Are Less Than the Identified Spray Drift Buffer Distance**

[40] This figure is based on a diagram from the Pest Management Regulatory Agency of Health Canada (2020), which EPA was permitted to reproduce. The original figure is available at: https://www.canada.ca/en/health-canada/services/consumer-product-safety/pesticides-pest-management/growers-commercial-users/drift-mitigation/protecting-habitats-spray-drift.html. EPA has edited the original figure to provide an example of the areas that can be subtracted from spray drift buffer distances.

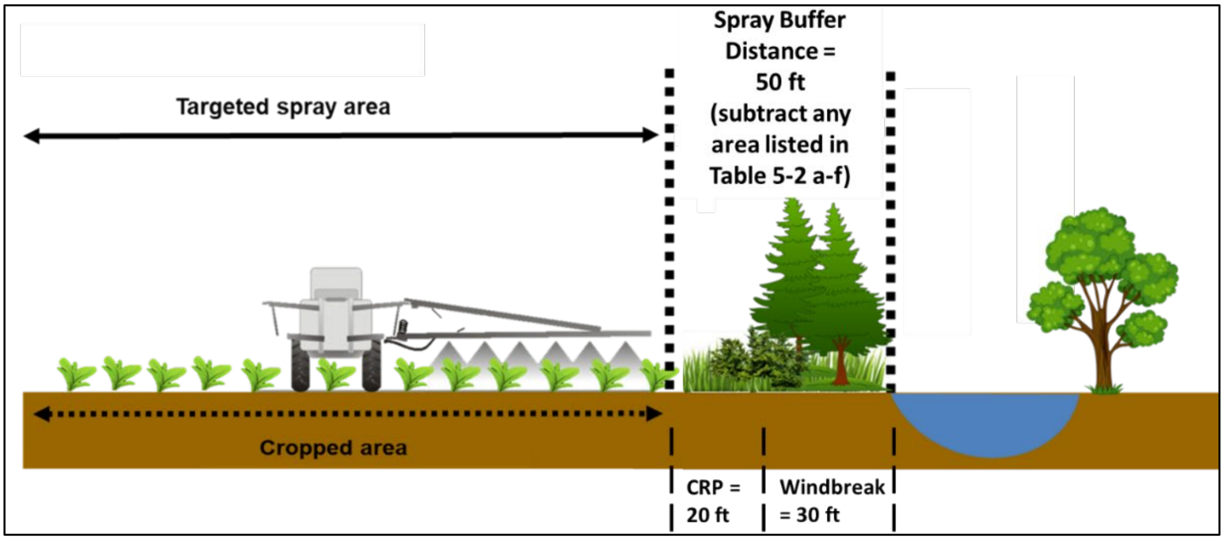


**Figure 7. Diagram of the Field (Cropped Area) with No Cropped Area Included in the Downwind Spray Drift Buffer Because Adjacent Managed Areas Are Equal to the Identified Spray Drift Buffer Distance**[40]

### *3.2.1.5 Spray Drift Exposure Associated with Overhead and Impact Sprinkler Chemigation Systems*

Overspray from overhead and impact sprinkler chemigation systems can expose non-target species to insecticides. EPA identified mitigation measures for overhead and impact sprinkler chemigation equipment when it identifies a potential for population-level impacts to listed species. The measures are listed below in **Table 12**. These measures include either spray drift buffers (that reduce the potential for spray drift by 1-2 orders of magnitude from these types of application) or other measures intended to reduce the potential for irrigation overspray into non-target areas. The type and extent of the identified measures depends on the level of the potential for population-level impacts as well as the type of chemigation equipment. The table below and the Ecological Mitigation Support Document provide additional discussion and details about the measures identified to mitigate low, medium, and high population-level impacts. The table below provides mitigation measures based on currently available data and technology. If new data (*e.g.*, spray drift data on impact sprinklers) or new technology (*e.g.*, commercially available chemigation nozzles that are classified according to ASABE Standard S572.1) become available, these mitigation measures may be reconsidered.

**Table 12. Mitigation Measures Identified for Pesticide Applications via Overhead and Impact Sprinkler Chemigation Systems**

| Potential for Population- Level Impacts from Step 1 | Mitigation Measures | |
|---|---|---|
| | **Overhead Chemigation[1]** | **Non-End Gun Impact Sprinklers** |
| Not Likely | None | None |
| Low | No end gun or 10 ft buffer | Limit throw distance to edge of field (treated area)[2] or 10 ft buffer |
| Medium | No end gun and one of the following: reduce pressure (<20 psi); reduce release height (<5 ft); have a windbreak[3] or 10 ft buffer | |
| High | 25 ft buffer or No end gun and two of the following: reduce pressure (<20 psi); reduce release height (<5 ft); have a downwind windbreak[3] | Limit throw distance to edge of field (treated area) AND have downwind windbreak[3]. Alternatively, use a 25 ft buffer |

[1] Refers to center pivot, overhead systems, traveler systems that have sufficient pressure/end guns.
[2] This can be accomplished by either reduced pressure and/or reduced throw angle.
[3] This can be a windbreak/hedgerow/riparian/forest/shrubland/woodlots. See the Ecological Mitigation Support Document for additional details.

#### *3.2.1.6 Summarizing Step 2 Spray Drift Mitigations*

In the sections above, EPA described in **Step 1** the process for determining the potential for population-level impacts from spray drift exposures and the level of spray drift mitigation that would be needed to address the potential for these impacts as well as identify mitigation measures and considerations to reduce the spray drift buffer.

**Figure 8** summarizes the steps involved in identifying whether spray drift mitigation measures would be needed to address the potential for population-level impacts to listed species from insecticide applications to a given farm/field and if so, which measures could be applied. The details supporting this decision tree are provided in the previous sections. As new information becomes available, EPA will update its mitigation options as appropriate and post theses updates on its mitigation menu website (https://www.epa.gov/pesticides/mitigation-menu). Therefore, the summary shown in **Figure 8** is for illustrative purposes only. Growers or pesticide applicators should consult the mitigation menu website to obtain the latest information pertaining to selecting spray drift mitigation measures for their specific situation. In general, spray drift mitigation measures are identified and selected according to the following steps:

- First, read the insecticide product label(s), look for use directions pertaining to spray drift mitigation (Step 1 in **Figure 8**).

- Identify whether the type of use or characteristics of the field and downwind areas exclude the need for additional spray drift mitigation (Step 2 in **Figure 8**).

- If spray drift mitigation is needed, identify the insecticide and use that requires the maximum spray drift buffer (Step 3 in **Figure 8**). Existing spray drift mitigation measures defined on the label should be considered in this step.

- Next, subtract the total distance of downwind "managed areas" downwind of the application site from this maximum buffer (Step 4 of **Figure 8**). If the spray drift buffer is greater than ten feet, additional spray drift mitigations could be considered.

- Finally, in step 5, identify additional spray drift mitigation measures that are applicable to the application scenario (*e.g.*, use of a hooded sprayer, have an appropriate windbreak), and add up the percent reductions that apply to those mitigation measures. If after applying the mitigations the remaining buffer distance is less than ten feet (rounding to the nearest five feet), no further ecological spray drift mitigation measures are needed (although any spray drift reduction measures specified on the label for human health would still apply). If the remaining buffer distance is ten feet or greater (rounding to the nearest five feet), this becomes the remaining spray drift buffer. Notably, there may be some circumstances which could require mitigations to less than ten feet; these will be addressed on a case-by-case basis.

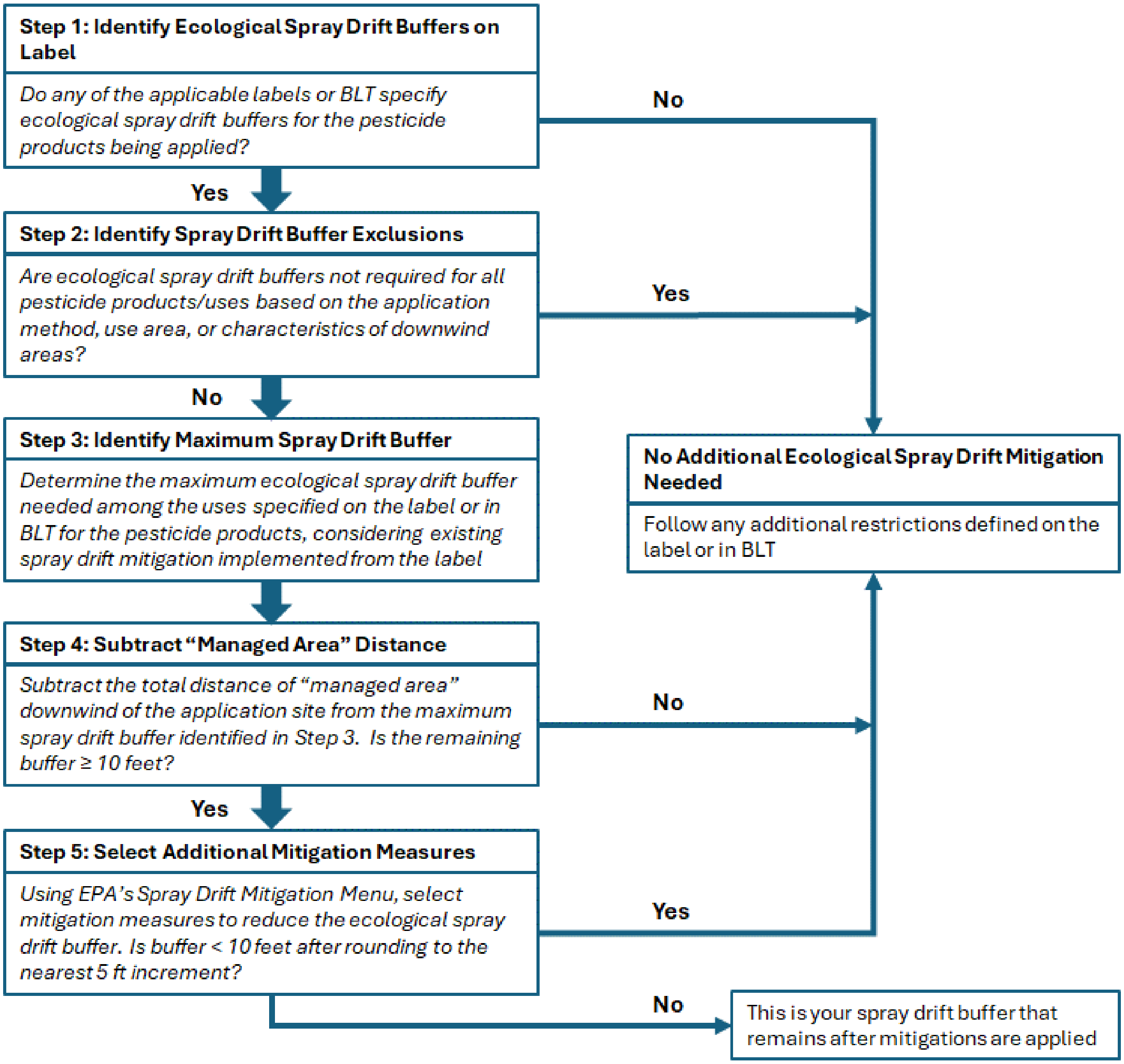


**Figure 8. Illustrative Process Summary for Identifying Ecological Spray Drift Mitigation Measures Required for Labeled Insecticide Uses**

### 3.2.2 Runoff/Erosion Mitigation Measures

EPA developed a runoff/erosion mitigation menu that would apply when EPA identifies the need for mitigations (during consideration of a FIFRA action) to address impacts to non-target species, including listed species. The mitigation menu was designed to provide flexibility for growers and other applicators to use mitigations that are best for their situation when a pesticide product labeling requires achieving a level of mitigation. These measures are identified in **Table 14** and are described in more detail in the Ecological Mitigation Support Document Version 2.0. EPA categorized these runoff/erosion mitigation measures as follows:

- **Application Parameters** that growers and other applicators may elect to employ to reduce potential pesticide runoff and erosion (annual application rate reduction, partial field treatment, soil incorporation).

- **Field Characteristics** that are likely to indicate the field will have less runoff and erosion than other fields and thus need fewer mitigation measures to reduce runoff/erosion transport (*e.g.,* fields with a low slope likely have less runoff/erosion, permeable sandy soils have less runoff than high clay content soils).

- **In-field Mitigation Measures** that applicators may elect to employ to reduce potential pesticide runoff and erosion are those that involve the management of the field (*e.g.,* management of irrigation water, cover crops, or reduced tillage).

- **Adjacent to the Field Mitigation Measures** are those that occur next to the field and down-gradient from where the pesticide application occurs and between the treated field and species' habitat (*e.g.,* grassed waterway, VFS). Some measures may be employed on the field and also adjacent to the field, so they are included in both categories (*e.g.,* VFS).

- **Systems that Capture Runoff and Discharge** are those that capture, collect, and discharge runoff through discrete conveyances (*e.g.,* water retention systems such as ponds and sediment basins).

- **Other Mitigation Measures** are those that may be considered but that do not fit into the categories above.

Additional considerations associated with the extent of mitigation associated with any particular field or area include:

- **Pesticide Runoff Vulnerability**: EPA conducted an analysis of pesticide runoff vulnerability across the lower 48 states that may influence the amount of runoff/erosion mitigation for a particular site. Based on this analysis, applications in areas that are less prone to pesticide runoff and/or erosion would need less mitigation (*i.e.* would receive mitigation relief points) than applications conducted in more vulnerable areas.

- **Areas 1000 Feet Down-Gradient from Application Areas**: These are areas where there is not a potential for population-level impacts from off-site exposure to runoff/erosion from pesticide applications.

- **Conservation Program and Runoff/Erosion Specialists/Mitigation Tracking:** Recognition through mitigation relief points available to growers and other applicators who work with a runoff/erosion specialist or participate in a conservation program that they would likely achieve higher than average mitigation measure efficacy and benefits of mitigation tracking.

- **Treated Seeds:** When a grower or other applicator uses a seed treatment on their field, the FIFRA label may indicate the need for a certain number of mitigation points and/or point to Bulletins. When a grower is planting seed that has previously been treated, the seed bag tag may include advisory language, including directing the grower to the mitigation menu website, to identify mitigation measures and levels of mitigation that the grower may use to decrease potential population-level impacts from the treated seed.

As described in **Section 3.2.2.5**, EPA has identified several mitigation measures that when employed on a field by themselves, would result in runoff/erosion exposures that would not likely have a potential for population-level impacts. If the mitigation measures are employed, then no further runoff/erosion mitigations would be needed:

- Systems with berms,
- Tailwater return systems, and
- Subsurface tile-drains, *with* controlled drainage structures.

In addition, EPA's evaluation indicated the runoff/erosion exposure from several insecticide application methods would be limited and thus the potential for population-level impacts is unlikely. These application methods include the following:

- Tree injection,
- Subsurface chemigation methods, including subsurface and under non-permeable plastic surfaces,
- Soil injection, and
- Less than 1/10 acre (<4356 square feet) treated and spot treatment (<1000 sq ft treated) (*e.g.,* when applied with backpack or handheld sprayers).

As detailed in the Ecological Mitigation Support Document, for each of the measures included in the runoff/erosion mitigation menu, EPA evaluated their effectiveness at reducing offsite transport via runoff/erosion (high, medium, or low). In general, a mitigation with a low, medium, or high efficacy achieves an average of 10-30%, 30-60%, and greater than or equal to 60% reduction, respectively. EPA's evaluation of the efficacy for each mitigation measure is ultimately based on available information that EPA considered and using its best professional judgment determined the mitigation's potential to be effective at reducing offsite transport of pesticides.

In order to include as many options as feasible across dozens of measures with varying degrees of efficacy, EPA utilized a point system for runoff/erosion mitigations to: (1) associate the number of points with each MoD category for runoff/erosion; and (2) assign lower or higher point values to mitigation practices that are less or more effective, respectively, in reducing runoff/erosion. EPA assigned efficacy points to each of the measures on the runoff/erosion mitigation menu based on the efficacy of reducing exposure of the mitigation measure. High efficacy mitigation measures are worth 3 points, medium efficacy measures are worth 2 points, and low efficacy measures are worth 1 point **(Table 14**).

#### *3.2.2.1 Level of Mitigation Identified for Runoff/Erosion*

Where EPA determines (through a FIFRA action) there is a potential for population-level impacts associated with runoff/erosion to be low, medium, or high, EPA would identify the level of mitigation to reduce exposures so that population-level impacts are no longer likely. EPA determines this first based upon the MoDs associated with the use of the pesticide being evaluated, which are related to the potential for population-level impacts. Mitigation measures (or combination of mitigation measures) that achieve three points are functionally equivalent to approximately an order of magnitude reduction in off-field exposure concentrations of pesticides transported via runoff. For erosion-prone chemicals and those bound to sediment, EPA adjusts the points to achieve an order of magnitude reduction. For erosion, two points are generally equivalent to an order of magnitude reduction given the lower mobility of soil particles relative to water and increased effectiveness of mitigation practices in reducing soil in runoff. This order of magnitude reduction is equivalent to the reduction needed to drop from one category of potential for population-level impacts to a lower category (*e.g.,* from high to medium). **Table 13** presents the number of points EPA has identified to address potentials for population-level impacts of runoff/erosion to aquatic habitats used by invertebrates (*e.g.,* mussels, insects).

**Table 13. Number of Mitigation Points Identified to Reduce Exposure via Runoff and Erosion**

| Potential for Population-level Impacts | Magnitude of Reduction in Exposure Needed to Result in a "Not Likely" Potential for Population-Level Impacts Conclusion | Mitigation Points Identified | |
|---|---|---|---|
| | | Runoff-Prone [$K_{OC}$ <1000 or $K_d$ <50][1] | Erosion-Prone [$K_{oc}$ $\geq$1000 or $K_d$ $\geq$50][1] |
| Not Likely | None | None | |
| Low | 10x | 3 | 2 |
| Medium | 100x | 6 | 4 |
| High | 1000x | 9 | 6 |

[1] The soil-water distribution coefficient ($K_d$) and organic-carbon normalized soil-water distribution coefficient ($K_{OC}$) are measures of the propensity of a chemical to be dissolved in water or sorbed to soil or sediment. $K_{OC}$ and $K_d$ values are measured in studies conducted under OPPTS Guideline 835.1230 (USEPA, 2008). The average $K_{OC}$ or $K_d$ is used to distinguish between runoff-prone and erosion-prone pesticides.

While a multitude of factors determine the fate and transport of a pesticide in the environment, one fundamental physio-chemical property is the sorption coefficient, given as the $K_{OC}$ or $K_d$.[41] This property describes whether a chemical tends to adsorb to soil particles or remain in water (USEPA, 2008). Chemicals with a higher $K_{OC}$ tend to adsorb to soil and are more likely to be transported by soil erosion, while chemicals with lower $K_{OC}$ tend to partition to water and are more likely to be present in runoff.

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[41] The organic-carbon normalized soil-water distribution coefficient ($K_{OC}$) is a measure the propensity of a pesticide to be dissolved in water or sorbed to soil or sediment. For some pesticides, sorption is described using the soil-water distribution coefficient ($K_d$) without organic-carbon normalization. $K_{OC}$ and $K_d$ values are measured in studies conducted under OPPTS Guideline 835.1230 (USEPA, 2008).

Several of the runoff/erosion mitigation measures listed in the Ecological Mitigation Support Document function by removing soil, and therefore soil-sorbed pesticides, from runoff. This difference between chemical sorption tendencies results in runoff and erosion mitigations being inherently more effective for erosion-prone pesticides. Examples of this phenomena can be seen in the literature for various mitigation measures, including vegetative filter strips, sedimentation basins, and cover crops/mulching. Across these three examples, mitigation measures were found to be 20-30% more efficacious for sediment prone pesticides than for runoff prone pesticides (Ecological Mitigation Support Document). EPA used this difference as the basis for reducing the number of mitigation points erosion-prone pesticides would need to prevent population-level impacts, compared to runoff prone pesticides (**Table 13**).

#### *3.2.2.2 Runoff and Erosion Mitigation Measures Menu*

EPA developed a runoff/erosion mitigation menu (housed on an EPA website) that would be available to growers and other applicators to assist with complying with pesticide labels that require mitigations for non-target species, including listed species. EPA assigned efficacy points to each of the measures on the runoff/erosion mitigation menu based on the efficacy of reducing exposure of the mitigation measure. As of March 2025, the mitigation measures included on the menu and associated point values are presented in **Table 14**.

Mitigation measures that have been identified as of March 2025 are described in the Ecological Mitigation Support Document Version 2.0, and the mitigation list and point system outlined in that document are expected to be incorporated into the mitigation menu website later in 2025.

EPA has identified runoff/erosion mitigations for which efficacy data are available to provide options and flexibility for the grower or other applicator.[42] EPA welcomes input on the efficacy of additional measures that growers and other applicators may be using that the Agency did not include. EPA acknowledges that the mitigation menu will continue to evolve over time and the Agency plans to update the mitigation menu with additional measures or refinements to those identified to date as new information becomes available.

[42] The Insecticide Strategy provides for mitigation points for measures already employed if the measures are known to be efficacious for reducing runoff/erosion. If a grower/applicator is already implementing a mitigation measure on the menu, they would be able to implement fewer additional measures on their field to achieve the mitigation points identified by the Insecticide Strategy.

**Table 14. Runoff/Erosion Mitigation Measures and Associated Point-Values for Reducing Exposures** [43]

| Mitigation Measure Title[1] | Conditions that Qualify[1,2] | Efficacy Classification | Points |
|---|---|---|---|
| **Application Parameters** | | | |
| Reduction in Pesticide Application Rate | Any application 10% to <30% less than the maximum labeled annual application rate | Low | 1 |
| | Any application 30% to <60% less than the maximum labeled annual application rate | Medium | 2 |
| | Any application ≥60% less than the maximum labeled annual application rate | High | 3 |
| Reduction in Proportion of Field Treated | 10 to <30% of Field Area not treated (Banded application, partial treatment, precision sprayers) | Low | 2 |
| | 30 to <60% of Field Area not treated (Banded application, partial treatment, precision sprayers) | Medium | 3 |
| | >60% of Field Area not treated (Banded application, partial treatment, precision sprayers) | High | 4 |
| Soil incorporation | Watering-in or mechanical incorporation before runoff producing rain event. | Low | 1 |
| **Field Characteristics[3,4]** | | | |
| Field with slope ≤ 3% | Naturally low slope or flat fields; flat laser leveled fields | Medium | 2 |
| Predominantly Sandy Soils[5] | Fields with 10-20% clay and 50-90% sand typically loamy sand and sandy loam but can include loam, silt loam, silt or sandy clay loam soils if well aggregated, of low bulk density, or contain >35% rock fragments) without a restrictive layer that impedes the movement of water through the soil impedes the movement of water through the soil (HSG B soils) | Medium | 2 |
| | Fields with ≤10% clay and ≥90% sand (typically sand but can include loamy sand, sandy loam, loam, or silt loam soils if well aggregated, of low bulk density, or contain >35% rock fragments) without a restrictive layer that impedes the movement of water through the soil (HSG A soils) | High | 3 |

[43] Current as of Insecticide Strategy Publication Date. The actual menu should be consulted from the website: https://www.epa.gov/pesticides/mitigation-menu.

| Mitigation Measure Title[1] | Conditions that Qualify[1,2] | Efficacy Classification | Points |
|---|---|---|---|
| **In-Field Mitigation Measures** | | | |
| Conservation Tillage | Reduced tillage, mulch tillage, ridge tillage | Medium | 2 |
| | No-till | High | 3 |
| Reservoir Tillage | Reservoir tillage, furrow diking, basin tillage | High | 3 |
| Contour Farming | Contour farming, contour tillage, contour orchard and perennial crops | Medium | 2 |
| In-field Vegetative Strips | Inter-row vegetated strips, in-field vegetative strips, strip cropping, contour buffer strips, contour strip cropping, prairie strip, alley cropping, vegetative barrier (occurring in a contoured field) | Medium | 2 |
| Terrace Farming | Terrace farming, terracing, field terracing | Medium | 2 |
| Cover Crop/Continuous Ground Cover | Cover crop, double cropping, relay cropping | Low (Tillage used) | 1 |
| | | Medium (No tillage, short term) | 2 |
| | | High (No tillage, long term) | 3 |
| Irrigation Water Management | Use of soil moisture sensors/evapotranspiration meters with center pivots & sprinklers; above ground drip tape, drip emitters; micro-sprinklers; computerized hole selection & surge values for furrow irrigation | Medium | 2 |
| | Below tarp irrigation, below ground drip tape; dry farming, non-irrigated lands | High | 3 |
| Anionic Polyacrylamide (PAM) | Use of water-soluble formulations of anionic polyacrylamide in irrigation water | Medium | 2 |
| Mulching with Natural and Artificial Materials | Mulching with artificial materials | Low | 1 |
| | Mulching with natural materials | High | 3 |
| Erosion Barriers | Wattles, Silt Fences | Medium | 2 |
| **Adjacent to Field Mitigations[6]** | | | |
| Grassed Waterway | Grassed waterway | Medium | 2 |
| Vegetative Filter Strips (VFS) – Adjacent to the Field | Vegetative barrier, field border 20 to <30 ft | Low | 1 |
| | Vegetative barrier, field border 30 to <60 ft | Medium | 2 |
| | Vegetative barrier, field border >60 ft | High | 3 |
| Vegetated Ditch | Vegetated ditch | Low | 1 |

| Mitigation Measure Title[1] | Conditions that Qualify[1,2] | Efficacy Classification | Points |
|---|---|---|---|
| Riparian Area | Riparian forest buffer, riparian herbaceous cover 20 to <30 ft | Low | 1 |
| | Riparian forest buffer, riparian herbaceous cover 30 to <60 ft | Medium | 2 |
| | Riparian forest buffer, riparian herbaceous cover ≥60 ft | High | 3 |
| Wetland and Riparian Habitat Improvement | Constructed wetlands, Wetland and Riparian Landscape/Habitat Improvement | Medium | 2 |
| Landscape/Habitat Improvement | Terrestrial landscape/habitat improvement 20 to <30 ft | Low | 1 |
| | Terrestrial landscape/ habitat improvement 30 to <60 ft | Medium | 2 |
| | Terrestrial landscape/ habitat improvement ≥60 ft | High | 3 |
| Filtering Devices with Activated Carbon or Compost Amendments | Filters, sleeves, socks, or filtration units containing activated carbon | High | 3 |
| | Filters, sleeves, socks containing compost | Low | 1 |
| **Systems that Capture Runoff and Have Controlled Discharges** | | | |
| Water Retention Systems | Retention pond, sediment basins, catch basins, sediment traps | Medium | 2 |
| Subsurface Drainages and Tile Drainage Installed *without* Controlled Drainage Structure | Subsurface tile drains, tile drains | Low | 1 |
| **Other Mitigation Measures** | | | |
| Mitigation measures from multiple categories (*i.e.*, in-field, adjacent to the field, or water retention systems) are utilized.[7] | See measures in categories above. Measures must be used from at least 2 of the following categories: in-field, field-adjacent, or systems that capture runoff and discharge | Low | 1 |

[1] EPA's Mitigation Menu and measure descriptions specific to pesticides are available in the following websites: https://www.epa.gov/pesticides/mitigation-menu and https://www.epa.gov/pesticides/menu-measure-descriptions. If the state has a more restrictive requirement, that must be followed in that state. Not all measures are applicable to all fields and crops.

[2] Only one of the measures that qualify from a single 'mitigation menu item' can be used. For example, a user could get mitigation points for cover cropping or double cropping but not both.

[3] Multiple field characteristics may apply to an individual field.

[4] Mitigation relief points for field characteristics are presented in this Mitigation Measures table for convenience, but since they are inherent characteristics of the field, they are mitigation relief points and presented as such on the mitigation menu website (https://www.epa.gov/pesticides/mitigation-menu).

[5] Soil texture and hydrologic soil group (HSG) areas defined by USDA's soil classification system. See USDA's Web Soil Survey tool to determine soil texture and HSG: https://websoilsurvey.nrcs.usda.gov/app/.

[6] Adjacent to the field mitigations should be located downgradient from a treated field to effectively reduce pesticide exposure in runoff and erosion.

[7] For example, if a cover cropping and adjacent to the field VFS are both utilized, the efficacy of the mitigation measures in combination may be increased.

#### *3.2.2.3 Mitigation Relief based on Pesticide Runoff Vulnerability*

The amount of runoff and erosion transport differs across the conterminous United States, especially due to differences in frequency and amount of rainfall. EPA evaluated the scientific literature and conducted analyses to differentiate geographical areas by rainfall and soil type and reduced the amount of runoff/erosion mitigation identified consistent with lower amounts of runoff/erosion in the appropriate areas. As described in more detail in the Ecological Mitigation Support Document, EPA evaluated the relative vulnerability of areas across the lower 48 states to pesticide runoff using PWC. EPA used a generic runoff-prone chemical with approximately three million scenarios across the lower 48 states to rank runoff vulnerability relative to the modeled maximum scenario. The scale of this modeling simulation was conducted at a much finer resolution than that of EPA's standard aquatic modeling for regulatory actions (*i.e.,* 2-digit Hydrologic Unit Code (HUC) resolution).

The evaluation of this information resulted in a determination that pesticide runoff vulnerability can be defined at a county level with four categories (very low, low, medium and high) representing spatially where exposures of pesticides in runoff may be representative of EPA's upper bound estimates (*e.g.,* high pesticide runoff vulnerability counties) compared to areas where concentrations in pesticide runoff are likely being overestimated (*e.g.,* counties with very low pesticide runoff vulnerability). The relative level of pesticide runoff vulnerability that EPA expects for each of these categories is summarized in **Table 15**.

Counties classified as highly vulnerable to pesticides occurring in runoff would reflect those that have the highest potential for population-level impacts. EPA chose the county-level scale to communicate runoff vulnerability to balance ease of communication, data resolution, and environmental variability. For medium, low, and very low vulnerability areas, EPA's evaluation shows the potential for population-level impacts may be increasingly overestimated compared to the highly vulnerable areas. To account for this overestimation, EPA identified mitigation relief in the form of points. EPA assigned relief[44] points to all counties with medium (2 points), low (3 points), or very low (6 points) pesticide runoff vulnerability (**Table 15**; **Figure 9**). This county-level relief reduces the amount of additional mitigation that would be identified in areas that do not have high pesticide runoff vulnerability. This approach represents a spatially refined analysis (compared to EPA's national-level screening assessments) where EPA can consider differences in exposure across the country and the amount of relief points align with the magnitude of difference methodology described in **Step 2**. Just as in **Step 2**, each order of magnitude reduction is equivalent to 3 relief points, so EPA assigned areas with very low pesticide runoff vulnerability 6 relief points (approximately 2 orders of magnitude reduction), 3 relief points to areas with low pesticide runoff vulnerability (approximately 1 order of magnitude reduction), and 2 relief points to areas with medium pesticide runoff vulnerability (approximately ½ order of magnitude reduction).

EPA estimates that these relief points may reduce the additional runoff mitigation burden (level of mitigation points identified) for approximately 80% of cultivated agriculture acres and 95% of specialty

[44] EPA describes relief as a level of reduction for required points of a given pesticide and is based on a field's geographic location.

and minor crop production acres. Relief points can be used when mitigations are applied across the full spatial extent of a use pattern (*e.g.*, specific crops) on the general pesticide product label or in PULAs that fall within counties where relief points are available.

**Table 15. Categories of Magnitude of Difference from Nationwide Maximum Pesticide Runoff Vulnerability Score with Corresponding Associated Percentiles and Classifications**

| Order of Magnitude Lower than Maximum | Pesticide Runoff Vulnerability | |
|---|---|---|
| | Percentile | Classification |
| ~2 | 0 – 9% | Very low |
| ~1 | 10 – 49% | Low |
| Half | 50 – 84% | Medium |
| Maximum | 85 – 100% | High |

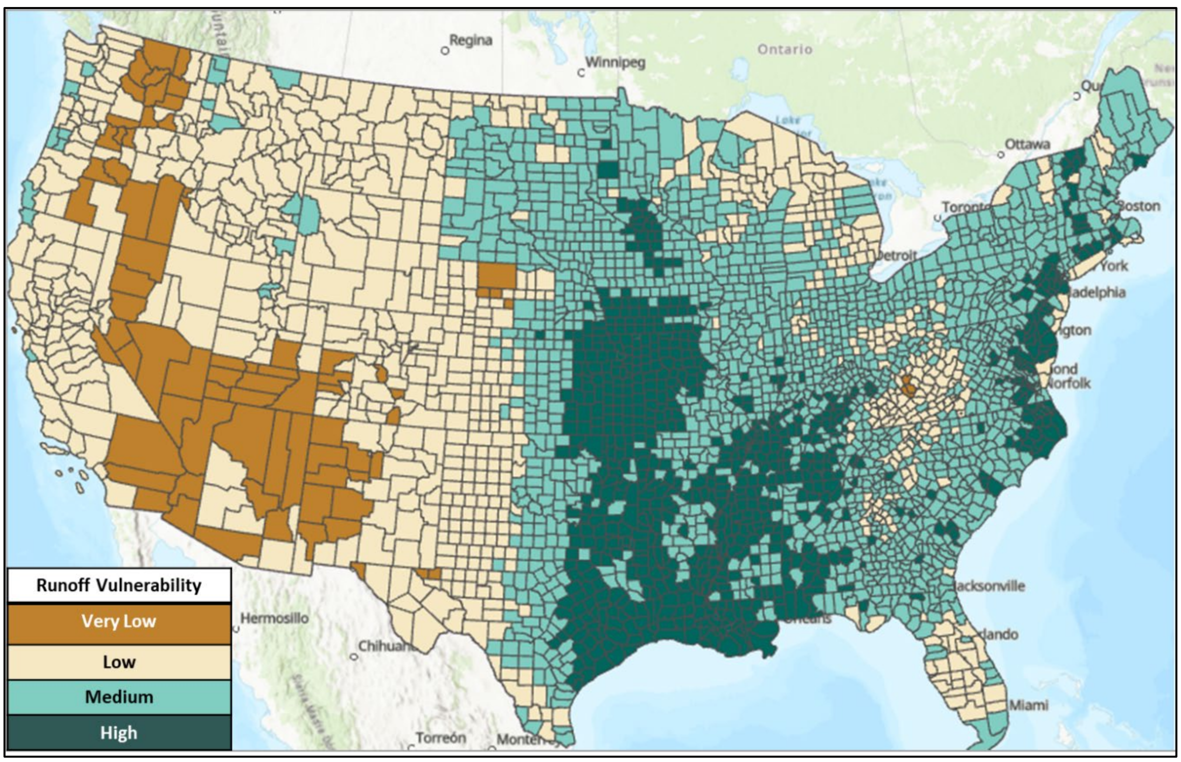

**Figure 9. Pesticide Runoff Vulnerability at the County Level**

#### 3.2.2.4 *Runoff/Erosion* Mitigation Relief for Areas 1000 feet Down-Gradient from Application Areas

Pesticide exposure to non-target organisms and their habitat via runoff/erosion is generally higher in areas that are closer to a pesticide application area. Runoff and erosion are directional, meaning off-site transport occurs when an adjacent area is at a lower elevation than a pesticide application area. As described in the Ecological Mitigation Support Document, based on an analysis of overland flow and sheet flow and the distance to various watersheds and waterbodies, EPA concluded that pesticide concentrations in runoff that have the potential to rise to population-level impacts can extend up to 1,000 feet downslope from a pesticide application. Accordingly, areas beyond 1,000 feet are likely to receive less runoff and erosion from the treated field, if at all, making the potential for population-level impacts unlikely. Therefore, EPA does not expect to identify runoff/erosion mitigations for pesticide applications areas more than 1,000 feet downslope from a terrestrial or aquatic habitat for listed species.

EPA has received comments from a wide variety of stakeholders that EPA should not rely on habitat descriptions to describe the types of habitats to which the downwind or downslope area applies because such descriptions can be ambiguous and difficult to interpret or translate from a label to the landscape that a pesticide user may be seeing.

When EPA develops PULAs for geographically specific runoff/erosion mitigations, it ensures the geographic extent of the mitigations does not extend beyond 1,000 feet from those areas it identifies for conservation of a listed species and its critical habitat (See **Section 3.3.2** for additional information on PULA development). However, in **Step 3** of the Insecticide Strategy framework, as described in **Section 3.3**, in some cases, EPA expects to identify mitigations on product labels for listed species that would apply across the full spatial extent of a use pattern (*e.g*., specific crops). In such cases, mitigations would be applicable only within 1,000 feet of habitats or waterbodies. To avoid confusion with trying to describe the number of possible habitats that may be applicable, EPA is using descriptions of managed lands as described below and summarized in **Table 16** to describe the type of landscape features that are included in the 1000-ft distance. For example, if a pesticide application is occurring in a landscape surrounded by other agricultural fields for more than 1000 feet downslope, then runoff or erosion mitigations would not be applicable.

Many farms have highly managed lands in areas adjacent to a pesticide application and EPA does not expect these managed lands to contain sufficiently suitable species habitat that enough individuals would be exposed to rise to a potential population-level impact. This similarly extends to managed areas containing mitigation measures to reduce drift or runoff/erosion as well as Conservation Reserve Program (CRP) lands. Additionally, EPA's use of the term "managed" is inclusive of all active management (*e.g.*, mowing, planting, thinning, logging) as well as passive management (*e.g.*, set aside lands such as riparian buffers that may have little to no active management). To the extent that managed areas represent the entirety of 1,000 feet downslope and immediately adjacent to a pesticide application, growers and other applicators would not need to implement runoff/erosion mitigations. **Table 16** describes the managed areas that EPA has identified for purposes of runoff/erosion mitigation.

**Table 16. Downslope Managed Areas within 1000 Feet Downslope of a Treated Area Where Runoff/Erosion Mitigations Would Not Be Needed**

a. Agricultural fields, pastures, forage fields, and private rangelands, including untreated portions of the treated field;
b. Roads, paved or gravel surfaces, mowed grassy/fallowed areas adjacent to field, and areas of bare ground from recent plowing or grading that are contiguous with the treated area;
c. Buildings and their perimeters, silos, or other man-made structures with walls and/or roof;
d. Areas present and/or maintained as a runoff/erosion measure as listed on EPA's Mitigation Menu website. Examples include vegetative filter strips (VFS), field borders, grassed waterways, vegetated ditches, riparian areas, managed/constructed wetlands, or other areas of intentional habitat improvement;
e. Areas present and/or maintained as a drift buffer reduction measure as listed on EPA's Mitigation Menu website. Examples include vegetative windbreaks, hedgerows, shelterbelts, riparian areas, private forests, woodlots, and shrublands;
f. Conservation Reserve Program (CRP)[1] and Agricultural Conservation Easement Program (ACEP) lands;
g. On-farm contained irrigation water resources that are not connected to adjacent water bodies, including on-farm irrigation canals and ditches, water conveyances, managed irrigation/runoff retention basins, farm ponds, and tailwater collection ponds.

[1] Growers and other applicators may need to ensure that pesticide use does not cause degradation of the CRP habitat.

EPA is currently exploring the possibility of describing protected areas or habitat, as opposed (or in addition) to managed areas that can be included when examining the area within 1,000 feet downslope of the treated field. This is based on multiple inquiries EPA received requesting guidance on what could be included in the downslope area based on the attributes of the grower's landscape on or around their farm. This indicates that the "managed area" language may be unclear for users and would need to have a much a longer list of landscape attributes. EPA also received comments indicating concern that the language allows for chemical trespass which can conflict with local and state drift restrictions, as well as best practices to ensure the pesticide product stays on-target. Labeling language listing areas to protect instead of listing areas to include in the downslope area may help simplify the label compliance process for growers. EPA plans to continue to improve upon and clarify this language and solicit feedback through its public comment processes through the registration and registration review process.

#### *3.2.2.5 Mitigation Measures That In And Of Themselves Reduce Exposure Such That Potential Population-level Impacts Are Unlikely*

In some instances, EPA may determine that growers and other applicators would not need additional runoff/erosion mitigation measures because a particular measure in and of itself reduces exposure such that potential population-level impacts are unlikely. Each of these measures is described in more detail in the Ecological Mitigation Support Document and summarized below.

Systems with permanent berms are treated fields that are surrounded by an elevated border or perimeter (*i.e.,* berms) at the time of application and carried through the cropping season. Under these conditions rainfall and irrigation water is expected to be kept on the treated field. Example cropping systems include cranberry bogs, rice paddies, and drainage ditch and berm systems.

For treated fields with irrigation tailwater return systems, all runoff water from rainfall or irrigation is collected and stored on site for later use. Thereby, runoff and/or erosion offsite from the field is not expected. Tailwater return systems are frequently paired with furrow and border-strip irrigation systems in both row and field crop agriculture.

If the field has subsurface drainage installed and maintained (*e.g.*, tile drains), runoff from the field will be greatly reduced. In order to maintain protection of non-target taxa, the subsurface tile drains must release the effluent (water) into water-controlled drainage structures or a saturation buffer zone that do not release water into downstream off-farm aquatic areas. Runoff from the entire field would need to be controlled and directed into a pond/saturation zone.

#### *3.2.2.6 Conservation Programs, Runoff/Erosion Specialists, and Mitigation Tracking*

EPA's evaluation of available efficacy data for many of the runoff/erosion mitigation measures demonstrates that the efficacy of many mitigations is highly variable from one study to the next (and from one site to the next). For any given mitigation measure, a range of efficacy is expected depending on the specific implementation of the measure, the environmental conditions of the area, site and soil characteristics of the treated field, maintenance, upkeep of the mitigation measure, and the physical-chemical properties of the pesticide.

Often, grower and other applicators work with a technical expert in runoff/erosion control or a conservation program with a goal of reducing runoff/erosion. Because these experts consider and make recommendations for the site-specific conditions, when a grower or other applicator installs a runoff/erosion measure to the specifications from such an expert, EPA has higher confidence that mitigation measures identified and implemented at the field level would achieve the higher end of the available efficacy data. As such, EPA is providing mitigation relief points for growers and other applicators that work with a qualifying technical expert **or** participate in a qualifying conservation program.

A grower or other applicator may receive mitigation relief points working with a technical expert or participating in a conservation program, but not both. The grower or other applicator would not get additional relief points for both working with an expert/specialist and for participating in a conservation program, since the expert/specialist is inherently part of the program. The grower or other applicator would receive relief points for any of their fields that are included in the expert consultation or conservation program, which could be an entire farm or a fraction of it (*e.g.,* some fields, but not all within a farm). Additionally, these relief points are not applicable to each mitigation measure but rather would be in addition to the points a grower or other applicator obtains from other mitigation menu items (*e.g.*, if the farm is located in an area of low runoff vulnerability) and for implementing mitigation measures. Each of these options and the associated mitigation relief points are described in more detail below.

#### 3.2.2.6.1 Following Recommendations from a Runoff/Erosion Specialist

Growers and other applicators may work with a technical expert to develop mitigation plans that work for their field and that are efficacious in reducing runoff and/or erosion. As described above, when a grower or other applicator is working with a technical expert who embodies the characteristics below, EPA expects that the mitigation measures would be selected and implemented considering site-specific conditions, including the soil type, field slope, hydrology, local climate, crop(s) grown, pest concerns, drainage systems, irrigation needs, and equipment availability. Technical experts have established norms and practices for specific cropping systems and regions based on real-world experience that can be accounted for in the planning process. Due to the ability of these technical experts to tailor best practices to local conditions, EPA expects the efficacy of runoff/erosion mitigation measures would be on the higher end of the range of efficacy (as compared to the average efficacy that EPA used when determining mitigation point values for different mitigation measures). To account for this, EPA identified **one runoff/erosion mitigation relief point** available to growers and other applicators that work with a runoff/erosion technical expert that meets the characteristics described below. The point for working with the technical expert is in addition to the points for implementing mitigation measures identified in the strategy.

EPA has reviewed available information regarding characteristics that often apply to meet the description of a technical expert. At a minimum, there is usually an education (and a continuing education) and an experience component. Based on this review, EPA identified three benchmarks for technical experts, which include:

- Have technical training, education and/or experience in an agricultural discipline, water or soil conservation, or other relevant discipline that provides training and practice in the area of runoff or erosion mitigation technologies/measures; **And**

- Participate in continued education or training in the area of expertise which should include runoff and erosion control; **And**

- Have experience advising on conservation measures designed to develop site-specific runoff and erosion plans that include mitigation measures described in EPA's Mitigation Website.[45]

EPA has identified the following examples of technical experts: NRCS and similar state or regional level program staff, Certified Crop Advisor, Pesticide Control Advisor, Certified Professional Agronomist, National Alliance of Independent Crop Consultants (NAICC), EnviroCert International, Inc., Certified Professionals in Erosion and Sediment Control, Technical Service Providers, and extension agents. **EPA acknowledges that this list is not exhaustive, and the inclusion of an organization should not be construed as an endorsement of any particular group by EPA.**

[45] EPA's Mitigation Menu is available at: https://www.epa.gov/pesticides/mitigation-menu and a description of the mitigations is available at https://www.epa.gov/pesticides/menu-measure-descriptions.

#### 3.2.2.6.2 Participating in a Conservation Program

Conservation programs can provide technical expertise as described above, as well as additional support to growers and other applicators. Based on EPA's review of available information on existing programs, this support may include oversight in the form of a review of design, installation, and upkeep/maintenance plans for the identified mitigations. In addition, the programs typically include documentation demonstrating how the site-specific plan meets any program requirements.

While conservation programs may not be solely designed to reduce offsite transport of pesticides, programs may offer several of the same types of mitigations that reduce offsite transport of nutrients and/or soil erosion from an agricultural field, thereby reducing offsite transport of pesticides. Evaluating a field for the purpose of reducing nutrients in runoff and/or soil erosion is likely to result in similar recommended mitigations as those included in the runoff mitigation menu.

In the Draft Herbicide Strategy (USEPA 2023), EPA proposed the possibility for an exemption for growers working within a conservation program or with a certified expert. When the Draft Insecticide Strategy and Final Herbicide Strategy were released (USEPA 2024a, 2024b), EPA's review of programs in the Ecological Mitigation Support Document (Version 1.0) found the following characteristics to be necessary to meet a designation of two mitigation relief points:

- The program provides advice from individuals who meet the same benchmarks provided above for technical experts; AND
- The program provides site-specific guidance tailored to the grower's crop and/or location; AND
- The program focuses on reducing or managing runoff and/or erosion (including for example, soil loss, soil conservation, water quality protection) from agricultural fields or other pesticide use sites; AND
- The program provides documentation of program enrollment. EPA is **not** suggesting that this documentation be provided to EPA; AND
- The program includes verification of implementation of the recommended measures or activities (demonstrating measures were established and maintained). Verification can be done through the conservation program and provided to the program enrollee. Verification is **not** required to be submitted to EPA.

Based upon feedback received during the comment periods for the Draft Herbicide and Insecticide Strategies, EPA reassessed the number of mitigation relief points designated to conservation programs. After completing the analysis, EPA determined there is a path forward for EPA to qualify individual conservation programs that meet 9 mitigation relief points. EPA's assessment is based on the mitigation measures the program is likely to use when combined with the mitigation relief points from EPA's Mitigation Menu; the ability of the program to adhere to the characteristics proposed in the Draft Insecticide Strategy could not be assessed without additional information from the programs. EPA will work with federal, state, and local stakeholders to identify programs that may qualify for 9 mitigation relief points, and EPA will develop a process to evaluate those programs. EPA expects to include opportunity for stakeholders to provide input. EPA intends to create a website that will house a list of qualified programs for the public. In the interim, conservation programs will be 2 mitigation relief points until they have been qualified as achieving 9 mitigation relief points. The rationale and additional characteristics of a conservation program that would be necessary to support an increase in relief points are described in more detail below.

During the comment periods for the Draft Herbicide Strategy and Draft Insecticide Strategy, stakeholders provided lists of approximately 75 different runoff/erosion focused conservation programs currently active in U.S. agriculture. EPA reviewed a subset of these programs and considered the mitigation measures that were most common in each program (*e.g.*, cover cropping) and how many points the measures would achieve. EPA considered landscape level information (*e.g*., county-level mitigation relief points; flat land; prevalence of sandy soils) and other common relevant practices from EPA's Mitigation Menu that were in the program areas but not part of the program.[46] The Agency evaluated the constituent practices of 22 conservation programs and tallied a minimum and maximum number of potential points achieved for the program.[47] Minimum points represent the fewest number of points a field would get, and the maximum points represent the highest number of points a field would get using the common practices of the program and practices identified by EPA using practices on EPA's Mitigation Menu that are common in the area but not part of the program. For more details on the results for the evaluated 22 submitted conservation programs, see **Appendix K** of the Ecological Mitigation Support Document (Version 2.0).

EPA understands that each conservation program may have a distinct list of options from which they make recommendations to growers to address runoff/erosion concerns, and their lists could have varying levels of overlap with EPA's Mitigation Menu. Additionally, EPA recognizes that a technical expert from a conservation program likely assesses the entire farm and determines where the mitigation should be placed, and which mitigation options work best for the field conditions.

[46] When EPA had knowledge of a practice on EPA's Mitigation Menu that is a common practice in an area (*e.g.*, vegetative ditches around fields) but the program did not list that practice as part of their program, EPA included the relevant mitigation points for the practice in the analysis.

[47] An initial 10 of 22 programs that EPA assessed were focused in the Midwest and were in areas receiving 2-3 mitigation relief points for pesticide runoff vulnerability. Because those programs received relief points, EPA focused efforts for the remaining 12 programs to assess programs that would not receive points for pesticide runoff vulnerability to ensure programs could still reach 9 points without the relief points. In total, 9 programs were operating in counties that would get relief points for low pesticide runoff vulnerability; 9 programs operate in counties that would not get relief points; and 4 programs operate in counties where some counties would get relief points and others would not.

*EPA's evaluation of the submitted conservation programs was conducted with three goals in mind:*

Goal 1. Estimate the likely mitigation points achievable under runoff/erosion focused conservation programs in concert with geographic components from EPA's Mitigation Menu, (*i.e.,* runoff vulnerability relief points, sandy soils, and flat fields):

Based on EPA's reevaluation, approximately 65% of evaluated conservation programs would achieve at least 9 runoff/erosion mitigation points if growers and other applicators did the minimum number of measures. When the growers and other applicators did everything the program typically offered, 95% of the programs would have achieved at least 9 points.

Goal 2. Consider additional characteristics that would build in assurances that qualifying conservation programs would achieve mitigation goals.

Since a small portion of evaluated programs were not predicted to achieve 9 points, EPA would generally need a program to fit the following in order to qualify: **"Programs would achieve a minimum of 9 points at the time of application, which would include 2 points for being part of a conservation program."**

To address stakeholder concerns about compliance, long term enrollment, and efficacy, EPA also is adding two additional characteristics for programs necessary to have confidence that an appropriate level of mitigation is achieved for each farm within a multi-farm operation, and that programs are maintaining the practices necessary to be considered a qualified conservation program:

- **"Operations that consist of multiple distinct 'farms' that consist of multiple fields with similar runoff/erosion concerns, would have a program implemented on each farm."**
- **"A program would maintain the above elements once it has been 'qualified'."**

Goal 3. Simplify the approach to reduce complexity and compliance concerns for growers participating in qualified conservation programs.

As laid out in the Final Herbicide and Draft Insecticide Strategies, growers would need to assess field conditions and apply runoff/erosion mitigation needs on every field. If EPA qualifies a program for 9 mitigation relief points, growers enrolled in that program would be able to address runoff/erosion concerns at the farm level, rather than on each individual field. This would decrease the burden on growers by reducing complexity.

*The following is an example of how EPA evaluated USDA-Natural Resources Conservation Service's (NRCS)s Environmental Quality Incentives Program[48] (EQIP) that includes NRCS Conservation Program Standard 595 Pest Management Conservation System[49](NRCS CPS 595) for planning runoff/erosion mitigation for agriculture.[50]*

In this hypothetical example, a grower requests help from NRCS in developing a runoff/erosion plan to reduce transport of pesticides to surface and ground water with the goal of being able to use a wide variety of pesticides in compliance with the instructions on those pesticides' labels or related Bulletins.[51] NRCS would make a site visit and do a farm-level, site-specific assessment. NRCS would likely recommend their EQIP program and use NRCS CPS 595 to develop a conservation plan for the grower that achieves the desired number of points (in most cases, this would be equivalent to at least 9 points). USDA-NRCS's EQIP program is a voluntary, financial assistance conservation program that can address many different resource objectives and, using NRCS CPS 595, can help the grower address the offsite movement of pesticides. To meet the grower's needs, NRCS develops an EQIP conservation plan that includes the NRCS CPS 595 "General Criteria" and "Additional Criteria" that "mitigates the effects of pest management activities that can impact water quality or other natural resources." To meet the "Additional Criteria," NRCS evaluates the farm using the Windows Pesticide Screening Tool[52] (WIN-PST), a tool designed by USDA to identify potential site-specific water quality impacts associated with specific pesticides. WIN-PST uses EPA's pesticide data for labeled pesticides, the USDA Soil Survey,[53] as well as locally observed soil properties to predict pesticide movement through leaching, aqueous runoff, or soil erosion. As part of the evaluation process, the grower provides NRCS with a list of pesticides they plan to use, which are then input into WIN-PST, and WIN-PST provides scores for each pesticide for that farm. NRCS works with the grower to develop a plan based on the final Hazard Rating from WIN-PST and recommends runoff/erosion practices needed to meet the grower's objectives identified as part of the conservation planning process. Inherent in the process for developing the conservation plan, the evaluation includes field conditions (*e.g.*, flat fields, sandy soils) that are incorporated into the determination of mitigation needs identified for a field. Therefore, the recommendations in the conservation plan would not include these because they are already included in the evaluation of the runoff/erosion vulnerability.

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[48] https://www.nrcs.usda.gov/programs-initiatives/eqip-environmental-quality-incentives

[49] https://www.nrcs.usda.gov/sites/default/files/2022-09/Pest_Management_Conservation_System_595_CPS_10_2019.pdf

[50] NRCS conservation practice standard Pest Management Conservation System (NRCS CPS 595) is not defined as a "program" by NRCS. EPA specifically evaluated the EQIP program where participants are focused on planning runoff/erosion mitigation for agriculture. EQIP uses the NRCS CPS 595 for implementing runoff/erosion mitigations. When those mitigations are in place at the time of application of pesticides, EQIP would effectively meet 9 mitigation points. Implementation must meet NRCS CPS 595 *General Criteria* and *Additional Criteria* in settings where pesticides are applied. The additional criteria require the use of the Windows Pesticide Screening Tool (WIN-PST) to screen environmental risks.

[51] EPA believes that the majority of growers will aim to reach 9 mitigation points because that will allow them to comply with labeling requirements no matter what pesticides they end up using. The maximum number of mitigation points necessary via a label or Bulletin is 9 points.

[52] https://www.nrcs.usda.gov/resources/tech-tools/windows-pesticide-screening-tool-win-pst

[53] https://websoilsurvey.nrcs.usda.gov/app/

Nevertheless, EPA took this evaluation of current field conditions into consideration when evaluating how many points to assign for the EQIP program. EPA expects that either a mitigation measure or field condition for which a grower would get points is either already implemented or present on the field or, if not, would be recommended by NRCS. If a mitigation is recommended by NRCS, it must be in place before or at the time of pesticide application. Note, however, there is no equivalent in the NRCS evaluation for EPA's geographic pesticide runoff vulnerability relief points. When a grower participates in EQIP with the objective of reducing pesticide runoff/erosion, and uses NRCS CPS 595 with the "Additional Criteria" for water quality in the development of the conservation plan, and implements the recommended practices identified in the conservation plan before or at the time of pesticide application, EPA has confidence that the resulting level of mitigation will be consistent with the runoff/erosion mitigation necessary to reduce the likelihood of potential population-level impacts to listed species as a result of pesticide movement through runoff/erosion.

For this hypothetical example, EPA relied upon a farm comprised of eight fields that is adjacent to a waterbody that has enrolled in EQIP (**Figure 10**). EPA assumed that a grower would go to NRCS with the goal of reducing runoff/erosion and ask for a plan to allow for flexibility in pesticide choices. During the conservation planning process, NRCS would make a site visit and complete a field-level, site-specific assessment of the farm utilizing NRCS CPS 595. NRCS staff would develop a conservation plan for this farm, including the use of WIN-PST to determine the pesticide with the greatest hazard concern, to provide the grower with a list of practices that would reduce the runoff/erosion for all pesticides across all of these fields. In this example, the conservation plan identified fields 2, 4, 5, 6, 7, and 8 as fields on the farm that need runoff/erosion mitigation, as they are adjacent to waterbodies and had WIN-PST results that indicate a mitigation need. The mitigation for these fields identified in the conservation plan includes three different options (alternatives) the grower can select from: 1) grassed waterways (if not already in place) and reduced tillage and farming on the contours; 2) grassed waterways and a fall planted cover crop; or 3) grassed waterways and no-till tillage (below is a description of how EPA assessed each of these options). Once the grower implements these practices, NRCS would visit the farm to verify that the practices in the conservation plan and EQIP contract have been implemented and distribute financial assistance under EQIP. Once the mitigation measures have been employed, the pesticide can be applied.

EPA has determined that appropriate participation in the EQIP program can be awarded 9 points. This total is based on the expected total of mitigations implemented on the fields, including existing practices in place before seeking NRCS's assistance in developing a plan to allow for flexibility in pesticide choices. For instance, the aerial image (**Figure 10**) shows there is a 50-ft riparian area between the fields and waterbody already established. NRCS would not pay a grower for a practice already in place; therefore, NRCS would not include the buffer in the plan. However, just because it is not part of NRCS's plan does not mean that the grower would not achieve the 2 points that EPA assigned for a 50-ft riparian area, plus 2 points for participation in a conservation program. This is illustrated by the hypothetical example. EQIP Option 1 included grassed waterways, reduced tillage, and farming on the contours, along with the 50-ft riparian area for a total of 10 points (**Table 17**, Option 1). EQIP Option 2 included grassed waterways, a cover crop that is planted in the fall and terminated using herbicides in the spring shortly before planting, along with the 50-ft riparian area for a total of 9 points (**Table 17,** Option 2). The EQIP Option 3 identified grassed waterways and no-till tillage practice along with the 50-ft riparian area for a total of 9 points (**Table 17,** Option 3). In this hypothetical example, the maximum number of points this program participant would achieve is 10 points and the minimum number would be 9 points. It is important to note that this example assumes the worst-case scenario for a grower whose fields have a slope >3%, soils that are not sandy, and are in an area with no geographic relief for pesticide runoff vulnerability. If the fields had one or more of the properties that warranted relief points, the associated points could have been used in the total number of mitigation points for a field.

NRCS did not identify mitigation needs for fields 1 and 3; however, EPA would also not identify runoff/erosion mitigation needs for those fields because they are more than 1000 ft from the waterbody. If the grower participated in EQIP and implemented any of the EQIP options, the resulting level of mitigation would be consistent with the goals of runoff/erosion mitigation for the strategy. Therefore, EPA determined that EQIP would qualify for 9 points when used with NRCS CPS 595 for planning runoff/erosion mitigation with the goal of being able to use a wide variety of pesticides.

Based on EPA's review of USDA-Natural Resources Conservation Service's (NRCS) Environmental Quality Incentives Program (EQIP), when incorporating NRCS Conservation Program Standard (CPS) 595 Pest Management Conservation System for planning runoff/erosion mitigation for agriculture, EPA has determined that this is an "EPA-Qualified Conservation Program".[54]

[54] "EPA-Qualified Conservation Program" - EPA evaluated these programs using the qualifying characteristics described in **Section 3.2.2.6.2**. These characteristics are intended to show how a qualified program, when mitigations are in place before or at the time of application, can achieve at least nine points of mitigation, thereby addressing any potential for potential population-level impacts to listed species from runoff/erosion.

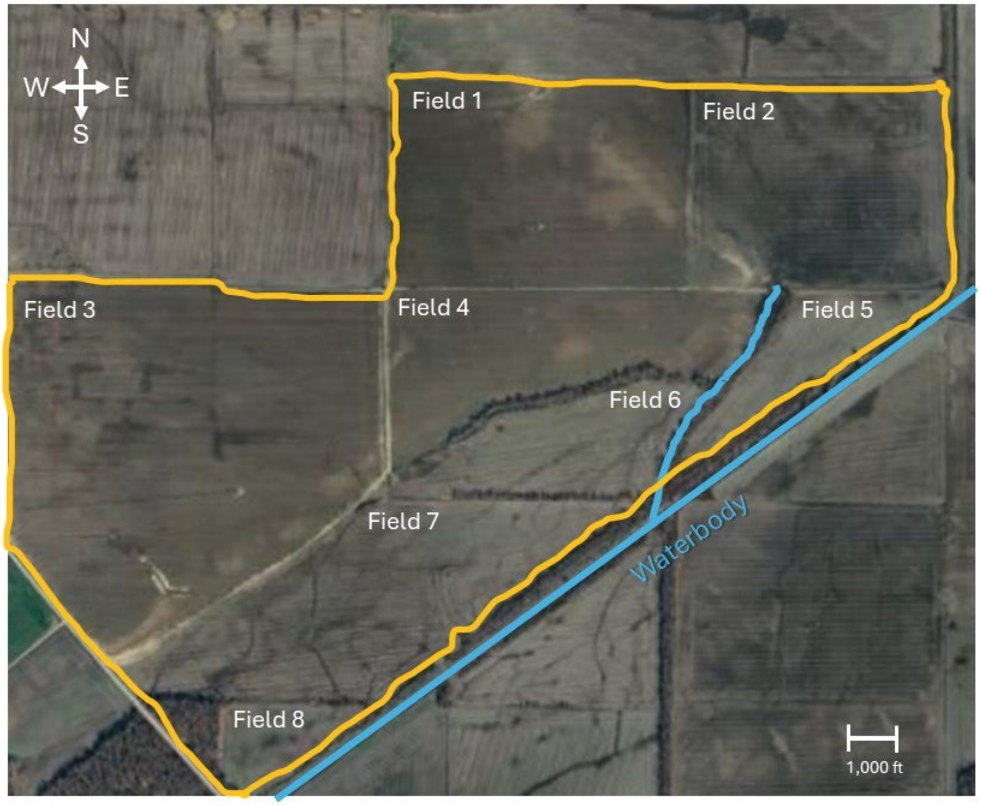


**Figure 10. Aerial View of a Hypothetical Farm (Outlined in Yellow) that Consists of Eight Fields and Is Adjacent to a Waterbody (Blue Line).**

**Table 17. Example of Three Different Options of Mitigation Measures Identified during Conservation Planning Utilizing NRCS CPS 595 and Enrolled in EQIP**

| Mitigation Measure | | Option 1 | Option 2 | Option 3 |
|---|---|---|---|---|
| Existing mitigation measures in place | 50ft riparian buffer | 2 | 2 | 2 |
| **Total Points for Mitigation in Place *prior to* EQIP Participation** | | **2** | | |
| Mitigation practice options identified by EQIP | Grassed waterway | 2 | 2 | 2 |
| | Reduced tillage | 2 | - | - |
| | Contour farming | 2 | - | - |
| | Cover crop | - | 3 | - |
| | No-till | - | - | 3 |
| | Conservation program | 2 | 2 | 2 |
| **Total Points with Additional EQIP-identified Measures** | | **10** | **9** | **9** |

In summary, as part of EPA's consideration of increasing the relief points assigned to qualifying conservation programs, EPA found the following characteristics could demonstrate a designation of 9 mitigation relief points. The characteristics for a program to qualify for 9 mitigation relief points include those described in the Final Herbicide Strategy and the Draft Insecticide Strategy as a 2-point program and the new characteristics mentioned above (indicated in bold below). For programs not qualified as a

9-point program, they would qualify for 2 mitigation relief points for meeting the characteristics not bolded below.

- The program provides advice from individuals who meet the same benchmarks provided above for technical experts; AND

- The program provides site-specific guidance tailored to the grower's crop and/or location; AND

- The program focuses on reducing or managing runoff and/or erosion (including for example, soil loss, soil conservation, water quality protection) from agricultural fields or other pesticide use sites; AND

- The program provides documentation of program enrollment. EPA is **not** suggesting that this documentation be provided to EPA; AND

- The program includes verification of implementation of the recommended measures or activities (demonstrating measures were established and maintained). Verification can be done through the conservation program and provided to the program enrollee. Verification is **not** required to be submitted to EPA; AND

- **Operations that consist of multiple distinct "farms" that consist of multiple fields with similar runoff/erosion concerns, would have a program implemented on each farm; AND**

- **Programs would achieve a minimum of 9 points at the time of application, which would include 2 points for being part of a conservation program; AND**

- **A program would maintain the above elements once it has been "qualified."**

EPA is aware that growers may have participated in a conservation program and have maintained the mitigation measures over time, but the growers are no longer part of the program due to program limitations. EPA is also aware that many technical experts provide services similar to those of a conservation program. For these reasons, EPA is also considering the possibility of a higher point value assigned to external parties who are not part of a conservation program (*e.g.*, technical experts [currently assigned 1 point]) who provide similar services as a conservation program or are trained to assess existing mitigations.

Also, EPA is considering options for how best to provide mitigation relief points for conservation programs/external parties that are not part of an evaluated conservation program that qualifies for 9 mitigation relief points. Currently, EPA would allow those programs/external parties who are not qualified to maintain the 2 relief points for programs or 1 relief point for external parties that EPA assigned in the Final Herbicide Strategy and Draft Insecticide Strategy, respectively. Additionally, EPA is considering how best to include programs and parties with mitigation points between 2 and 9 without introducing additional complexity. The grower or other applicator could then add these to the points from other mitigation measures.

Regardless of the mitigation relief point values EPA ultimately decides upon, growers and applicators will still need to adhere to all requirements on pesticide labels, including any spray drift requirements or directions to follow Bulletins.

*Continued work to develop a process for identifying and providing lists of qualified programs/external parties*

EPA's analysis showed that many programs are capable of achieving 9 mitigation points and have a high likelihood that the evaluated programs are achieving the runoff/erosion mitigation goals of the strategies. However, EPA recognizes that it needs to have a system in place to qualify programs/parties to ensure the programs/parties will provide the necessary level of protection. In order to develop that process, EPA will engage with stakeholders to ensure that qualified programs are identified. Additionally, EPA will need to develop a process in which the Agency is able to evaluate the programs and a method to communicate qualified programs to the public. EPA will also continue discussions with federal partners and other stakeholders concerning these efforts and will also seek comment, through Paperwork Reduction Act (PRA) obligations, on any necessary information collections.

##### 3.2.2.6.3 Mitigation Tracking

All of the mitigation measures identified in in this Insecticide Strategy have been determined by EPA to provide some level of reduction of the potential for population-level impacts to listed species from pesticide exposure in runoff/erosion. Keeping track of the mitigations a grower or other applicator employs at the field and farm level could provide several benefits to the grower or other applicator. Tracking of the employed mitigation measures could help a grower or other applicator ensure that they are achieving the number of points to satisfy any labeling requirements that include mitigations to address population-level impacts. Additionally, tracking the mitigations employed could assist with future planning of farm needs, and is generally aligned with the concepts of agricultural best management practices (commonly known as BMPs). Where a grower or other applicator has a well thought out plan for the growing season that includes the tracking of mitigation measures employed, EPA would have increased confidence that measures have been implemented and properly accounted for. Therefore, EPA is assigning one available point for any grower or other applicator who tracks their mitigations in addition to any points for working with a specialist or participating in a conservation program. Working with a runoff/erosion specialist and/or participation in a program is not required to be eligible for this point, and therefore this point is available for any grower or other applicator that tracks their mitigation measures.

#### *3.2.2.7 Summarizing Step 2 Runoff/Erosion Mitigations*

In the sections above, EPA described in **Step 1** of the framework the process for determining potential for population-level impacts from exposure via runoff and erosion to determine the level of runoff and erosion mitigation needed. EPA then discussed the county-level geographical runoff vulnerability across the country to determine areas that have lower vulnerability to pesticide runoff and erosion (and consequently receive mitigation relief points indicating their reduced vulnerability). EPA then identified mitigation measures that further reduce the potential for population-level impacts from pesticide exposure in runoff and erosion and showed how these receive mitigation points based on the average efficacy of the mitigation measure. Finally, EPA identified those conditions under which the identified runoff/erosion mitigation measures should receive greater mitigation relief points because the Agency has higher confidence that mitigation measures identified and implemented at the field level would achieve the higher end of the available efficacy data (*e.g.* participation in a conservation program or following recommendations from a technical expert in reducing runoff/erosion exposure).

**Figure 11** summarizes the steps involved in identifying whether runoff/erosion mitigation measures are needed for protecting listed species from insecticide applications to a given farm/field and if so, which measures are required. The details supporting this decision tree are provided in the previous sections. As new information becomes available, EPA will update its mitigation options as appropriate and post theses updates on its mitigation menu website (https://www.epa.gov/pesticides/mitigation-menu). Therefore, the summary shown in **Figure 11** is for illustrative purposes only. Growers or pesticide applicators should consult the mitigation menu website to obtain the latest information pertaining to selecting runoff/erosion mitigation measures for their specific situation. In general, runoff/erosion mitigation measures are identified and selected according to the following steps.

- First, read the insecticide product label(s), look for use directions pertaining to runoff/erosion mitigation that includes runoff mitigation points (Step 1 in **Figure 11**).

- If the label includes runoff mitigation points, evaluate whether the type of use or characteristics of the field and downslope areas are excluded from requiring runoff mitigation (Step 2 in **Figure 11**). If runoff mitigation points are needed, identify the insecticide and use that requires the highest number of points (Step 3 in **Figure 11**).

- Next, subtract the number of mitigation relief points, if any, for farming conducted in geographic areas determined to have limited runoff potential)[55] or other reasons specified in EPA's runoff mitigation menu such as participating in qualified conservation programs, use of technical experts, mitigation tracking, or existing mitigation measures that have been implemented (Step 4 of **Figure 11**). The result is the total number of points that a user would need to achieve to apply the insecticide product. After these subtractions, if runoff/erosion mitigation points are still greater than or equal to 1, the user would need to find enough measures from the mitigation menu to meet or exceed those remaining mitigation points. If the resulting number of points to be achieved is zero or less, a user would not need to employ any additional runoff/erosion mitigation measures to apply the pesticide. However, spray drift mitigation may still be needed as described in **Section 3.2.1**.

[55] The county-based list of mitigation relief points is available on the mitigation menu website, https://www.epa.gov/pesticides/mitigation-menu

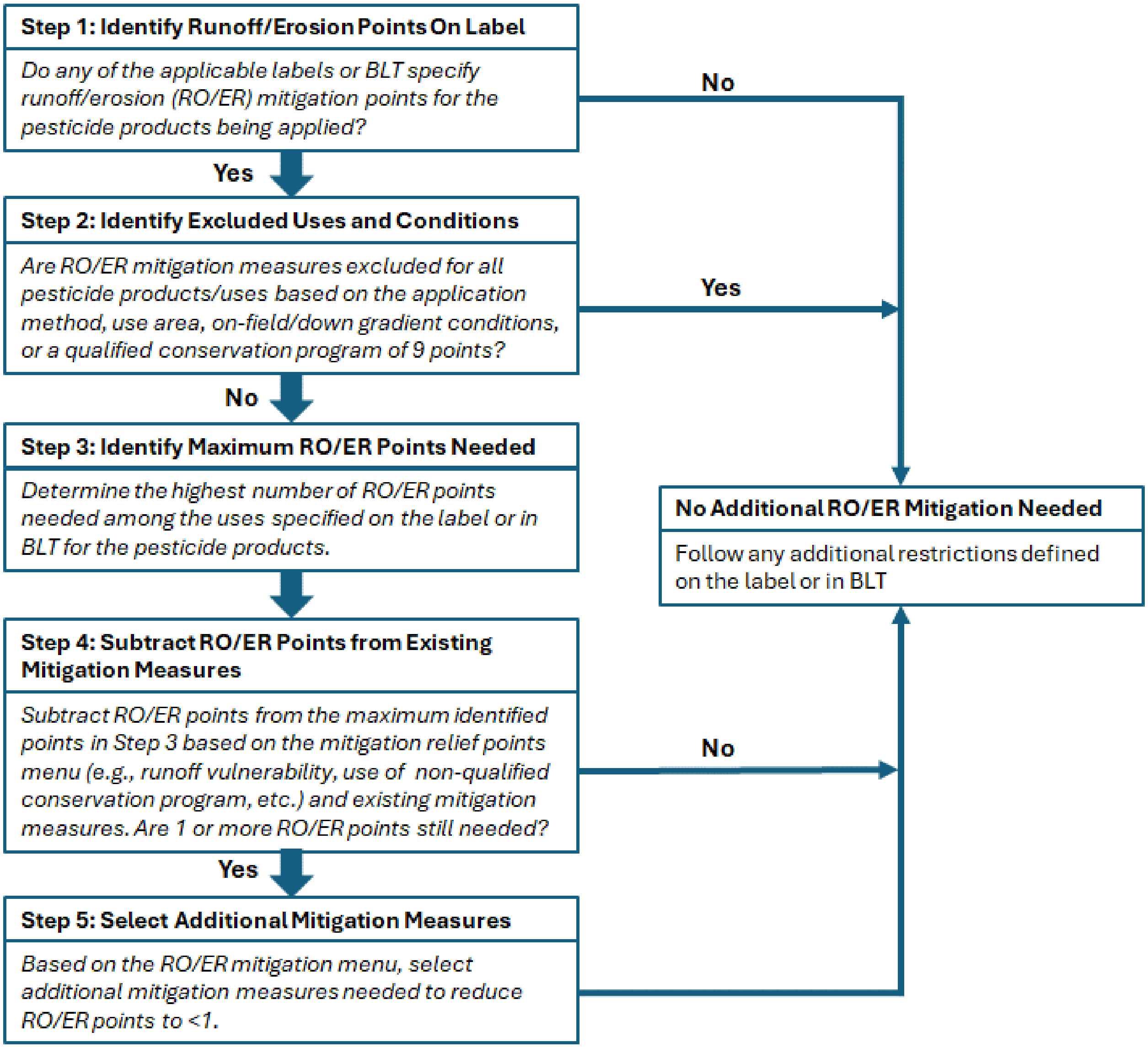


**Figure 11. Illustrative Process Summary for Identifying Runoff/Erosion Mitigation Points and Associated Mitigation Measures Required for Labeled Insecticide Uses**

### 3.2.3 Mitigation Measures and Additional Considerations for Listed Terrestrial Invertebrates from On-Field Exposure

While **Sections 3.2.1** and **3.2.2** describe mitigations to address potential off-field exposures that may result in population-level impacts, there are a small subset of listed terrestrial invertebrates that may be present on treated agricultural fields and for which on-field mitigations (*e.g.* bloom and/or timing restrictions) may be identified to prevent population-level impacts. In discussions with FWS and after reviewing comments, the following four species were identified as potentially being present on the field to the extent that there could be population-level impacts following insecticide applications:

- Karner blue butterfly (*Lycaeides melissa samuelis*)
- Mitchell's satyr butterfly (*Neonympha mitchellii mitchellii*)
- Fender's blue butterfly (*Icaricia icarioides fenderi)*
- Dakota skipper (*Hesperia dacotae*)

These four species occur in a limited geographic area in the country. The mitigations described in this section will be as spatially refined as possible through the PULA process. EPA will also refine the timing of any identified mitigations based on the life history of the species (*i.e.*, only identifying on-field mitigations when the species and relevant life stage of the species is expected to be on the field).

#### *3.2.3.1 Process for Determining Invertebrates Where Additional On-Field Mitigation May Be Identified*

To evaluate on-field species that might raise to the level of population-level impacts, EPA first conducted a screen based on the extent of overlap of a species range with USDA's Cultivated Cropland Data Layer (CDL)[56] and incorporated known areas of insecticide usage (based on the Census of Agriculture (CoA) and California Department of Pesticide Regulation (CDPR) usage data). If that overlap for a species was less than 5%, EPA did not consider that species to have a potential for population-level impacts, which is consistent with recent Biological Evaluations for insecticides including sulfoxaflor and cyantraniliprole (USEPA 2023a; 2023b). For the remaining species, EPA considered if a species (larvae and/or adult) is expected to use agricultural fields for feeding (*e.g.,* feed on crop leaves or nectar, feed on insects), breeding, and/or shelter such that enough individuals would be exposed and impacted to affect the population. These considerations include an evaluation of readily available species information from FWS, such as habitat, preferred food sources (*e.g.,* larval host plants, nectar sources), life cycle timing relative to insecticide exposures, available information on whether a species is known to use agricultural crops, fields, and/or orchards, and Physical and Biological Features (PBF) defined for designated critical habitat. EPA further consulted with FWS and their species experts to determine the extent to which the remaining species may be on treated fields and identify the types of agricultural uses that represent

[56] https://www.nass.usda.gov/Research_and_Science/Cropland/SARS1a.php

attractive habitat for those species. This resulted in the removal of several species[57] between the Draft and Final Insecticide Strategy that were determined to be unlikely to have population-level impacts from insecticide exposures on the treated field itself.

#### *3.2.3.2 Identification of On-Field Mitigation Measures*

When considering a FIFRA action, if EPA identifies exposure for any of the covered listed species that results in potential for population-level impacts, the Agency would identify mitigations to reduce exposures on field to address the potential for population-level impacts. The types of mitigations that EPA identifies will depend on the species. If EPA identifies a potential for population-level impacts for any of the listed terrestrial invertebrates identified above for a particular crop or group of crops, EPA may identify timing restrictions for insecticide applications relative to a crop's blooming period to address potential population-level impacts. EPA has implemented such measures previously for selected insecticides to reduce potential on-field exposure of bees and such measures may be considered for the identified butterfly species. EPA has also identified mitigation measures to minimize risk of acute risk to bees, some of which include targeting applications to early morning/late evening times when bees are less likely to visit a treated crop (USEPA 2017). For many butterfly species, EPA is less concerned for exposure to the larval life stage that tends to feed on specific plant species that would not be on an agricultural field. Adult butterflies typically have limited lifecycles (*e.g.,* present for 2-4 weeks of the year) and EPA may identify insecticide timing restrictions to protect adult butterflies based on the listed species' lifecycle. EPA may also identify time of day restrictions for the terrestrial invertebrates and/or the butterflies depending on when the species is active. Most adult butterflies are active during the day.

In discussions with USDA and FWS and using Census of Agriculture data (2022), for the moth and butterfly species in **Table 18**, EPA identified where substantial pollinator-attractive crops acreage (generally at least 100 acres in a given county) indicated there could be potential for population-level impacts rising from on-field exposures. EPA used the 2017 USDA document "Attractiveness of Agricultural Crops to Pollinating Bees for the Collection of Nectar and/or Pollen" to identify crops that do not produce nectar, and therefore, are not suitable forage for adult moths and butterflies (USDA 2017). Additionally, for the Final Strategy, EPA did not include crops that require buzz pollination (*e.g.*, tomatoes and peppers, where bees vibrate their wings and as a result pollen is released from the flower) as any nectar that might be present is inaccessible to adult moths and butterflies.

[57] The Bartram's scrub-hairstreak butterfly, Kern primrose sphinx moth, delta green ground beetle, valley elderberry longhorn beetle, American burying beetle, and Salt Creek tiger beetle were removed as species identified as having potential on-field population-level impacts between the Draft and Final Insecticide Strategy.

**Table 18. On-Field Terrestrial Invertebrate Species and Pollinator-Attractive Blooming Crops (for Butterflies) Cultivated in Counties with Species Range**

| Species (life stage) | Crops or Crop Groups/UDLs with Significant Acreage in Counties within Species' Range that Could Be Impacted |
|---|---|
| Dakota skipper (adult-stage only) | **Other Grains**: buckwheat, canola, safflower, sunflower, flax<br>**Vegetable and Ground Fruit:** chickpeas, dry beans, dry peas, lentils, mustard, radishes (daikon) |
| Fender's blue butterfly (adult-stage only) | **Other Crops**: clover (grown for seed production)<br>**Other Orchards**: pome fruit, stone fruit<br>**Other Row Crops**: sugarbeets grown for seed production<br>**Vegetable and Ground Fruit**: dry and fresh beans, berries, cucurbits, mint, peas |
| Mitchell's satyr butterfly (adult life-stage only) | **Other Orchards**: pome fruit, stone fruit<br>**Vegetable and Ground Fruit**: snap beans, berries, cucurbits, black eyed peas |
| Karner blue butterfly (adult life-stage only) | **Other Orchards**: pome fruit, stone fruit<br>**Vegetable and Ground Fruit**: dry beans, snap beans, berries, cucurbits, peas |

EPA continues to work with FWS and USDA on language that might be applied to mitigate on-field exposures for these species. For example, for crops that have a well-defined/determinate blooming period (*e.g.* pome and stone fruit uses within the Fender's blue butterfly's PULA), EPA may consider label language that specifies not to apply the product during bloom. For crops that have a longer/indeterminate blooming period (*e.g.* cucurbit uses within the Karner blue butterfly's PULA), EPA may consider label language that specifies a timing restriction (*e.g.,* apply only within a time period of 2 hours before sunset through 2 hours after sunrise, when bees and other pollinators are least active).

An example of these sorts of mitigations can be seen in the final FWS Methomyl Biological Opinion (USFWS, 2024). In that opinion, FWS determined that, with mitigations for on-field bloom-related timing restrictions on a certain subset of registered crops (within vegetable and ground fruit and other orchard crops), in addition to spray drift mitigations, population-level impacts from on-field exposures were not likely to occur for Mitchell's satyr butterfly, Dakota skipper, Fender's blue butterfly and Karner blue butterfly. These bloom-related timing restrictions are not intended to be applied on a national scale or within the species' entire ranges and would be limited to the PULAs for these species. EPA is also aware that in this final Biological Opinion there were some terrestrial plant species (*e.g.*, Carter's small-flowered flax) that although not present on the field were determined to have sufficient proximity to agriculture and vulnerability that the loss of on-field pollinators from insecticide exposure on the treated field had the potential to result in population-level impacts, such that similar on-field bloom-related timing mitigations were proposed in these species' PULAs. Similar mitigations for the covered listed on-field terrestrial invertebrates and potentially for some terrestrial plant species highly reliant on on-field pollinators may be considered as EPA implements the strategy for FIFRA actions where the Agency determines a potential for on-field population-level impacts for a listed species.

When implementing the Insecticide Strategy in FIFRA actions, any mitigations identified for on-field exposures should be targeted based on the species' life history and when adults of the species may be present and foraging on the blooming crop. For example, adults of the Dakota skipper are expected to be present only in mid-June to mid-July. For applications of a contact insecticide (*e.g.* a pyrethroid), a mitigation might specify that for the subset of Other Grains and Vegetable and Ground Fruit crops specified in **Table 18**, applications made between June 15 and July 15 must be applied at night (or using the two-hour window after sunrise and before sunset as described above in the example for methomyl)**.**

There may be chemistries (*e.g.,* persistent chemicals) and situations (*e.g*., where pest pressures are anticipated to be high during bloom periods) where bloom-related timing restrictions/mitigations are not feasible. EPA will continue to work with USDA and FWS to identify where any potential bloom-related mitigations are feasible. Where bloom-related mitigations are impractical and/or overly burdensome, EPA will continue its efforts working with FWS and stakeholders to develop a process for identifying potential offsets to mitigate the potential for population-level impacts (see **Section 4.6**).

### 3.3 Step 3. Identify Geographic Extent of Mitigation

For the Insecticide Strategy, when EPA determines the mitigations in this strategy are applicable to a FIFRA action, either the Agency would have the necessary mitigations on product labels (*e.g.* when applicable for a use pattern such as specific crops) or only in geographically specific areas through the use of Pesticide Use Limitation Areas (PULA). Depending on the insecticide, EPA may use both or one or the other option or a combination of both. As discussed below, EPA would expect mitigations to be on the general label when mitigations are identified for listed generalists that are broadly reliant on invertebrates for prey or pollination in upland terrestrial areas, larger aquatic systems (*e.g.,* large lakes) and/or flowing water habitats (*e.g.,* rivers), and using BLT when additional mitigations are identified for listed invertebrates, listed obligate species, or for listed generalist species that are primarily reliant on invertebrates in wetland habitats.

EPA generally prefers that applicants and registrants include mitigations on the general pesticide product label, if practical, which simplifies the process for growers and other applicators. This is most appropriate where mitigations broadly apply for a pesticide or pesticide product (*e.g.,* cover large geographic areas) instead of where mitigations apply only to certain geographic areas.

**Key Definitions for Step 3 of the Insecticide Strategy Framework**

**Bulletins Live! Two (BLT):** BLT is the web-based application to access Endangered Species Protection Bulletins (Bulletins). EPA uses BLT to communicate where additional pesticide use directions may be needed to protect listed species in geographically specific areas.

**Pesticide Use Limitation Areas (PULA):** A PULA is the specific geographic area associated with particular pesticide mitigations for a listed species, groups of listed species, or designated critical habitat. PULAs are used in BLT to provide pesticide applicators with specific locations where use restrictions may apply to their intended pesticide application to protect listed species or their designated critical habitat.

**Endangered Species Protection Bulletins:** A Bulletin is the printed copy from the BLT application that provides the geographically specific mitigations for the pesticide application. The general pesticide product labeling directs applicators to the BLT system. Bulletins typically include both the PULA and the mitigations that apply within that PULA. When implementing the Insecticide Strategy in FIFRA actions, EPA will include mitigations for each PULA # on the general pesticide product label and the BLT system will be used to help the applicator identify which PULA # applies to their location. When directed by the label to comply with Bulletins these become enforceable pesticide use limitations to protect listed species or designated critical habitat.

Where EPA identifies mitigations specific to certain geographic areas, it generally uses Geographic Information System (GIS) mapping information to identify where a pesticide limitation applies to a listed species or group of species. Such areas, along with a description of the use directions applicable to that area for a pesticide, are called PULAs. PULAs focus on areas where pesticide exposures are likely to impact the continued existence of a listed species, which may include a reduction in survival or recovery of the species. Thus, the purpose of a PULA is to identify geographic areas where pesticide mitigations apply to conserve a listed species and designated critical habitat. EPA develops PULAs to allow applicators to determine if their intended pesticide application falls within a location where additional use restrictions apply to protect listed species or critical habitat. These geographic-specific restrictions are published in Bulletins that are accessed through the BLT website. In other words, where the pesticide product labeling directs an applicator to BLT, the information in BLT informs the applicator where and what additional restrictions or mitigations must be followed to protect listed species for a particular location. To date, EPA has typically used this system to mitigate for specific pesticide products and individual species. Pesticide product labels direct applicators to BLT and to follow any applicable Bulletins. The BLT system allows EPA to reduce complexity on pesticide product labels and limit geographically specific listed species protections to only where they would apply. Bulletins typically include: 1) the geographic extent of the PULA where the same set of mitigations apply, and 2) a description of additional mitigations that apply within the PULA (referred to as “pesticide use limitations”). In this strategy, when the mitigation measures apply only to a limited geographic area for an insecticide use, EPA expects to publish a specific PULA representing the area that would have additional use restrictions in BLT.

EPA has identified approximately 660 listed species that are listed generalists for the Insecticide Strategy (**Figure 1B**). These species range across the majority of the conterminous United States, therefore, as explained above, when EPA determines, as part of a FIFRA action, a potential for community-level impacts for most listed generalist species (excluding generalist species that are primarily reliant on wetland habitats), EPA plans to implement mitigations for listed generalists broadly across the full spatial extent of a use pattern within the conterminous United States. In addition, as described in **Section 3.3.1**, EPA identified 94 listed invertebrates (or obligate species) and 31 listed generalist species primarily reliant on wetland habitats that may have additional potential for population-level impacts from direct exposures to off-site transport of spray drift and/or runoff/erosion. To the extent that EPA identifies additional mitigations to address any identified impacts for these species or to on-field species (**Section 3.2.3**), the Agency expects to identify geographically specific mitigations and communicate these areas through Bulletins that are based on refined PULAs. The following sections describe EPA’s current thinking on how the general pesticide product label and PULAs (using BLT) may both be used to identify mitigations associated with this strategy. This geographic framework is relevant to both runoff/erosion mitigation measures and spray drift mitigation measures.

### 3.3.1 Mitigations in Geographically Limited Areas (Identified Using BLT)

As of December 2023, 245 listed (endangered, threatened, and proposed) invertebrate species were under FWS authority. This includes species of insects (*e.g.,* butterflies, beetles), mussels, snails, crayfish, and shrimp. Whether insecticides are likely to cause population-level impacts from direct exposures depends on numerous factors including species characteristics, pesticide properties, and use patterns. In this strategy, EPA’s evaluation of the potential for population-level impacts for these listed species is based on similar analyses that EPA conducted in recent Biological Evaluations (*e.g.,* Sulfoxaflor Biological Evaluation, USEPA 2023a). To evaluate if a listed species might rise to the level of population-level impacts from agricultural uses of insecticides, EPA first conducted an analysis by considering the degree of overlap of a species range with cultivated land (areas reported by USDA where agriculture is grown). If that overlap for a species was less than 5% after taking into account available usage data from Census of Agriculture and California Department of Pesticide Regulation, EPA did not consider that species to have a potential for population-level impacts. For those species with a 5% or higher overlap, EPA also considered whether there were species-specific factors that would limit exposure such that there would not be a population-level concern.[58,59] EPA similarly applied this approach to listed animals and plants with obligate relationships to invertebrates. EPA identified 91 species of listed invertebrates or obligate species that may have a potential for population-level impacts such that additional mitigations beyond the ones directly on the label and identified for generalists may be indicated (**Table 19**).

Additionally, following the publication of the Draft Insecticide Strategy and the public comment period, EPA received many comments expressing that mitigations were overly restrictive to protect listed generalists. EPA recognizes that mitigations designed to protect listed aquatic generalists in wetland ecosystems would often be higher than mitigations needed to reduce potential for population-level impacts in other habitats such as upland/terrestrial, larger aquatic, and flowing water habitats (where exposures are anticipated to be lower than in the smaller wetland systems). Therefore, applying a level of mitigation identified for wetland species on the general label would often be overly restrictive for these other habitats. Therefore, in the Final Insecticide Strategy, EPA is separating the 30 species of listed generalists (24 wetland plants, 5 amphibians and 1 reptile) that are dependent on invertebrates in wetland habitats from other listed generalist species dependent on invertebrates in other habitats. This is described in **Table 20** below as Insecticide Strategy Group 11 (Wetland Generalist species). While that means the Final Insecticide Strategy has more species identified in PULAs, than the Draft Strategy, the overall effort is intended to reduce the level of mitigation on the general label compared to the level of mitigation for these 30 wetland generalist species that would be in spatially refined PULAs. Additionally, this list of species (see **Appendix B** for the list of species in this Insecticide Strategy Group) may be further refined as EPA continues to refine the PULA list. For example, any of these wetland generalist species that, after further EPA review of the species information, do not predominately rely on aquatic invertebrates for prey, pollination, habitat or dispersal, may be removed from the wetland generalist mitigations, as any mitigation measures in place to address spray drift and/or runoff for non-wetland generalist species would be sufficient to address any potential population-level impacts.

The placement of all the listed and wetland generalist species in Insecticide Strategy Groups does not mean that EPA has determined that a particular chemical would have a potential for population-level impacts to these species. Rather, it means that these 123 listed species (93 listed invertebrates/obligates and 30 listed wetland generalists) represent the maximum number of species where EPA may find a potential for population-level impacts and, therefore, identify potential mitigations. Therefore, where EPA finds a potential for population-level impacts for these species, EPA expects to communicate additional mitigations to address these impacts in limited geographic areas only and communicate the locations where mitigations would apply in BLT. In this case, the pesticide product label would direct applicators to the BLT system. **Appendix C** includes detail on how EPA evaluated the 248 listed invertebrate species and any obligate species to identify the 93 species that could have a potential for population-level impacts as well as the 30 listed generalist species that depend on aquatic invertebrates in smaller wetland habitats. EPA developed a process to identify those

[58] EPA used spatial data representing the listed species range and designated critical habitat locations provided by the FWS as of December 1, 2023 (USFWS, 2022b).

[59] This is referred to as “modifiers” because we considered factors relevant to species life history and habitats that could modify the standard exposure assumptions such that exposure would be limited.

areas for a species and plans to incorporate only those refined areas when developing PULAs.[60] Areas that would ultimately be included in a PULA will likely be substantially less than indicated in those figures because PULAs only include key areas relevant to species conservation, which in many cases will not be an entire species range. See **Section 3.3.2** for more information.

**Table 19. Summary of Number of Listed Invertebrates Where Mitigations May Involve Bulletins on Bulletins Live! Two. Also Included are Listed Animals and Plants that are Obligate to Invertebrate Species for Diet or Pollination and Listed Generalist Species Dependent on Aquatic Invertebrates in Wetland Habitats**

| Taxon | Habitat Type | Number of Species |
|---|---|---|
| **Listed invertebrate species with direct impacts** | | |
| Beetles | Terrestrial | 6 |
| Butterflies | Terrestrial | 16 |
| Dragonflies | Aquatic and terrestrial | 1 |
| Mussels | Aquatic | 49 |
| Shrimp and Amphipods | Aquatic | 12 |
| Snails | Aquatic | 7 |
| **Listed species with impacts to invertebrates that are obligate** | | |
| Birds (obligate to snail) | Aquatic | 1 |
| Plants (obligate to specific bumble bee pollination) | Terrestrial | 1 |
| **Listed generalists dependent on smaller wetland habitats** | | |
| Plants | Aquatic | 24 |
| Amphibians | Aquatic | 5 |
| Reptiles | Aquatic | 1 |
| **Total** | | **123** |

#### *3.3.1.1 PULAs Representing Groups of Species with Similar Mitigations*

Many of the 123 listed species described above will likely share the same level of mitigation for a particular insecticide. This is because they share similar modeled habitats and/or population-level endpoints based on the assessment of sensitivity differences among species groupings. While the mitigations identified may vary across insecticides, EPA anticipates the level of mitigation for a particular pesticide would be the same. Therefore, EPA is planning to group these species into common PULAs. Where multiple species share the same levels of mitigations, EPA is expecting to group the areas important for the conservation of each of those species into one aggregated PULA. EPA's current thinking on how to appropriately group those PULAs is described in this section. EPA identified different PULA groups for levels of spray drift and/or runoff/erosion mitigations. EPA has identified 11 possible groups where listed species would generally have the same mitigations due to similarity of habitat and taxonomy. Specific species that fall into each group are included in **Appendix C**. Where possible, EPA grouped species based on a common level of mitigation including areas where less mitigation may be appropriate as EPA's standard modeling is expected to overestimate population-level impacts due to factors such as spray drift interception or larger waterbodies with greater dilution potential, as described in **Section 3.1.1**. EPA also grouped species when toxicity data may be available to differentiate

[60] https://www.epa.gov/pesticides/epa-updates-process-developing-maps-protect-endangered-species

between sensitivities of different types of invertebrates (*e.g.* molluscs). These groupings are based on the concepts incorporated in **Step 1** where EPA identifies the potential for population-level impacts based on different considerations of exposure, species habitat, taxonomy, and characterization of the expected differences in EPA's exposure models and exposures in species' habitats.

*Spray drift-only mitigations:* For this strategy, EPA has identified multiple species of beetles and butterflies and one dragonfly where the same level of spray drift mitigations may be appropriate for some agricultural insecticide uses to address a potential for population-level impacts in habitats off of the treated field. There is also one listed plant species (Furbish lousewort) that is obligate to a bumble bee species, so EPA would likely identify the same level of spray drift mitigations for this species. In other words, even though the bumble bee that the listed plant is dependent on is not itself a listed species, the level of spray drift mitigation identified for the lousewort plant that depends upon the bumble bee is anticipated to be the same as for a listed bee species. EPA is currently investigating differences in insect sensitivities at the order level. For most insecticides, honey bee toxicity data are available. In some cases, toxicity data are also available for butterflies and/or beetles. Data are rarely (if ever) available for dragonflies. When toxicity data are available for an insecticide, EPA plans to consider if it can identify different levels of mitigations for bees, butterflies (and moths), and beetles.[61] In cases where only honey bee toxicity data are available, EPA expects to use the honey bee as a surrogate for all insect orders. In those cases, the mitigations will be the same for insect species regardless of order. **Table 20** summarizes these 3 groups. As EPA begins to apply the Insecticide Strategy to pesticide registration decisions, EPA may determine that different groupings are more appropriate.

**Table 20. Summary of 11 Potential Invertebrate Species Groups for Insecticide Strategy PULAs**

| Insecticide Strategy Group (PULA) # | Habitat Description | Taxon | Toxicity Surrogate Used to Derive Buffer | EPA Standard Habitat Used to Calculate EECs | MoD Level Where There Is Potential for Population - Level Impacts | Types of Mitigations[1] |
|---|---|---|---|---|---|---|
| 1 | Terrestrial Areas Near Treated Fields | Bees and Dragonflies | Bee | Near Field | ≥1 | Spray Drift |
| 2 | | Butterflies | Butterfly | Near Field | ≥1 | |
| 3 | | Beetles | Beetle | Near Field | ≥1 | |
| 4 | Vernal Pools | Crustaceans | Crustacean | Edge of Field and Wetland | ≥1 | Spray Drift and Runoff/Erosion |
| 5 | Wetlands | Aquatic Insects | Aquatic Insect | Wetland | ≥1 | |
| 6 | Small Water Bodies and Wetlands | Mussels/Snails | Mussel | Wetland | ≥1 | |
| 7 | Wetlands and Ponds | Crustaceans | Crustacean | Wetland and Pond | ≥1 | |
| 8 | Low Flow Waters, Ponds | Mussels/Snails | Mussel | Pond | ≥1 | |

[61] For example, the methoxyfenozide case study indicated that lepidoptera are much more sensitive compared to bees and beetles. Therefore, less mitigation may be identified for bees and beetles, compared to butterflies.

| Insecticide Strategy Group (PULA) # | Habitat Description | Taxon | Toxicity Surrogate Used to Derive Buffer | EPA Standard Habitat Used to Calculate EECs | MoD Level Where There Is Potential for Population - Level Impacts | Types of Mitigations[1] |
|---|---|---|---|---|---|---|
| 9 | Medium/Large Flowing Waters, Lakes, Reservoirs | Mussels/Snails | Mussel | Pond | ≥10[3] | |
| 10 | Karst Systems (Caves, Pools)[2] | Crustaceans | Crustacean | Pond | ≥10[3] | |
| 11 | Wetlands | Generalists | Aquatic Invertebrate Community | Edge of Field and Wetland | ≥1 | |

[1] For this type of mitigations, applicators would use BLT to identify the mitigations needed (in place of the mitigations on the general label).
[2] For the PULA representing species in Karst Systems, EPA is considering specifying that mitigations would only apply to applications within a certain distance of sinkholes. This approach is consistent with FWS's previous mitigations for species in these types of habitats (USFWS 2022).
[3] The threshold for the onset of potential population-level impacts is higher in Insecticide Strategy Groups 9 and 10 than in other groups due to habitat modifiers (*e.g.* fast flowing water) for which EPA's standard modeling approaches are considered overly conservative to represent these habitats.

*Spray drift and runoff/erosion mitigations:* EPA may have sufficient toxicity data to differentiate impacts to listed aquatic insects, crustaceans, and mollusks. These taxa represent different types of listed species that use aquatic habitats. There are many more listed mollusks (56 species of mussels and snails) identified as possibly needing PULAs compared to aquatic-phase insects (one species) and crustaceans (12 species). Also, the Everglade snail kite is a listed bird that is obligate to an aquatic snail (a mollusk). When considering the different types of habitats used by listed aquatic invertebrates or obligates and the three taxonomic categories that can be used to distinguish toxicity and impacts, EPA has identified 7 potential groups for aquatic invertebrates (and one group that encompasses wetland generalist plants and animals) where potential spray drift and runoff/erosion mitigations have been identified (**Table 20**).

*On-Field Mitigations:* EPA has identified four species within Insecticide Strategy Group 2 (Butterflies and Moths) that may potentially be on-field to the point where mitigations that reduce movement of a pesticide off of a treated field may not be sufficient to prevent population-level impacts. Exposure on the agricultural field itself may be sufficient to cause population-level impacts.

Over time, EPA expects the list of species to change (as the listing status of species change) as well as available information about a species. Therefore, EPA expects to revisit the species included in the grouped PULAs and update them as needed. EPA may also change the groupings based on public comments or after it gains experience in implementing ESA strategies. If EPA identifies a need for on-field mitigations to address potential for population-level impacts to a subset of species that feed on treated crops, EPA plans to consider adding a PULA group for on-field mitigations. EPA is currently developing a process on how best to communicate the groupings and associated mitigations on pesticide product labels, BLT, and other possible platforms (such as EPA's Mitigation Menu website).

EPA plans to minimize complexity for pesticide users while maximizing flexibility and accommodating new information as it becomes available.

### 3.3.2 Plan for Developing PULAs for the Insecticide Strategy

EPA received comments on the Draft Vulnerable Species Pilot and the Draft Herbicide Strategy that asked EPA to reconsider the maps that EPA plans to use when identifying geographically specific locations where mitigations may be needed for a given listed species. Commenters stated that using entire species ranges as the basis for a PULA overburdens pesticide applicators unnecessarily because this captures many areas that are not needed to protect listed species at a population level. Commenters requested that EPA refine PULAs that are overly broad, such that they minimize impacts on agriculture. EPA agreed with these comments. In response, EPA recently developed an approach to refine maps to develop PULAs so that they identify those areas where mitigations are needed for species conservation (and minimize extraneous areas) to conserve a listed species and its critical habitat (if designated).[62] This approach was developed with input from FWS, USDA, and other technical experts. EPA expects that for many species, the refined PULAs would represent only portions of the range that are key to a species' conservation, not the entirety of an unrefined range. Therefore, refining the PULAs would provide more realistic locations and lessen their impact for growers and other applicators. This approach focuses on identifying those areas most critical to conserve a listed species and then including adjacent areas (1000 feet or less) to account for potential offsite transport from a treated field. Most listed species are not expected to occur on agricultural fields. Therefore, EPA would identify mitigations only for those parts of fields located within the extent of the buffered PULA.

EPA expects to create PULAs for all species relevant to the Insecticide Strategy. EPA would then create grouped PULAs by combining the species-specific PULAs where the same mitigations have been identified (groups described above; species in each group provided in **Appendix B**). EPA does not intend to apply the Insecticide Strategy to a FIFRA action until relevant PULAs are available.

To date, EPA expects hundreds of PULAs will need to be developed. EPA is currently prioritizing map development for the Vulnerable Species Action Plan, the Herbicide and Insecticide Strategies, and certain new active ingredient registration actions. EPA released its mapping process to allow non-government entities to create maps if they choose to do so. EPA may revise our approaches based on lessons learned through this collaborative development and plans to provide updates on its progress in the development of all PULAs across the different strategies on its website. At the time EPA prepared this document, the Agency is aware of maps being developed for approximately 250 species, 50 of which are included in the Insecticide Strategy.

[62] https://www.epa.gov/pesticides/epa-updates-process-developing-maps-protect-endangered-species

# 4 Plan for Implementing the Insecticide Strategy

The Insecticide Strategy itself is not self-implementing. Rather, EPA plans to consider the applicability of this strategy to inform conventional new active ingredient registration actions and conventional registration review actions, focusing on agricultural uses of insecticides in the CONUS. This section describes EPA's plan for implementing the Insecticide Strategy through these actions.

As EPA considers applications for new conventional active ingredients and works on conventional registration review actions, the Agency will continue its current practice of providing opportunities for public input on proposed decisions, including mitigation that may come from this strategy. EPA expects to consider the appropriateness of applying the Insecticide Strategy for other actions on already registered active ingredients (*e.g.,* select new uses). When applying all (or part) of the strategy, EPA may propose label language as part of a FIFRA action that directs a user to access the BLT website for geographically specific mitigations through Bulletins. The Agency may propose label language/mitigations that are not spatially explicit and described on product labels. EPA may also propose label language that requires a specific level of mitigation and directs the user to a mitigation menu website. Using a mitigation menu website allows EPA to update the menu over time with additional mitigation options, which allows applicators to use the most up-to-date mitigations without requiring pesticide product labels to be amended each time new measures become available. Further, EPA may determine that additional mitigations would be appropriate for some listed species beyond the mitigations on the general pesticide product label. Those additional mitigations would be identified on Bulletins accessed through EPA's BLT website. Thus, mitigation measures may appear in up to three places: on a product label, on a mitigation menu website, and in Bulletins.

Through the FIFRA registration or registration review action, EPA will determine what type(s) of mitigation language is needed. Pesticide product labeling could direct the user to EPA's Mitigation Menu website, which describes the mitigation options from which the user can select to achieve the necessary level of mitigation specified on the label. EPA does not plan to include a mitigation menu on the label itself because the Agency plans to update the menu with additional measures systematically, on a defined timeline as data to support additional measures is reviewed. Only by posting the menu online can EPA readily keep it updated with all available options. The current mitigation menu website[63] reflects mitigations for both runoff/erosion and spray drift. EPA also plans to provide educational outreach and support to stakeholders as EPA begins implementing this strategy through FIFRA actions.

## 4.1 Registration Review and Registration Decisions

In the context of ecological risks, FIFRA requires that a pesticide not cause an "unreasonable risk to man or the environment, taking into account the economic, social, and environmental costs and benefits of the use of any pesticide." EPA generally evaluates the magnitude of environmental costs of the use of a pesticide in terms of its potential to cause adverse effects on ecosystem goods and services of value to society. The benefits of a pesticide typically accrue to the user; in the case of an agricultural pesticide the magnitude of benefits can be measured in terms of improved pest control leading to better yields,

[63] https://www.epa.gov/pesticides/mitigation-menu

higher quality produce, and/or decreased costs of pest control. The magnitude of benefits generally depends on the target pest and the damage it may cause, the cost-effectiveness of other pest control methods, the value of the crop, and the overall cost of production. EPA has long described this as a "risk-benefit" balancing approach where the magnitude of the risks is weighed against the magnitude of the benefits. For risk management decisions, the FIFRA mandate implies that EPA consider the magnitude of reductions in potential for adverse effects on human health and the environment against the impacts on users of mitigation requirements, *i.e.*, loss of benefits in terms of reduced pest control and/or increased costs.

Broadly speaking, this balancing can be achieved in two ways. One, EPA could adjust the level of mitigation, *e.g.*, the size of a spray drift buffer, according to the impact on the user. Two, EPA could choose a mitigation approach that minimizes the cost of achieving a certain level of mitigation, *e.g.*, setting application parameters for droplet size and boom height to reduce exposure in lieu of a spray drift buffer. In both registration and registration review decisions, this balancing is usually done according to the specifics of the case and either or both adjustments, if any, can be made. These decisions are made according to the registration of a specific chemical for use on a specific site.

Historically, EPA has largely approached risk management with specific mitigation actions that are required of all users for a pesticide on a use site. Drawing on experience from the mitigation strategy used for Enlist (2,4-D), EPA's development of the Herbicide and Insecticide Strategies has taken a more "performance standard" approach to reduce off-field movement that produces a similar level of mitigations through varying methods chosen by the user. For example, EPA sets, through a points system, the level of runoff control needed and provides the grower with a suite of options that can be implemented so that the grower can minimize the cost of achieving the required number of points, based on his or her unique situation. At the same time, the strategies allow growers to achieve mitigation relief based on geographic runoff vulnerability and field characteristics that reduce the potential for adverse effects. This approach is generic across chemicals and agricultural use sites.

Further balancing may be appropriate in registration and registration review decisions for specific pesticides and uses. For example, there may be other, chemical-specific measures that could reduce the costs of achieving a given level of mitigation. In certain high benefit/high grower impact cases, EPA could potentially support lowering the level of mitigation growers are required to achieve. In these cases, EPA may have to consider, in deliberation with the Services, other actions to protect listed species such as habitat conservation plans or offsets (see **Section 4.6**). While EPA risk management decisions issued under FIFRA will consider grower benefits and potential impacts of mitigation, potential impacts to species of wildlife that are in danger of becoming extinct will be given more weight than potential risks to species that are not. This will keep the Agency moving forward in addressing its obligations to protect listed species under the ESA.

The conventional pesticide registration review workload includes hundreds of pesticide active ingredients, which represent thousands of individual products. EPA is regularly updating its registration review schedule, which takes into consideration the timing of the issuance of the Final Herbicide, Insecticide, and Rodenticide Strategies. However, there may be instances where the timing of insecticide reviews does not coincide with the timing of the Insecticide Strategy due to other risk mitigation

priorities (*e.g.,* human health protection), existing consultation schedules, litigation, and/or Agency resource constraints. Overall, however, the Agency's efforts to align its registration review schedule with the publication of this Final Strategy should improve efficiency and consistency in the consideration and application of early mitigations for the protection of listed species in EPA's registration review work.
As part of the registration review process, EPA issues a Proposed Interim Registration Review Decision (PID) or Proposed Final Registration Review Decision (PFD) with proposed mitigation measures before issuing an Interim Registration Review Decision (ID) or Final Registration Review Decision (FD), respectively. Assessments of the benefits of the uses and the impacts of potential mitigation are usually published along with or are contained in the proposed decisions (PIDs/PFDs). Stakeholders can comment on the benefit/impact assessments and the proposed mitigation measures, including those that will be informed by the Final Insecticide Strategy. After comments received on the PID or PFD are considered, EPA would determine whether any changes are needed to what was proposed before issuing any respective ID or FD.

EPA is prioritizing making effects determinations, and consulting as appropriate, for new conventional active ingredient actions. Typically, as part of the process for reviewing a new active ingredient action, EPA takes comments on a proposed decision. The proposed decision would include a discussion of mitigation determined to be necessary, including measures to protect listed species. EPA would then consider comments received before making the final registration decision. In addition, EPA may determine that applying the strategy is appropriate in other registration actions (*e.g.,* new uses).

When EPA identifies mitigation to address population-level impacts using this strategy, a proposed decision associated with that action would include information on the mitigation. EPA may propose spray drift restrictions on use, such as spray drift buffers based on the application method, as well as runoff/erosion mitigation. In some cases, EPA expects to propose that the mitigations would apply across the full spatial extent of a use pattern (*e.g.,* specific crops) within the conterminous United States, by specifying the mitigation requirements on the general pesticide product label. In other cases, EPA plans to propose mitigations in geographically specific areas only.

When EPA identifies the need for runoff/erosion mitigation for a particular conventional insecticide new active ingredient registration or registration review action, the proposed decision would discuss product label statements related to these mitigations. The statements may include directions for use that require mitigation measures to achieve the minimum number of runoff/erosion mitigation points for that pesticide and use site. There could also be a statement on the pesticide product labeling directing the user to the mitigation menu website and/or to BLT. EPA may also propose that the labeling include specific mitigation measures to be followed such as application restrictions within certain distances around water bodies or holding times for treated fields that use flood-irrigation systems. The mitigation points on product labeling would be specific to the approved agricultural uses for that product.

Similar to runoff/erosion mitigation, the proposed decision would discuss label statements related to spray drift mitigations. The pesticide user would rely upon the product label and BLT to identify the level of spray drift mitigation required and where it would apply. EPA intends to update the mitigation menu website with additional information on spray drift mitigations. In many instances, the user could reduce the size of a spray drift buffer, if a label specifies one, by employing one or more of the spray drift buffer reduction mitigation measures as described in the strategy. In other cases, the surrounding conditions (*e.g.*, managed lands) and/or buffer reduction mitigations may satisfy the conditions such that exposure is not likely to have a population-level impact; therefore, a spray drift buffer may not be required as part of this strategy. Pesticide labeling will more precisely describe what measures would be needed and where additional information describing the measures can be found, if necessary.

If a label requires a minimum number of mitigation points to be achieved, it will direct users to access EPA's Mitigation Menu website for detailed information on what mitigation measures a pesticide user could choose from (and the points associated with each measure) to meet the minimum points. The mitigation menu website also contains details on situations (*e.g.* county-based mitigation relief) and options (*e.g.* participating in a qualifying conservation program) that provide mitigation relief and describes how much relief. Currently, the website has a section describing many of the mitigation measures being considered in this strategy.[64] The mitigation menu website will continue to be updated for each mitigation measure.

When a pesticide product label directs a user to the mitigation menu website for measures to meet the associated points on the label, the measure would need to be employed consistently with the description on the website. EPA worked with USDA on the descriptions of the mitigation measures. In August 2024, EPA provided information on the Agency's descriptions and the cross-references to NRCS conservation practices, entitled "Crosswalk of EPA's Ecological Mitigation Measures with USDA NRCS Conservation Practices in Support of EPA's Endangered Species Strategies" located in the Herbicide Strategy Docket on www.regulations.gov and on EPA's Mitigation Menu website. EPA has updated the document to reflect changes described in the Final Insecticide Strategy. The Crosswalk document and the descriptions are currently housed on the mitigation menu website and are in the Insecticide Strategy Docket on www.regulations.gov. EPA intends to review the Crosswalk and determine necessary revisions as new conservation practices are added to EPA's Mitigation Menu.

Providing a mitigation menu on a website allows EPA to update and expand the menu as the Agency receives more information on the efficacy of additional potential mitigation measures and to incorporate emerging and future technologies. EPA can therefore provide up-to-date available mitigations in a timely manner, providing for more flexibility for growers and other applicators. As a result, growers and other applicators would likely have multiple options when deciding what mitigation measures to apply to achieve the total number of points required by the product's label. It is essential that EPA communicates with applicators, farm managers, and landowners in the agricultural community. Likewise, communication among applicators, farm managers, and landowners on necessary mitigation measures is essential when planning an application.

EPA understands that many pesticide applicators use multiple pesticides on the same field at the same time. In this case, if a pesticide user applies more than one pesticide at the same time to a field, then the user would need to comply with all of the product labels among the pesticides that they plan to apply. This principle applies to listed species mitigation and all other use restrictions on the label, as these

[64] Available at this pinpoint site https://www.epa.gov/pesticides/mitigation-menu#measures

other use directions may be associated with ecological and/or human health risks identified by the Agency.

EPA understands that the spray drift and runoff/erosion mitigation can be complicated. While complex, providing a mitigation menu/list of options to provide mitigation points or reduce buffer distances allows for much greater flexibility to growers to meet the mitigation needs for individual pesticides. To help growers and other applicators consider their options, EPA developed a runoff calculator[65] and runoff calculator user guide[66] that growers can use to help determine what mitigation relief measures apply to them and their associated points for runoff/erosion, number of points associated with mitigations they may already have in place, and what further actions they may need to take to meet the total required points. EPA is developing other resources that could further help applicators, farm managers, and landowners work through the label complexity, including a spray drift calculator that is being released at the same time as this Final Insecticide Strategy.

To further help farmers or other pesticide users consider their options and understand how their current practices, location, and field properties relate to mitigation points, EPA is developing a mobile-friendly application (*i.e.,* App). EPA plans to develop the App in stages. The first stage is planned be a relatively simple App that converts the mitigation calculator(s) described in the previous paragraph into an easy-to-use mobile App. EPA plans to then conduct outreach and discuss both how to improve the App, and what additional functions would be most useful. EPA would then continue to add capabilities and improve its functionality and user-friendliness. EPA expects that subsequent versions of the App would serve as a 'one stop shop' that connects to all of the information sources needed to determine runoff and spray drift mitigations, such as soil properties, location-based mitigation relief points for runoff vulnerability, Bulletins Live! Two, descriptions and definitions of runoff practices, among others. EPA is developing a plan at the time this strategy is released and expects to release the first phase/version of the application in 2025. EPA looks forward to continuing to work with interested stakeholders to improve both the App and other available tools that help communicate how to comply with mitigation requirements as they begin to appear on pesticide labels.

### 4.2 Benefit/Impact Assessment

EPA normally defines the benefit of as pesticide as the extent to which it is important to its user, which in agriculture would be farmers where benefits will often be different for different crops. The benefits of a pesticide are based on various agronomic factors, chemical characteristics, and alternative control strategies, which influence how a grower manages insect pests. Both quantitative measures (*i.e*., dollars saved compared to alternative pest control methods) and qualitative measures (*e.g.*, chemical characteristics that make it easy to use or an important tool in resistance management) are used to inform the magnitude of this benefit. The unit of analysis is an acre of a crop treated with the pesticide. EPA assesses benefits at this unit of analysis both because growers make pest control decisions at the acre- or field-level and because risks to non-target organisms occur in and around treated fields; thus, the risk and benefit considerations are on roughly the same scale.

[65] Available at https://www.epa.gov/system/files/documents/2024-10/runoff-mitigation-calculator-tool.xlsm
[66] Available at https://www.epa.gov/system/files/documents/2024-10/mitigation-calculator-user-guide.pdf

#### 4.2.1. Benefit Assessments for Registration Decisions

EPA evaluates benefits of pesticides proposed for registration based on claims and supporting evidence submitted by the registrant/applicant. EPA utilizes sources including extension recommendations, scientific literature, and/or pesticide market research data, where available, to verify the registrant's claims. In EPA's review of registrant-claimed benefits, the benefits of the use of the pesticide primarily accrue to the user, though benefits may also be social (*e.g.*, improved recreation or aesthetics) or environmental (*e.g.*, habitat restoration or invasive species control).

The benefits of a new pesticide may be measured in terms of improved pest control leading to reductions in yield loss or increases in crop quality, the extent to which it facilitates integrated pest management and/or resistance management, and/or decreases cost of production. EPA pesticide benefit assessments evaluate the benefits for the use of a pesticide based on a weight of evidence approach. Decreases in production cost may not necessarily be monetary, but could be measured in terms of effort, flexibility, time, and management complexity. The benefits of a pesticide are typically measured against common alternative control strategies, including non-chemical means, if applicable.

#### 4.2.2 Benefit Assessments for Registration Review Decisions

EPA first examines how a pesticide is currently being used by farmers. EPA evaluates pesticide usage data to identify use patterns, including variations in regional and seasonal usage, average application rate, frequency of application, and methods of application. EPA also reviews pesticide usage information from market research data and scientific publications to identify major target pests and any attributes of the pesticide that may be useful in the pest control system. Together, this information establishes a baseline of where, when, and how farmers use the pesticide.

EPA then evaluates the magnitude of benefits of the pesticide by assessing the biological and economic impacts that farmers of a particular crop or crop group might experience should they need to employ alternative chemical insect control strategies in the absence of the pesticide. EPA identifies the likely alternative control strategies by reviewing extension recommendations and grower survey information and considering economic factors. Using a partial budget analysis, EPA may quantify benefits of the pesticide by comparing its per acre cost to the cost of these likely alternative active ingredient(s). This cost comparison is expressed as a percent of a grower's per acre net operating revenue, defined as gross revenue minus operating costs. If use of the next best available active ingredient(s) results in crop yield loss and/or crop quality reductions related to diminished pest control, these are also discussed and potentially quantified. Finally, benefits of use of the pesticide, including its utility in resistance management, simplicity of use, flexibility in timing of use, and management and/or integrated pest management programs, are discussed qualitatively.

A similar approach is followed to assess the impacts of potential risk mitigation measures on the use of a pesticide. These measures may affect how the pesticide is used or other production practices. In the case of the strategies, including runoff/erosion control measures and spray drift buffers, the impacts could include, but are not limited to, additional management effort to plan season-long pest control and individual applications, investments in land modifications, and changes in overall production practices. Some of these effects require consideration of impacts beyond per-acre changes in pest control and entail costs, which may include lost production, at the field or farm level. The magnitude of potential impacts is subject to high variability across farm and field characteristics and, therefore, impacts are largely described qualitatively.

### 4.3 Education and Outreach

EPA acknowledges the critical need for additional education and outreach as this and other strategies are finalized and implemented in pesticide decisions. This section describes EPA's education and outreach efforts over the past three years and describes EPA's next steps.

Various educational webinars were held in 2022 and 2023 that pertain to early listed species mitigation efforts under FIFRA and to help users navigate Bulletins Live! Two. In November 2022, EPA organized a webinar to present the Workplan Update. The webinar covered the FIFRA Interim Ecological Mitigation measures, draft Section 3 label language that directs users to the BLT system for implementing geographically specific mitigation measures, and current and future initiatives to prioritize mitigation for listed species. The Workplan Update webinar can be accessed online at: https://www.youtube.com/watch?v=ENMUQdPdvyY.

In August 2023, another similar webinar was held by EPA and USDA OPMP to introduce the Draft Herbicide Strategy. The webinar covered the Draft Herbicide Strategy, including draft mitigation measures, the implementation plan, example crop scenarios, and topics for public comment. The Draft Herbicide Strategy webinar recording can be accessed online at: https://www.youtube.com/watch?v=vmm_oTmxdLU.

In November 2023, EPA organized a webinar to provide an overview of the BLT system. The November 2023 webinar described how Bulletins relate to the general label, explained how to use BLT, demonstrated how to look for geographically specific mitigation, and addressed frequently asked questions. Materials from the November 2023 webinar can be accessed online at: https://www.epa.gov/endangered-species/materials-november-2023-bulletins-live-two-webinar.

In June 2024, EPA held another public webinar to introduce the first version of the mitigation menu website and to seek stakeholder feedback. The mitigation menu website webinar recording can be accessed online at: https://www.youtube.com/watch?v=kVkjWlX03go. The mitigation menu can be accessed at: https://www.epa.gov/pesticides/mitigation-menu.

In September 2024, similar to the webinar to introduce the Draft Herbicide Strategy and the Vulnerable Species Action Plan, EPA hosted a webinar to introduce the Draft Insecticide Strategy, including draft mitigation measures, the implementation plan, and topics for public comment. The Draft Insecticide Strategy webinar recording can be accessed online at: https://www.youtube.com/watch?v=Xzr_el5-Or8

In October 2024, EPA released a runoff points calculator and mitigation calculator user guide that growers can use to help determine what mitigation relief measures apply to their fields and their associated points for runoff/erosion, number of points associated with mitigations they may already have in place, and what further actions they may need to take to meet the total required points. EPA is developing other resources that could further help applicators, farm managers, and landowners work through the label complexity. The runoff points calculator is available online at: https://www.epa.gov/system/files/documents/2024-10/runoff-mitigation-calculator-tool.xlsm. The mitigation calculator user guide is available online at: https://www.epa.gov/system/files/documents/2024-10/mitigation-calculator-user-guide.pdf. EPA has also released a runoff/erosion mitigation points calculation worksheet, available online at: https://www.epa.gov/system/files/documents/2025-01/runoff-mitigation-worksheet.pdf.

In October 2024, EPA released the Pesticide and Endangered Species Educational Resources Toolbox. EPA compiled the materials in this toolbox for a variety of stakeholders who may have differing levels of knowledge about EPA's efforts to protect listed species. For example, crop consultants, agricultural retailers, extension agents, and others may use these materials to educate growers and applicators on the ESA strategies or mitigation measures they may see on product labels. The Pesticide and Endangered Species Educational Resources Toolbox catalogs educational resources including guidance documents, handouts, presentations, informational webinars, and other resources relating to EPA's endangered species work. The toolbox can be sorted alphabetically, by publication date, or by topic and has a search function that allows users to search by keyword or phrase. EPA will continue adding new materials to the toolbox as they are developed. The Pesticide and Endangered Species Educational Resources Toolbox is available online at: https://www.epa.gov/endangered-species/pesticides-and-endangered-species-educational-resources-toolbox.

Additionally, in October 2024, EPA released "A Helpful Guide to Bulletins Live! Two", a one-page guide, to assist users in navigating BLT. The guide can be accessed online at: https://www.epa.gov/system/files/documents/2024-10/blt-flyer_2024.09.24.pdf
Additional educational webinars and materials are being considered as strategies are finalized and as strategies are included in pesticide decisions.

In 2023, 2024, and 2025, EPA also met with agricultural stakeholders, including various crop/commodity groups to understand the grower perspective and potential land/crop management challenges associated with implementation of the strategy.

In Spring 2024, EPA and USDA OPMP hosted a workshop on ecological risk mitigation. EPA also hosted stakeholder workshops to discuss PULA refinements and offsets.

EPA continues to work with regulatory partners and stakeholders, such as the states through the State FIFRA Issues Research and Evaluation Group (SFIREG) and the Association of American Pesticide Control Officials (AAPCO), to discuss the enforcement perspective and potential implementation challenges.

EPA continues to develop new communication and educational materials for the Pesticide and Endangered Species Educational Resources Toolbox. These include handouts, presentations, webpages, and informational webinars. These materials are intended to support awareness of new label requirements resulting from implementation of the Herbicide and Insecticide Strategies and of the new types of mitigations included in the strategies and related efforts. Because pesticide users may have been using these products for several years or decades, awareness of any changes in how these pesticides may be used is key to their ability to comply.

EPA also recognizes that the main sources of information for many growers and other applicators are states, crop consultants, extension agents, and pesticide distributors. EPA will continue to coordinate with them to improve grower and other pesticide user awareness. Therefore, providing the appropriate support materials to the professionals who advise growers and other pesticide applicators will help improve compliance with label restrictions, including Bulletins, and thus help decrease pesticide exposures to listed species. Additionally, the Office of Pesticide Programs (OPP) is working with the Office of Enforcement and Compliance Assurance (OECA) to get feedback on labeling and to understand potential compliance concerns.

### 4.4 Consultation with FWS

EPA's historical focus has been to identify and implement mitigations directed at protecting listed species through 7(a)(2) consultations. This has been an inefficient process that takes many years and many staff from EPA and FWS to carry through to the end. Therefore, EPA is currently meeting its 7(a)(2) ESA obligations for only a subset of its pesticide-related actions. EPA is revising its approach to addressing its ESA obligations by using a more efficient tiered approach that includes both proactive conservation of many species through the evaluation of groups of pesticides (*e.g.*, Insecticide Strategy) and mitigation of specific species impacts for individual pesticide active ingredients or groups of pesticides through consultation. With this approach, EPA and FWS can consult under both Section 7(a)(1) and Section 7(a)(2) of the ESA. EPA and FWS recently signed a joint statement[67] to ensure EPA's strategies align with Section 7(a)(1) of the ESA, which requires Federal agencies to have programs for the conservation of endangered and threatened species. Under the joint statement, the agencies plan to work together to streamline consultations for conventional pesticide actions, meeting the ESA Section 7(a)(2) requirement for federal agencies to ensure that their actions are not likely to jeopardize the continued existence of any listed species or its critical habitat.

In cases where a FIFRA action includes approaches that promote the recovery of species (such as the Insecticide Strategy (or elements of it, as appropriate), then those approaches would be incorporated into actions before 7(a)(2) consultation begins, thereby allowing 7(a)(2) consultations to focus on any remaining concerns specific to the pesticide. With this tiered approach, the EPA approaches will serve as a mitigation filter where, by promoting recovery, pesticide impacts to many species may be reduced, leaving a limited number of remaining impacts to focus upon in a streamlined 7(a)(2) consultation. This approach will allow EPA and FWS to more efficiently use their available resources to maximize protections of listed species that may be affected by pesticides in a timely manner.

[67] https://www.epa.gov/endangered-species/joint-statement-cooperation-between-epa-and-fws-help-protect-endangered-species

**Figure 12** depicts how EPA envisions incorporating the approaches into registration review decisions and how this could help streamline Section 7(a)(2) consultations because mitigations could be incorporated into the action prior to initiating or completing any necessary consultation. **Figure 13** depicts how EPA envisions incorporating approaches into registration decisions. Throughout the registration and registration review processes, EPA provides for multiple opportunities for input from the public through comment periods. The feedback EPA receives could inform recovery actions, assessments, and mitigations considered by EPA and FWS.

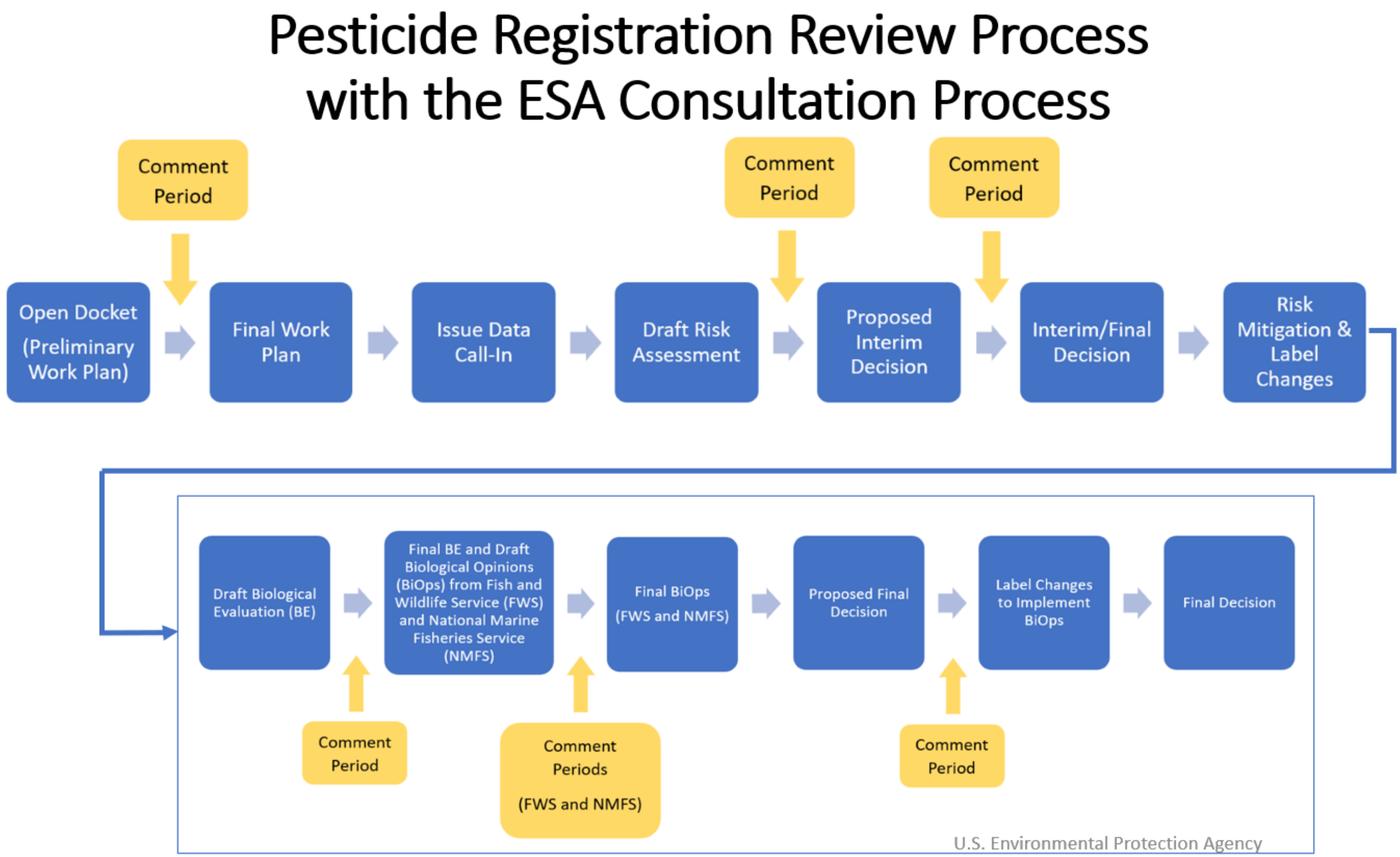


**Figure 12. Tiered Process Where Approaches are Incorporated into Registration Review of Specific Pesticides (Individual or Groups). The Application of Pesticide Multi-chemical Approaches Early in the Process Allows EPA to Further the Recovery and Conservation of Species and Streamline Section 7(a)(2) Consultations. Comment Periods are on EPA's Documents or FWS and NMFS Biological Opinions Where Noted.**

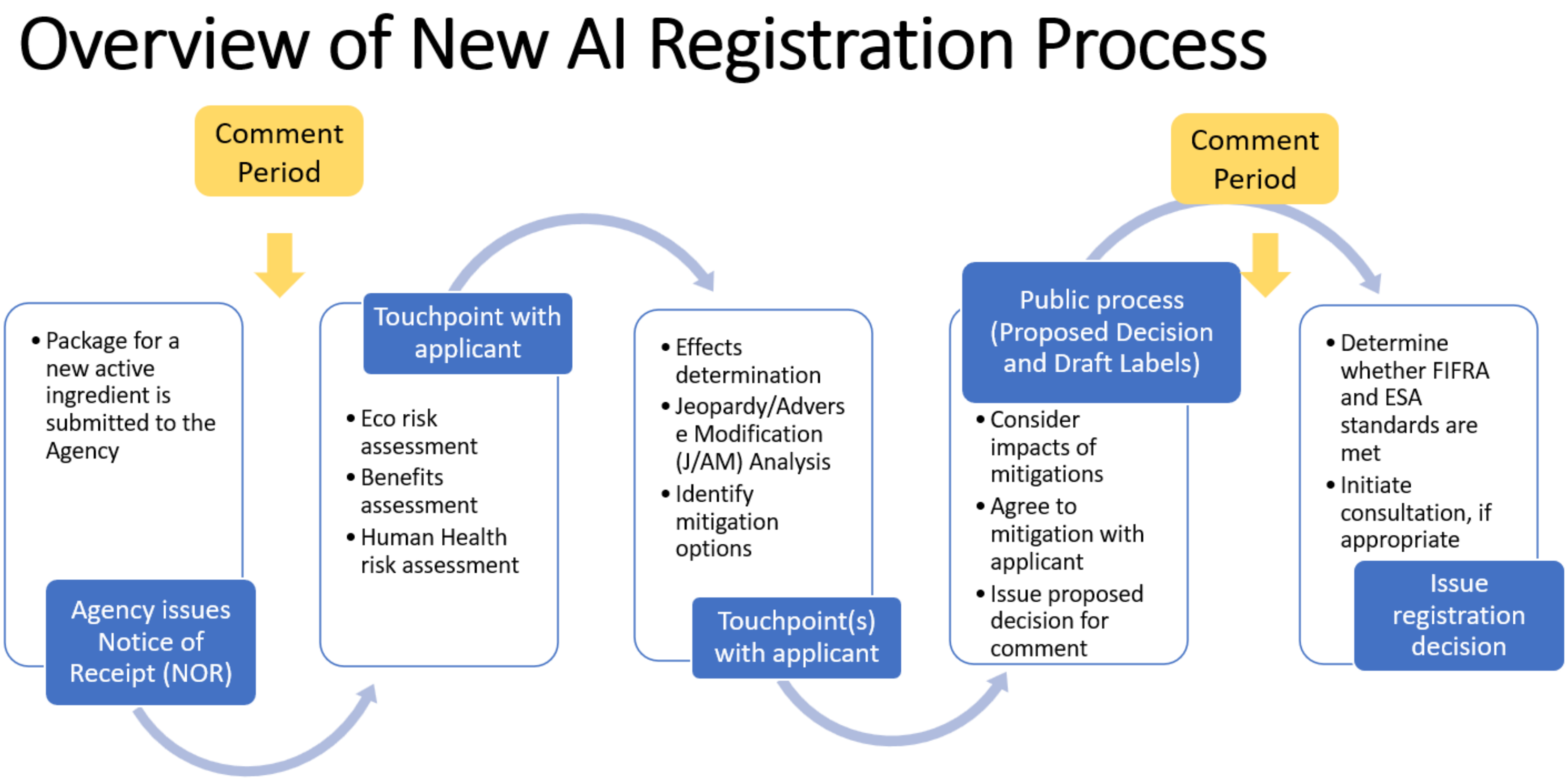


**Figure 13. Approaches Incorporated into the Registration of New Active Ingredients. The Application of Pesticide Multi-chemical Approaches (Such as the Insecticide Strategy) Early in the Process Allows EPA to Further the Recovery and Conservation of Species and Streamline Section 7(a)(2) Consultations.**

### 4.5 Interaction between FIFRA Interim Ecological Measures and the Insecticide Strategy

EPA released in its Workplan Update the FIFRA Interim Ecological Mitigation (IEM) that may be identified as necessary in registration review decisions and registration actions, in part to meet the requirement from the Omnibus Act of 2022 for registration review interim decisions to include measures that reduce the effects of pesticides on listed species.[68] The FIFRA IEM was released for public comment from November 16, 2022 to February 14, 2023. EPA received comments from over 100 individual stakeholders and stakeholder groups as well as two mass mail campaigns for a total of over 7,700 public comment submissions. EPA subsequently reviewed the comments received and updated the FIFRA IEM measures. EPA considered the need to be consistent across the FIFRA IEM and Insecticide Strategy mitigations to the extent appropriate. To that end, EPA is using the same runoff/erosion "mitigation menu" for FIFRA IEM and the strategies and is considering how the "mitigation menu" approach could work for other types of mitigation across strategies in the future (*e.g.,* Fungicide Strategy).

There are differences between the FIFRA IEM measures and the Insecticide Strategy mitigations related to the factors considered in determining the type, level, and extent of mitigations. EPA expects that the level of spray drift and runoff mitigation in the strategy would be greater than or replace the FIFRA IEM for agricultural uses. This is because the mitigations for the strategy focused on addressing the potential for population-level impacts to listed species would be at least as stringent as mitigation identified under FIFRA IEM for all non-target species. It is possible that other parts of FIFRA IEM labeling may be retained on a case-by-case basis if not addressed as part of the strategy. Examples of FIFRA IEM labeling that may be retained include the Bulletins reference, the seed treatment labeling, the directions for how to report ecological incidents, the pollinator best management practices labeling, and water protection statements—these elements are not currently part of the strategy. EPA plans to make clear in its regulatory decision documents which mitigations EPA considers appropriate for the insecticide and why, given the context of different yet overlapping efforts of FIFRA IEM and the strategies. The pesticide labeling itself, however, will not always explain why specific mitigation has been required, and applicators will need to follow the label directions regardless.

Lastly, EPA released the Final Herbicide Strategy in September 2024. That strategy does not impact insecticides directly, but may impact pesticide applications in general, particularly when multiple pesticides are used in the field. As is already the case, when multiple pesticide products are used, users will need to check requirements across all products being used and comply with the most restrictive measures.

When EPA identifies listed species mitigation that would cover an entire use area in the conterminous United States, such mitigations would likely appear on the general pesticide product label. In general, EPA expects listed species mitigations would apply broadly when there is potential for population-level impacts to entire invertebrate communities (*e.g.,* multiple species with impacts) that would lead to impacts to listed species of generalists (listed species that depend on invertebrates). EPA expects to identify less mitigation for such generalists compared to listed invertebrate species that are directly

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[68] Section 711 in Public Law 117-328.

affected by insecticides or obligate listed species that depend on a single (or very few) invertebrate species. This is because a population-level impact to generalists is expected to occur only when more than just a few species of invertebrates within a community are impacted. In contrast, a population-level impact to a listed invertebrate or obligate may occur when a single, or very few, species are impacted. Additionally, EPA expects to identify less mitigation for listed generalists that depend on larger aquatic habitats, flowing water habitats, terrestrial habitats, or those that depend on a variety of habitats, compared to listed generalists that depend on smaller wetland habitats where exposures of their dependent prey items to insecticides can be more significant.

### 4.6 Consideration of Offsets

The Insecticide Strategy includes mitigations that focus on minimization of exposure and impacts; however, offsets may be helpful or even necessary for addressing mitigations for some species (especially those where on-field mitigations are needed). At times, federal agencies have used offsets to meet ESA obligations (also known as compensatory mitigation) to address the impacts of their actions that cannot be avoided or minimized. Offsets are considered after feasible avoidance and minimization measures have been exhausted but more is needed to protect species. This could include actions such as habitat preservation or restoration, invasive species control, and species reintroductions. These actions can directly further species recovery (sometimes more than on-site avoidance and minimization) and can provide even greater flexibility by creating more options to meet ESA obligations. EPA plans to identify opportunities for offsets to complement traditional avoidance and minimization measures for pesticides, although a process still needs to be developed. Encouraging habitat creation and incorporating offsets into a mitigation approach may result in less minimization requirements in cases where habitat has been created for a species.

# 5 Conclusions and Next Steps

EPA developed the Insecticide Strategy to identify and implement (during a FIFRA action) early protections for listed species by reducing the potential for population-level impacts associated with invertebrates. This Insecticide Strategy includes a framework and an implementation plan. The framework is intended to provide EPA a process for confidently identifying when the uses of an insecticide have a potential for population-level impacts and how to identify effective and reasonable mitigations that are flexible and practical for growers and other applicators treating different crops and/or in different parts of the country. This strategy is designed to reduce exposure to listed invertebrates (and listed species that depend on invertebrates from spray drift and runoff/erosion). This strategy also includes on-field mitigations for the limited number of listed invertebrates that occur on treated fields and orchards. The implementation plan discusses EPA's current thinking on how the Insecticide Strategy can be applied to FIFRA registration and registration review actions. This strategy includes EPA's implementation expectations on how pesticide applicators will be able to understand necessary mitigations by using the general pesticide product label, a mitigation menu website, and BLT. EPA plans on communicating and educating stakeholders and applicators so that they understand applicable mitigations for their intended insecticide applications. This strategy is one of EPA's ESA strategies to efficiently avoid population-level impacts to listed species. EPA plans to continue to develop additional options, such as offsets, that may increase the flexibility available to growers and other applicators. This Insecticide Strategy is part of a process that EPA has undertaken with FWS, that should result in more efficient and effective insecticide specific consultations under ESA Section 7(a)(2).

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# 7 Abbreviations and Nomenclature

| | |
|---|---|
| a.e. | Acid equivalents |
| ACEP | Agricultural Conservation Easement Program |
| APEZ | Aquatic Plant Exposure Zone |
| BE | Biological Evaluation |
| BiOp | Biological Opinion |
| BLT | EPA's Bulletins Live! Two website |
| CFR | Code of Federal Regulations |
| CH | Designated critical habitat |
| CRP | Conservation Reserve Program |
| DSD | Droplet size distribution |
| ECOS | USFWS Environmental Conservation System |
| EEC | Estimated Environmental Concentration |
| EFED | Environmental Fate and Effects Division |
| EPA | United States Environmental Protection Agency |
| ESA | Endangered Species Act |
| FD | Final Decision |
| FIFRA | Federal Insecticide, Fungicide, and Rodenticide Act |
| ft | Feet |
| GIS | Geographic Information System |
| ha | Hectare |
| HUC | Hydrologic Unit Code |
| IEM | Interim Ecological Mitigations |
| in | Inch |
| ID | Interim Decision |
| $K_d$ | Solid-water distribution coefficient where the solid is soil or sediment |
| $K_{OC}$ | Organic-carbon normalized solid-water distribution coefficient where the solid is soil or sediment |
| $K_{OW}$ | Octanol-water partition coefficient |
| lb | Pound |
| LOAEC | Lowest Observed Adverse Effect Concentration |
| m | Meters |
| MAgPIE | Model of Agricultural Production and its Impact on the Environment |
| MATC | Maximum Acceptable Toxicant Concentration |
| MCPA | 2-Methyl-4-chlorophenoxyacetic acid and its salts and esters |
| MOA | Mode of Action |
| MoD | Magnitude of Difference/ratio of exposure estimate to population-level toxicity endpoint |
| mph | Miles per hour |
| NASS | National Agricultural Statistics Service |
| NMFS | National Marine Fisheries Service |
| NOAA | National Oceanic and Atmospheric Administration |
| NOAEC | No Observed Adverse Effect Concentration |
| NRCS | National Resource Conservation Service |
| $^{o}F$ | Degrees Fahrenheit |

| | |
|---|---|
| OPP | Office of Pesticide Programs |
| PAT | Plant Assessment Tool |
| PBF | Physical and Biological Features |
| PFAM | Pesticide in Flooded Applications Model |
| PFD | Proposed Final Decision |
| PID | Proposed Interim Decision |
| PULA | Pesticide Use Limitation Area |
| PWC | Pesticide in Water Calculator |
| RH | Relative Humidity |
| RQ | Risk Quotient |
| SSD | Species Sensitivity Distribution |
| TPEZ | Terrestrial Plant Exposure Zone |
| U.S. | United States |
| UDL | Use Data Layer |
| USDA | United States Department of Agriculture |
| USEPA/ EPA | U.S. Environmental Protection Agency |
| USFWS/ FWS | United States Fish and Wildlife Service |
| VFS | Vegetative filter strip |
| VSP | Vulnerable Species Pilot |
| WPEZ | Wetland Plant Exposure Zone |

# Appendix A. Detailed Explanation of Step 1: Identify Potential for Population-Level Impacts

This appendix provides a detailed explanation of **Step 1** of the Insecticide Strategy which is summarized in **Section 3.1**. Detailed information is provided here on:

- Calculating Magnitudes of Difference (MoD),
- Estimating exposure,
- Deriving toxicity thresholds, and
- How other information is considered when determining the potential for population-level impacts to listed species.

## A.1 Calculating the Magnitude of Difference (MoD)

EPA calculates the MoD as the ratio of the estimated environmental concentration (EEC) divided by the relevant toxicity threshold concentration:

$$\boldsymbol{Magnitude\ of\ Difference} = \frac{\boldsymbol{Estimated\ Environmental\ Concentration}}{\boldsymbol{Toxicity\ Threshold\ Concentration}}$$

The EEC used to calculate the MoD differs depending on several factors including:

- Application parameters (*e.g.,* rate, crop, method, frequency),
- The type of habitat being assessed (*e.g.,* terrestrial areas, small vernal pools, larger wetlands, ponds, rivers and streams),
- The type of exposure being assessed (*e.g.,* water column, sediment, diet, soil, and direct contact exposure),
- The duration of exposure being assessed (short-term acute vs. longer term chronic exposures),
- The species group being assessed, if differences in sensitivity are indicated, and
- Whether the MoD is being used in assessment of direct impacts on listed invertebrates or indirect impacts to listed generalist species that depend on invertebrates for diet or pollination.

Once calculated, the MoD is then used in conjunction with other information to assign a potential for population-level impacts for the species being assessed. The MoD values reflect order of magnitude (10X) ranges to match the level of precision EPA considers in the underlying toxicity and exposure information.

To account for different species habitats, EPA uses a variety of exposure models to determine EECs. These models are further explained in this appendix. When information indicates that different listed species groups vary in their sensitivity to an insecticide, the toxicity threshold concentration is determined separately. The process for evaluating sensitivity differences among listed species groups is described in **Section A.3.1** of this appendix. Once the MoD is calculated, EPA considers other information including uncertainty/bias in exposure or toxicity estimates when assigning the potential for population-level impact categories (not likely, low, medium, high) to the MoD ranges.

## A.2 Derivation of the Estimated Environmental Concentration (EEC) for the MoD

### A.2.1 Exposure Model Descriptions

EPA uses various standard exposure models[69] to calculate aquatic and terrestrial EECs for calculating the MoD. A summary of the models used in the Insecticide Strategy Case Studies Summary and Process document is provided below. When the Insecticide Strategy is implemented to inform a particular registration or registration review decision for a given insecticide, the most recent version of EPA's pesticide exposure models will be used.

#### A.2.1.1 On-Field Exposure Modeling

##### Terrestrial Residue Exposure Model (T-REX)

EPA used the Terrestrial Residue Exposure Model (T-REX) v1.5.2 to evaluate potential exposures to listed terrestrial invertebrates following a foliar application. Since the strategy is designed to evaluate the potential for population-level impacts, the mean rather than upper-bound Kenaga residues reported from T-REX were used to assess potential exposures. This refinement is considered appropriate considering the population-level focus of the Insecticide Strategy (exposures relevant to populations are likely relevant to multiple fields, where an average exposure is representative, rather than single fields represented by an upper bound). Two levels of exposure were considered from T-REX: 1) residues in or on exposed arthropods, which can represent either the residues expected to be encountered by a flying terrestrial invertebrate on the field at the time of a spray application (contact toxicity) or the oral exposure represented by an insectivorous insect (such as the Delta green ground beetle, *Elaphrus viridis*, consuming other recently exposed insect prey and 2) residues on exposed plant matter, representing oral exposure either via exposed nectar or pollen (to pollinators) or exposed leafs/stems (typically to larval insects such as butterflies). The estimates generated by T-REX are compared to empirical data where available.

##### Modeling Soil Applications and On-Field Residues

Following a soil application, soil-dwelling terrestrial invertebrates (*e.g.,* American burying beetle, *Nicrophorus americanus*) may be exposed. Pollinators or herbivorous invertebrates may also be exposed following a soil application of a systemic insecticide and systemic uptake into the plant. To evaluate residues in the soil, EPA assumed the chemical is uniformly distributed in the top six inches (~15 cm) of the soil. Concentrations are based on application rate, soil depth, and soil bulk density and result in estimated concentrations of 0.5 mg ai/kg-soil per one pound ai per acre application rate (USEPA 2012).

For systemic uptake within the plant, EPA used the soil module within the Bee-REX model (version 1.0, USPA 2014) to derive concentrations based on the application rate, the $K_{OC}$, and the log $K_{OW}$. As noted in

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[69] Current models and their user guides can be found at https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment.

EPA's Pollinator Risk Assessment Guidance (USEPA *et al*., 2014), there are a number of limitations in this model including the limited dataset used to derive concentrations (one plant species and two classes of non-ionic pesticides), and the limited relevance for either ionic compounds whose transport may not be predicted well using the log $K_{OW}$ and $K_{OC}$ or for chemicals that are more likely to be phloem transported than xylem transported. Empirically derived residue values (*e.g.,* measured residues in pollen and nectar for a given pesticide and crop) will be considered in addition to or in place of model-derived estimates where appropriate.

#### A.2.1.2 Off-field Exposure Modeling Resulting from Spray Drift

##### Spray Drift to Terrestrial Habitats

As noted in the Insecticide Strategy, when the on-field residues calculated above from T-REX result in low potential for population-level impacts, EPA identifies a lower limit buffer distance based upon the application method parameters (*e.g.*, aerial, medium droplet spectra). When the on-field residues calculated in T-REX result in high potential for population-level impacts, EPA identifies a maximum buffer distance as appropriate for the application method parameters. In those cases where EPA identifies a medium potential for population-level impacts, EPA identifies a chemical-specific buffer.

To derive the chemical-specific buffer, EPA uses the AgDRIFT® model (version 2.1.1) and the terrestrial toxicity endpoints to estimate off-field spray drift EECs and the distance where exposures would not be likely to result in population-level impacts. The drift analysis assumes a single application at the listed maximum single application rate. When considering potential impacts to listed species, exposure estimates represent the 90$^{th}$ percentile point deposition estimates (lb a.i./A) for ground applications[70], 50$^{th}$ percentile point deposition estimates for airblast applications (limitation of the model) and a mechanistic model output for aerial applications. EPA employed the Tier I exposure methods within AgDRIFT® for ground boom and airblast applications and the updated Tier III AgDRIFT® deposition curve[71] was used to calculate the drift fraction from aerial applications. For airblast, the off-field exposure estimates using the sparse orchard setting, which reflects young and/or dormant trees, though when implementing the Insecticide Strategy in a FIFRA action, the Agency may consider other orchard settings where they are more reflective of uses and anticipated exposure conditions. In cases where EPA identifies a medium potential for population-level impacts, and the resultant distance in AgDRIFT® is either below the lower limit buffer or above the maximum buffer distance (typically, this occurs when MoDs were close to the thresholds for either low or high potential for population-level impacts, respectively), EPA identifies the lower limit or maximum buffer distance, respectively, as the chemical-specific buffer.

##### Spray Drift to Aquatic Habitats

[70] 50th percentile estimates for ground applications are used as a line of evidence for supporting the maximum buffer distances presented in **Section 3.2.1** but 90th percentile estimates are appropriate for risk assessment.
[71] Updated default spray drift modeling assumptions for aerial pesticide applications are described in the Ecological Mitigation Support Document.

Similar to the terrestrial spray drift modeling that begins with on-field residues, for aquatic spray drift modeling, EPA first determines exposures in the waterbody (either the EPA pond, EPA wetland, or the small vernal pool) that is considered immediately adjacent to the treated field using the AgDRIFT® spray drift model. When these exposures would result in a low potential for population-level impacts, EPA identifies a lower limit buffer distance based upon the application method parameters (*e.g.,* ground, very fine to medium droplet spectra, high boom). When these exposures result in high potential for population-level impacts, EPA identifies a maximum buffer distance as appropriate for the application method parameters. In those cases where EPA identifies a medium potential for population-level impacts, EPA identifies a chemical-specific buffer.

To derive the chemical-specific buffer, EPA uses the AgDRIFT® spray drift model and the aquatic toxicity endpoints to estimate off-field distances to the different receiving waterbodies (*i.e.,* small vernal pools, EPA farm pond, EPA wetland) that result in exposures that would not be likely to result in population-level impacts. The EECs generated represent 90$^{th}$ percentile estimates (µg a.i./L) for ground applications and 50$^{th}$ percentile for airblast applications. EPA employs the Tier I exposure methods within AgDRIFT® for ground boom and airblast applications and the updated Tier III AgDRIFT® deposition curve[72] was used to calculate the drift fraction from aerial applications. In cases where EPA identifies a medium potential for population-level impacts, and the resultant distance in AgDRIFT® is either below the lower limit buffer or above the maximum buffer distance (typically, this occurs when MoDs were close to the threshold for either low potential or high potential for population-level impacts), EPA identifies the lower limit or maximum buffer distance, respectively, as the chemical-specific buffer.

#### A.2.1.3 Off-field Exposure Modeling Resulting from Runoff

##### Pesticide in Water Calculator

EPA generates surface water EECs using the Pesticide in Water Calculator (PWC), which combines the Pesticide Root Zone Model (PRZM) and the Variable Volume Water Model (VVWM) in a single graphical user interface.[73] For the case studies considered in this Insecticide Strategy, aquatic modeling was conducted using PWC version 2.001 and scenarios approved for use in ecological risk assessment released in April 2023. Consistent with EPA's standard FIFRA-based ecological risk assessments, EPA selects standard crop scenarios coupled with weather information to assess runoff potential from vulnerable agricultural use sites. Each standard crop scenario is comprised of information from many thousands of sites with soil, climatic, crop, and agronomic data as inputs for PWC. Each PWC crop scenario is based on up to 54 years of daily weather values that are applicable to a given location. Furthermore, each standard PWC crop scenario is based on the 90$^{th}$ percentile estimated exposure within each 2-digit HUC hydrologic region[74] (**Figure A-1**). For evaluating runoff/erosion exposure only,

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[72] Updated default spray drift modeling assumptions for aerial pesticide applications are described in the Ecological Mitigation Support Document.

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

[74] Watersheds in the United States were delineated by the U.S. Geological Survey (USGS) based on surface hydrologic features and are 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

the spray drift contribution in PWC is set to zero. For each PWC crop scenario, the EEC is calculated as the maximum annual concentration of a specified duration (acute = 1-day average; chronic = 21-d average) that has a return frequency of 1 in 10 years. Thus, within a PWC crop scenario, the EEC is considered a conservative (high end) estimate of exposure. To generate the range of potential EECs, EPA modeled both the lowest and highest annual application rate for registered uses within each Use Data Layer (UDL). To account for areas where concentrations in pesticide runoff are likely being overestimated, EPA will provide mitigation relief in the form of points as described in **Section 3.2.2.3**.

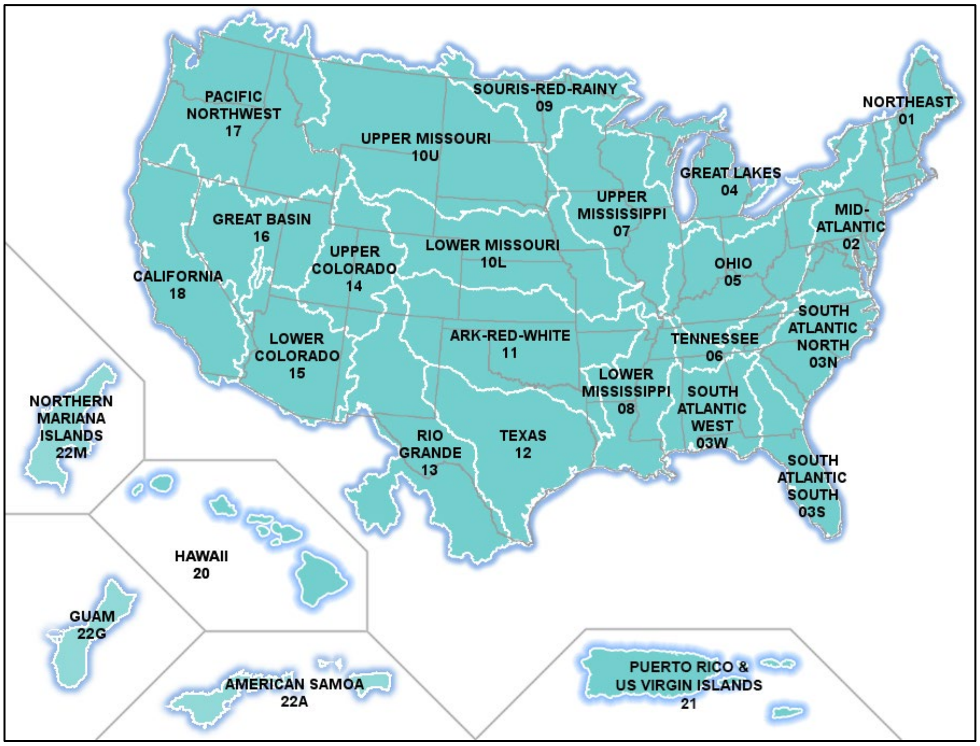


**Figure A-12. Map of the High-Resolution National Hydrography Dataset (NHD Plus) Hydrologic Regions (USGS, Undated)[75]**

Crops are grouped into different PWC scenarios based on agronomic practices. In order to determine exposure scenarios to calculate MoDs, a single 90$^{th}$ percentile scenario is then selected for each crop or group of crops within each hydroregion or subregion where the crop is present, based on Cropland Data Layer (CDL) data, for a total of up to 21 scenarios to represent each group of crops on a national scale. The 90$^{th}$ percentile is intended to represent a conservative scenario to begin the analysis for potential population-level impacts. The variability in exposures across different scenarios and geographies and how that is addressed in the varying mitigation identified is addressed in **Step 2** which utilized PWC model output, including geographic variability in runoff exposure to develop the relief point approach.

(these levels range from region to subwatershed). Two-digit HUCs are the first level of classification and represents specific hydrologic regions distributed across 21 HUC-02 regions of the United States, eighteen of which are within the conterminous 48 states. HUC-02 regions 3 and 10 were subdivided into multiple smaller subregions.

[75] Map of the HUC-02 Water Resource Regions was downloaded from the National Hydrography Dataset Plus United States Regional Dataset (https://www.usgs.gov/media/images/epas-nhdplus-us-regional-dataset-map).

Since pesticides with different $K_{OC}$ values behave differently in the different scenarios, separate sets of 90th percentile scenarios are selected for each crop or group of crop scenarios to represent chemicals based on three ranges of organic carbon (OC)-normalized sorption coefficient ($K_{OC}$) values: $K_{OC}$ <100 L/kg-OC, $K_{OC}$ from 100 to 3000 L/kg-OC, and $K_{OC}$ >3000 L/kg-OC.

### Plant Assessment Tool (PAT)

EPA used the PAT (v 2.8) model for estimating environmental exposure in aquatic habitats considered representative of wetland habitats, large vernal pools, backwater habitats, and shallow, slow-moving streams. PAT is a mechanistic model that incorporates pesticide environmental fate (*e.g.*, degradation) and transport (*e.g.*, sorption) data that are typically available for conventional pesticides to estimate concentrations in wetland aquatic habitats. EPA modeled wetlands using outputs from PRZM and the VVWM, which are then processed in PAT to estimate aquatic concentrations. Specifically, the WPEZ module of PAT is intended to represent a non-target wetland waterbody that is exposed to pesticides via overland flow[76] and spray drift. For evaluating runoff/erosion exposure only, the spray drift contribution in PAT is set to zero. The wetland can be immediately adjacent to the treated field or some unspecified distance away. The WPEZ is intended to represent a location that can exist as 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 the runoff from an adjacent treated field. The WPEZ is described as a one-hectare (ha) wetland receiving inputs from an 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 a fixed 5-cm depth. This model excludes comparisons of standing water concentrations to aquatic taxa when water depth is less than 0.5 cm.

### Edge of Field (EoF) Calculator

Edge of Field (EoF) concentrations are used to represent runoff exposure to listed species that may inhabit small vernal pools (1 $m^2$ x 0.1 m deep based on the aquatic “bin 5” used in previous EPA biological evaluations) and provide direct comparisons with the WPEZ modeling. These concentrations are calculated based on the total runoff flux and runoff depth provided by the output files of PWC using the EoF calculator version 2.2.1. These values represent complete displacement of the water in a confined receiving waterbody by the runoff from the treated field. While these values do not incorporate spray drift, they are considered conservative estimates of the exposure from runoff since they do not include degradation or dilution in the receiving waterbody. Spray drift exposure to vernal pool species was calculated and assessed separately using AgDRIFT® version 2.1.1.

### Pesticides in Flooded Applications Model (PFAM)

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

For applications to intermittently flooded fields such as rice grown in flooded fields and cranberries harvested via flooding, EPA used either the Pesticide in Flooded Applications Model (PFAM; version 2) or the Tier 1 Rice Model to generate water column EECs in the rice paddy or cranberry bog, in tailwater leaving the rice paddy or cranberry bog, and in larger order lotic environments (*e.g.,* Sacramento and Black Rivers) to provide a bounding of potential exposure in downstream rivers. As the overland sheet-flow runoff is not expected to occur in fields with levees or berms around the fields and in situations where water movement off of the field is controlled with a weir, EPA did not evaluate runoff risks to aquatic organisms for these types of cropping systems.

PFAM is not appropriate for estimating exposures from some cultivation methods of rice and cranberry. Specifically, some rice and cranberry crops are not grown or harvested in flooded fields. For example, rice grown in the mid-South is sometimes grown similar to row crops[77] (*i.e.*, "furrow irrigated rice" or "row rice"), and high bush cranberries are not flood harvested. For these non-flooded crops, traditional runoff models (PWC) are appropriate for evaluating this exposure pathway. In future assessments, EPA may use PAT to evaluate the potential for exposure of terrestrial and wetland invertebrates for insecticide use on row rice in the mid-South. Rice is not currently grown in this manner in California.

### A.2.2 Considering Listed Invertebrate Habitats in Exposure Model Selection

For each of the approximately 140 listed aquatic-phase invertebrate species covered in the Insecticide Strategy, the types of habitats described by FWS is specifically considered for determining the most applicable exposure model to use to estimate the EEC. In **Table A-1**, EPA classifies listed aquatic invertebrates according to various types of aquatic habitats that vary by their size and hydrologic features. The applicable standard exposure model used to estimate EECs for these species is also shown in **Table A-1**. In addition, separate modeling is conducted for flooded agricultural uses (*e.g.*, rice, cranberry) using the Pesticides in Flooded Applications Model version 2 (PFAM).

**Table A-1. Habitat Types of Listed Aquatic-phase Invertebrates and Associated Exposure Models**

| Common Habitat Characteristics | # Listed Aquatic Invertebrartes[1] | Exposure Model[3] (Route of Exposure) |
|---|---|---|
| Small vernal pools[2] | 6 | PWC EoF Calculator (runoff)<br>AgDRIFT® (spray drift) |
| Larger vernal pools, wetland areas, spring fed seeps and marshes, low gradient streams with slow current/flow, spring fed pools, backwater pool areas | 38 | PAT-Wetland (runoff)<br>AgDRIFT® (spray drift only) |
| Ponds, lakes, reservoirs, streams and rivers with moderate to fast flow regimes, karst systems | 155 | PWC - Standard Farm Pond (runoff)<br>AgDRIFT® (spray drift only) |

[1] Species listed as of December 2023 in the conterminous US under FWS jurisdiction. Species counts reflect listed invertebrates that occur in multiple habitat types.

[77] https://www.uaex.uada.edu/farm-ranch/crops-commercial-horticulture/rice/ArkansasFurrowIrrigatedRiceHandbook.pdf

[2] Approximately 100ft$^2$ or smaller; Species count in small vernal pools excludes 2 species included in the Vulnerable Species Project.
[3] PWC = Pesticides in Water Calculator version 2.001 available online at: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment;
EoF = Edge of Field calculator version 2.2.1;
PAT = Plant Assessment Tool version 2.8 available online at: https://www.epa.gov/endangered-species/provisional-models-and-tools-used-epas-pesticide-endangered-species-biological#pat;
AgDRIFT® version 2.1.1 available online at: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment#AgDrift

For listed terrestrial-phase invertebrates, the primary route of exposure considered is spray drift and subsequent exposure through:

- Direct contact with spray droplets,
- Consumption of contaminated diet (pollen, nectar, foliage, other invertebrates) and/or,
- Contact with contaminated soil (*e.g.,* burrowing species).

**Table A-2** summarizes the exposure routes and applicable exposure model used in calculating the MoD values for terrestrial invertebrates. Empirically-derived residue values in plant tissues (*e.g.,* measured residues in pollen, nectar, and/or leaves for a given pesticide and crop) will be considered in addition to or in place of model-derived estimates where appropriate.

**Table A-2. Terrestrial Exposure Routes Assessed for Listed Terrestrial-phase Invertebrates and Associated Exposure Models**

| Terrestrial Exposure Route (*Common Taxa Represented*) | # Listed Terrestrial Invertebrartes[1] | Exposure Model[3] |
|---|---|---|
| Direct Contact *(all taxa)* | 51 | T-REX v. 1.5.1 (residues on arthropods) |
| Consumption of Plant Foliage *(larval butterflies/moths, terrestrial snails)* | 43 | T-REX v. 1.5.1 (residues on broadleaf plants) |
| Consumption of Nectar (*adult butterflies/moths/bees*) | 31 | Bee-REX v. 1.0 (application method specific residues in nectar) |
| Other invertebrates (*beetles, dragonflies, arachnids*) | 7 | T-REX v. 1.5.1 (residues on arthropods) |
| Contact with Soil | 5 | Soil screening-level exposure model |

[1] Excludes 17 listed terrestrial invertebrate species that are restricted to caves where no/negligible exposure is expected to occur and precludes likely population-level impacts.

Details of the habitat descriptions for each listed aquatic- and terrestrial-phase invertebrate are provided in **Appendix C (Listed Species Information and Overlap Calculations)**.

## A.3 Derivation of Toxicity Thresholds for the MoD

The overall approach for considering the aforementioned factors when deriving toxicity endpoints for calculating MoD ratios (hereafter termed MoD toxicity thresholds) is shown in **Figure A-2**.

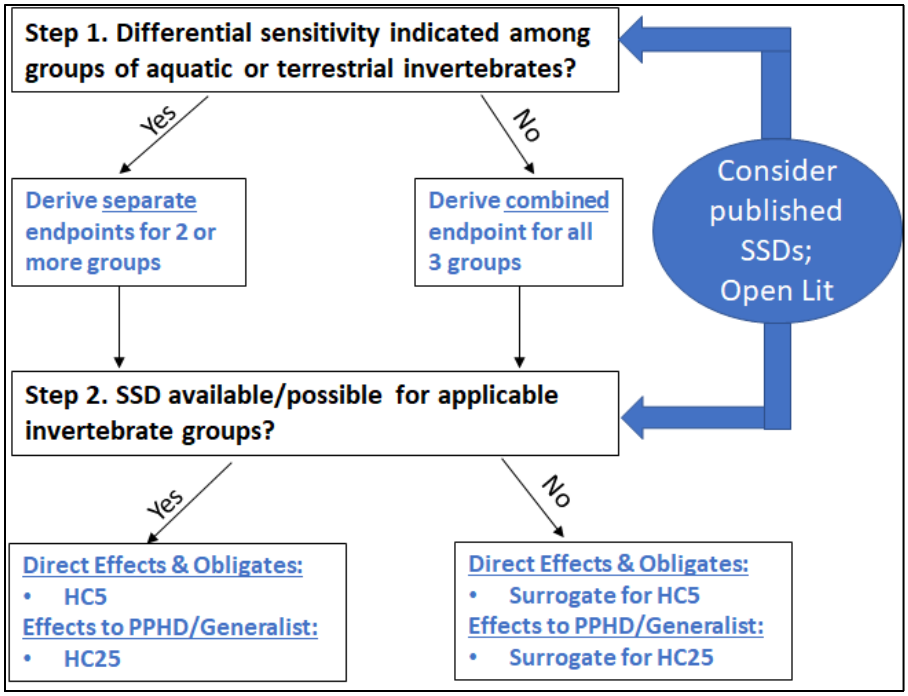


**Figure A-2. Generalized Approach for Deriving Toxicity Endpoints Used for Magnitude of Difference Ratios**

### A.3.1 MoD Toxicity Threshold Step 1: Assessing Sensitivity Differences Among Listed Taxa

The first step in deriving MoD toxicity endpoints involves identifying whether differential sensitivity among applicable taxonomic groups of listed invertebrates is likely. Notably, many insecticides are developed with Modes of Action (MoA) that target specific pests (*e.g.,* mites, mosquitoes, flies, moths, nematodes). Therefore, systematic differences in sensitivity of species among different taxonomic groups are expected at least for some insecticides due to varying physiological, genetic, and biological attributes which affect a species' susceptibility. In these cases, separate MoD toxicity endpoints are derived for the appropriate taxonomic groups.

In this first step, all available information is considered to identify if systematic differences in sensitivity likely exist between taxonomic groups of listed invertebrates. Multiple lines of evidence are considered including:

- The insecticidal MoA,
- Variability in toxicity data used in previous EPA risk assessments, and
- Variability in toxicity data published and curated in USEPA's ECOTOX database.[78]

In addition, mechanistic-based models may be considered on a case-by-case basis, such as SeqAPASS,[79] which can inform the likelihood of broad sensitivity differences among various taxonomic groups. The

[78] https://cfpub.epa.gov/ecotox/

[79] Sequence Alignment to Predict Across-Species Susceptibility (https://www.epa.gov/comptox-tools/sequence-alignment-predict-across-species-susceptibility-seqapass-resource-hub)

SeqAPASS tool has also been used to infer sensitivity differences among various taxa based on comparison of key amino acid sequences of target receptor proteins (Lalone *et al*., 2016).

Importantly, determining whether systematic differences in sensitivity to an insecticide exist among different taxonomic groups depends on the magnitude, consistency, and quantity of data available to support such conclusions. For example, if very few data are available within each taxonomic group being evaluated (*e.g.,* 1 or 2 species per group), then conclusions regarding taxonomic differences in sensitivity are unlikely to be scientifically robust, unless they are supported by other lines of evidence. In general, the greater the amount of data available for different species and taxonomic groups, the more likely that conclusions regarding taxonomic differences in sensitivity will be sufficiently robust for use in risk assessment. When sufficient toxicity data are present to evaluate taxonomic differences in sensitivity, at least 1 order of magnitude (10-fold) difference between toxicity endpoints for sensitive species among taxonomic groups is generally needed before separate MoD endpoints could be considered. Toxicity data from ECOTOX may provide a useful line of evidence in this step since registrant-submitted data are typically more limited in the breadth of species tested.

### A.3.2 MoD Toxicity Threshold Step 2: Selecting Derivation Method

In the second step, EPA decides whether the available data are sufficient to develop a species sensitivity distribution (SSD). SSDs are a statistical representation of sensitivity differences among species to a given chemical exposure and are useful in setting toxicological thresholds that are protective of certain percentages of tested species (*e.g.,* the $5^{th}$ percentile in an SSD would be protective of 95% of tested species). EPA develops SSDs[80] for invertebrates using the acute $LD_{50}$ and $LC/EC_{50}$ values when sufficient information is available.[81]

When sufficient data are available to generate an SSD for an active ingredient, EPA uses the $5^{th}$ percentile of the SSD to set the MoD toxicity endpoint for evaluating direct, population-level impacts to listed invertebrates and obligately dependent listed animals or plants. The $HC_5$ is considered a conservative basis for evaluating direct effects to listed invertebrates since it assumes that the species is more sensitive than 95% of the tested species. For evaluating indirect impacts to listed generalists that depend on invertebrates for survival, the $25^{th}$ percentile ($HC_{25}$) of the SSD is selected. A higher percentile (lower sensitivity) of the SSD is used to evaluate potential effects to listed generalists because such effects are presumed to occur at the community level, rather than for a population of a single species.

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[80] Species Sensitivity Distributions (SSD) are a common tool used for setting limits on exposure to a chemical or stressor. SSDs model the variation in the sensitivity of different species to a chemical and fit equations to understand the distribution of species sensitivity to a chemical. EPA uses the SSD Toolbox to generate SSDs. The Toolbox is available at: https://www.epa.gov/chemical-research/species-sensitivity-distribution-ssd-toolbox.

[81] $LD_{50}$ is the lethal dose (*e.g.,* mg ai/kg-body weight) that results in 50% mortality of the tested individuals (usually with terrestrial species) relative to controls. The $LC_{50}$ is the lethal concentration (*e.g.,* mg a.i./L water) that results in 50% mortality of the tested individuals (usually with aquatic species) relative to controls. The $EC_{50}$ is the concentration causing a 50% effect (*e.g.,* immobilization) relative to controls.

When data are insufficient to derive an SSD, individual species toxicity data are used as a surrogate to the $HC_5$ and $HC_{25}$ for setting the invertebrate MoD toxicity endpoints. With acute toxicity data, EPA sets its toxicity threshold for population-level impacts at the 10% effect level for mortality. The 10% effect threshold is considered appropriate for evaluating population-level impacts since it is reasonably low and corresponds to the acceptable amount of mortality in controls of acute toxicity tests (*i.e.*, is representative of background mortality). EPA intends to estimate the 10% effect threshold by multiplying the aquatic invertebrate $LC_{50}$ value by 0.5 and the terrestrial invertebrate $LD_{50}$ by 0.4. These values represent the ratio of the $LC_{10}$ to $LC_{50}$ when considering a central estimate of slope (USEPA 2000 and 2014).

To evaluate chronic population-level endpoints for a listed invertebrate species, EPA uses the Maximum Acceptable Toxicant Concentration (MATC), which is the geometric mean between the NOAEC and the lowest tested dose that resulted in significant adverse effects (LOAEC). The MATC is set using data for the most sensitive species tested.

For evaluating potential indirect impacts to listed generalists that depend on invertebrates for survival, other lines of evidence (*e.g.,* ECOTOX data and SSDs published in the scientific literature) are considered when selecting the most appropriate $LC_{50}$ or $LD_{50}$ value to represent a threshold for community-level effects. The goal is to select a species that can reasonably represent the lower quartile of the acute SSD ($HC_{25}$).

**Table A-3** summarizes the MoD and the groups of species with similar characteristics that are linked to that MoD. For terrestrial invertebrates, the relevant exposure pathways evaluated are for species on the treated field (including from contact with a foliar spray, deposition on or systemic uptake into attractive dietary matrices, and soil exposures) and those exposed via spray drift off the field. For aquatic invertebrates, exposure is evaluated via both runoff and spray drift.

**Table A-3. Summary of Magnitude of Difference Calculations for Different Species Groups**

| Species Group (also includes CH) | EEC (Model[1]) | Toxicity Threshold[2] |
|---|---|---|
| **Treated field and adjacent terrestrial habitat (exposure off-field via spray drift only)** | | |
| Listed **terrestrial invertebrates** and listed obligate species | Mean Kenaga Arthropod and Broadleaf plant EECs (T-REX)<br><br>Spray drift point deposition (AgDRIFT®)<br><br>Residues in pollen and nectar from systemic uptake (Bee-REX for soil treatment, upper bound empirical residue data for seed treatment)<br><br>Soil Exposures (screening model) | **Acute:**<br>• (With SSD): 5th percentile of SSD of $LD_{50}$<br>• (Without SSD): $LD_{50}$ * 0.4 or 0.5 from most sensitive terrestrial invertebrate<br><br>**Chronic:** MATC (geometric mean of NOAEC and LOAEC) |
| Listed generalist species that depend on terrestrial invertebrates | | **Generalists:** 25th percentile of SSD of acute $LD_{50}$ values or most appropriate $LD_{50}$ for terrestrial invertebrates |
| **Aquatic Habitats (EPA Pond, PAT wetland, small vernal pool; Runoff and/or Spray drift)** | | |

<table>
<tr><th>Species Group<br>(also includes CH)</th><th>EEC (Model[1])</th><th>Toxicity Threshold[2]</th></tr>
<tr><td>Listed aquatic invertebrates and associated listed obligate species</td><td rowspan="2">Water Column: 1-in-10 year daily and 21-d average EEC (PWC, PAT, Edge of Field Calculator)<br><br>Sediment: 1-in-10 year 21-day average EEC (PWC and PAT)<br><br>Rice paddy/Cranberry bog: Concentration in water (µg ai/L) released after holding period for applications to intermittently flooded fields (PFAM)<br><br>Spray Drift Only: concentration based on waterbody area/volume and spray drift estimate (AgDRIFT®)</td><td>Acute:<br>• (With SSD): $5^{th}$ percentile of SSD of $LC_{50}$<br>• (Without SSD): $LC_{10}$ from most sensitive aquatic invertebrate<br><br>Chronic: MATC (geometric mean of NOAEC and LOAEC)</td></tr>
<tr><td>Listed generalist species that depend on aquatic invertebrates</td><td>Generalists: $25^{th}$ Percentile of SSD of $LC_{50}$ values or lowest $LC_{50}$ for aquatic invertebrates</td></tr>
</table>

[1] CH=designated Critical Habitat; EEC = estimated environmental concentration; Model names are explained in the text.
[2] $LD_{50}$ ($LC_{50}$) = dose (concentration) resulting in 50% mortality to tested organisms. SSD = species sensitivity distribution; $HC_5$ ($HC_{25}$) = hazard concentration estimated for $5^{th}$ percentile ($25^{th}$ percentile) of the SSD. A toxicity extrapolation factor of 0.4 is used for terrestrial invertebrates and 0.5 is used for aquatic invertebrates based on previous analyses of acute toxicity dose-response curves (USEPA *et al*., 2014, USEPA 2004). Model names are explained in the text.

## A.4 Additional Information Considered for Assessing Potential Population-level Impacts

In addition to the MoD, EPA uses additional information as lines of evidence recommended in the *Revised Method for National Level Listed Species Biological Evaluations of Conventional Pesticides* and other ecological assessment guidance documents (USEPA, 1998; USEPA, 2004; USEPA, 2020 and USFWS, 2022) when evaluating the potential for population-level impacts. For the Insecticide Strategy, the level of confidence relates to the potential for terrestrial and aquatic invertebrate population-level impacts or terrestrial and aquatic invertebrate community-level impacts as well as potential impacts to diet and habitat for animals. Lines of evidence inform the reliability and variability of both exposure and impacts estimates.

EPA evaluates these lines of evidence in ecological impact assessments supporting registration actions. Thus, this information is readily available to support **Step 1** of the strategy analysis. When multiple lines of evidence are complementary (*e.g.*, laboratory and field-based data are consistent in terms of effect and exposure), potentially including monitoring data, higher tier studies, or ecological incident data that reinforce estimates of exposure and the potential for population-level impacts, then these increase EPA's confidence in predicting the potential for population-level impacts.

### A.4.1 Representativeness of Exposure Estimates of Listed Species Habitats

In comparison to EPA's typical screening-level assessments that are more generic and broad taxa-based (*e.g.* freshwater invertebrates), for the Insecticide Strategy, the representativeness of the exposure estimates (*i.e.,* level of confidence and bias) for the types of listed invertebrate habitats is particularly impactful to assigning the potential for population-level impacts. As described previously in the Insecticide Strategy, there is a large diversity of habitats where the listed invertebrate species can occur. For example, aquatic species can be found in small vernal pools that seasonally dry up, prairie potholes that are interspersed with agriculture, small and large wetlands, ponds, lakes, streams, and rivers. Terrestrial species can be found in meadows adjacent to agriculture, at high elevation mountainous regions, remote areas like cliff faces and waterfalls, and also in nearby forests. Since EPA has a finite set of exposure models to represent such a large diversity of aquatic and terrestrial habitats of listed invertebrates, an important consideration when assigning the potential for population-level impacts is how well our models represent these habitats. For example, EPA's previous analyses indicate that exposure estimates for the farm pond have a tendency to overestimate concentrations in streams and rivers with substantial flow regimes by an order of magnitude or more (USEPA 2016). Since exposure estimates for the farm pond are used as a proxy for other larger aquatic waterbodies including rivers and streams, the potential for population-level impacts begins at a MoD of 10 in these environments rather than 1 in recognition of the upward bias in the farm pond exposure estimates for these habitats. A similar situation exists when considering estimates of spray drift for species that live in areas where pesticide sprays may be intercepted by trees, shrubs, and other obstacles to direct contact with spray droplets. EPA's spray drift estimates assume relatively little or no interception of spray droplets as they move from the treated field. In such cases, EPA is providing additional reductions in spray drift distances and associated mitigations for species that are expected to reside in areas where spray drift is expected to be substantially lower than model estimates. For evaluating impacts to generalists that depend on communities of aquatic invertebrates, EPA uses the more conservative of the exposures and MoDs generated for the EPA Wetland and the EPA Pond. EPA does not use the more conservative exposure values from the small vernal pool modeling for generalists as the small vernal pool represents a highly conservative scenario that would generally not be considered realistic for generalist species that may rely on communities of aquatic invertebrates throughout a diversity of aquatic habitats.

For evaluating the impact of the representativeness of EPA's exposure estimates of listed invertebrate habitats, EPA considers detailed information from FWS on the habitat characteristics of these species, as summarized in **Table A-4**.

**Table A-4. Consideration of Habitat Characteristics on the Potential for Population-level Impacts or Spray Drift Mitigation**

| Habitat Type and Characteristics | # of Listed Invertebrates[1] | Impact on MoD or Mitigation | Rationale |
|---|---|---|---|
| **Listed Aquatic-Phase Invertebrates** | | | |
| Moderate/fast flowing streams and rivers | 94 | Potential for population-level impact begins at MoD of 10 rather than 1 | Extensive analysis of pond EECs indicates bias of 10X or more in representing these habitats (USEPA 2016) |
| Cave/karst aquatic systems | 12 | Potential for population-level impact begins at MoD of 10 rather than 1 | Spray drift not expected; Groundwater dominated systems also expected to reduce exposure compared to EPA EECs |
| High elevation habitats (*e.g.,* glaciers, meltwater streams) | 4 | Species excluded from further evaluation | Exposure via runoff or spray drift is not expected |
| **Listed Terrestrial-Phase Invertebrates[2]** | | | |
| Interior forests | 2 | Species excluded from further evaluation | Exposure via spray drift is not expected |
| Remote locations (*e.g.,* cliff faces/rocky outcrops, falls) | 6 | Species excluded from further evaluation | Exposure via spray drift is not expected |
| Terrestrial invertebrates restricted to caves | 16 | Species excluded from further evaluation | Exposure via spray drift is not expected |

[1] Note: the same species can be represented by multiple habitat types and characteristics. Includes species under FWS jurisdiction in the conterminous US excluding species represented in the Vulnerable Species Pilot Project.

[2] Also excludes listed species with less than 5% overlap with USDA cultivated land data layer and all insecticide usage information.

### A.4.2 Representativeness of Toxicity Estimates and Other Considerations

Looking closer at the listed invertebrate species within the scope of the Insecticide Strategy, the habitats where these listed species can occur are highly diverse. For example, aquatic species can be found in small vernal pools that seasonally dry up, prairie potholes that are interspersed with agriculture, small and large wetlands, ponds, lakes, and streams and rivers. Terrestrial species can be found in meadows adjacent to agriculture, at high elevation mountainous regions, remote areas like cliff faces and waterfalls, and in nearby forests. Since EPA has a finite set of exposure models to represent such a large diversity of aquatic and terrestrial habitats of listed invertebrates, an important consideration when assigning the potential for population-level impacts is how well its models represent these habitats. For example, EPA's previous analyses indicate that its exposure estimates for the farm pond have a high tendency to overestimate concentrations in streams and rivers with substantial flow regimes by an order of magnitude or more (USEPA 2016). Since exposure estimates for the farm pond are used as a proxy for other larger aquatic waterbodies including rivers and streams, the potential for population-level impacts begins at a MoD of 10 in these environments rather than 1 as shown previously in **Table 2** in recognition of the upward bias in the farm pond exposure estimates for these habitats. A similar situation exists when considering estimates of spray drift for species that live in areas where pesticide sprays may be intercepted by trees, shrubs, and other obstacles to direct contact with spray droplets. EPA's spray drift estimates assume relatively little or no interception of spray droplets as they move from the treated field. In such cases, EPA also as signs higher thresholds of MoDs to the various categories for assigning the potential for population-level impacts.

With respect to toxicity, EPA also considers the uncertainty and potential bias in toxicity data when assigning the potential for population-level impacts. The MoD ranges shown in **Table 2** could conceivably be lowered when other information indicates the available toxicity test data do not adequately capture the expected sensitivity of one or more types of listed invertebrates. Conversely, the MoD ranges may be increased if information suggests the opposite situation is likely to occur.

EPA also considers information such as data on pesticide residues in environmental media (*i.e.,* monitoring data; targeted pesticide residue studies) in conjunction with model-based estimates of exposure. Generally, monitoring data can support the model-based exposure estimates when concentrations are reasonably similar; however, monitoring data often are not targeted to when and where insecticides are applied, so lack of agreement does not usually impact the MoD ranges associated with the potential for population-level impacts. As part of EPA's 2014 Guidance for Assessing Pesticide Risks to Bees (USEPA *et al.,* 2014), EPA evaluates submitted data on pesticide residues in various crop matrices (*e.g.*, pollen, nectar, leaves, flowers). Such data are not only useful for refining risk estimates to bees particularly for systemic pesticides, but also will be considered when assessing the potential for population-level impacts to other (non-bee) listed terrestrial species. Ecological incident data reported to EPA also represent a similar confirmatory line of evidence as monitoring data. Suitable data from higher tier studies (*e.g.,* field studies) will also be considered as a line of evidence for setting toxicity thresholds for listed species.

In addition, chemical-specific attributes will be considered when evaluating spray drift MoDs with respect to chronic toxicity. This may be particularly impactful for pesticides with relatively short persistence in/on dietary items of terrestrial invertebrates relative to the exposure duration associated with chronic toxicity thresholds. For example, if an insecticide demonstrates short persistence on foliage (*e.g.,* half life < 1 day) relative to the exposure duration associated with the chronic toxicity threshold (*e.g.,* 10 days for adult honey bees), then marginal exceedances of the MoD thresholds may be discounted (other factors not withstanding).

In summary, EPA decides on the likelihood of population-level impacts by considering multiple factors, including:

- MoDs,
- Representativeness (or lack thereof) of exposure estimates of species habitat,
- Representativeness of toxicity estimates of surrogate test species, and
- Monitoring and incident data as confirmation.

Based on the variability in the MoD estimation process, there may be cases in which the MoDs calculated for a given use and application method (*e.g.,* aerial spray application to corn) span more than one category of potential population-level impacts (*e.g.,* $1 \leq$ MoD $< 10$ = low, $10 \leq$ MoD $< 100$ = medium, MoD ≥100 = high). When this occurs, EPA will consider multiple factors when assigning the likelihood of population-level impacts. For example, one factor to consider with aquatic MoDs is how well the modeled PWC exposure scenarios represent areas where the crop is grown. Other considerations include how many (and by what magnitude) the MoD values extend beyond a given category of potential population-level impacts. MoDs which exceed a classification category with relatively low frequencies and marginal magnitudes may have less influence when assigning the overall likelihood category for population-level impacts.

## Appendix B. Listed Species Included in Insecticide Strategy PULAs

As of April 2025, EPA identified 93 listed invertebrates (or obligate species) that may have a potential for population-level impacts from direct exposures to off-site transport of spray drift or runoff/erosion. Many of these 93 listed species will likely share the same level of mitigation for a particular insecticide. This is because they share similar modeled habitats and/or population-level endpoints based on the assessment of sensitivity differences among species groupings. EPA is planning to group these species into common PULAs. Where multiple species share the same levels of mitigations, EPA is expecting to group the areas important for the conservation of each of those species into one aggregated PULA. Additionally, 30 listed generalists that are primarily dependent on wetland habitat have been grouped in a PULA as EPA anticipates that for some FIFRA actions, additional mitigation may be identified for these species, compared to the mitigation identified for listed generalists in other habitats (which are not grouped in PULAs and for which mitigations would be identified directly on the label). EPA has identified 11 possible groups (**Table B-1**) where listed species would generally have the same mitigations due to similarity of habitat and taxonomy. The purpose of this appendix is to provide more information on species included in each group. As EPA reviews FIFRA actions, the list of species will continue to be updated and incorporated into EPA's assessments and effects determinations.

**Table B-1. Summary of 11 Potential Invertebrate Species Groups for Insecticide Strategy PULAs**

| Insecticide Strategy Group (PULA) # | Habitat description | Taxon | # of species* |
|---|---|---|---|
| 1 | Terrestrial areas near treated fields | Bees and Dragonflies | 2 |
| 2 | | Butterflies | 16 |
| 3 | | Beetles | 6 |
| 4 | Vernal pools | Crustaceans | 4 |
| 5 | Wetlands | Aquatic insect | 1 |
| 6 | Small water bodies, Wetlands | Mussels/snails | 9 |
| 7 | Wetlands and ponds | Crustaceans | 4 |
| 8 | Low flow waters, ponds | Mussels/snails | 19 |
| 9 | Medium/large flowing waters, lakes, reservoirs | Mussels/snails | 36 |
| 10 | Karst systems (caves, pools) | Crustaceans | 4 |
| 11 | Wetlands | Generalists | 30 |

*Some species are included in multiple PULA groups because they occur in multiple types of habitat.

## B.1 Spray Drift Mitigations

For this strategy, EPA has identified multiple species of beetles and butterflies and one dragonfly where the same level of spray drift mitigations may be appropriate for some agricultural insecticide uses to address a potential for population-level impacts in habitats off of the treated field (**Table B-2**). There is also one listed plant species (Furbish lousewort) that is obligate to a bumble bee species, so EPA would likely identify the same level of spray drift mitigations for this species. EPA is proposing to group terrestrial species by the following three taxa: butterflies, beetles, and bees (used as a surrogate for dragonflies as terrestrial toxicity data are rarely, if ever, available for this taxon) to allow for cases where toxicity data are available for an insecticide that shows different sensitivities across these species' groups.

**Table B-2. Species Included in Spray Drift Mitigation PULA Groups**

| Taxon | Common name | Scientific name | Entity ID^ | PULA # | Species habitat description (From FWS sources) |
|---|---|---|---|---|---|
| Bees | Furbish lousewort* | *Pedicularis furbishiae* | 790 | 1 | Riverbanks |
| Dragonflies | Hines emerald dragonfly** | *Somatochlora hineana* | 445 | 1 | Marshes, near streams |
| Butterflies (and moths) | Langes metalmark butterfly | *Apodemia mormo langei* | 421 | 2 | Sand dunes |
| | Callippe silverspot butterfly | *Speyeria callippe callippe* | 430 | 2 | Grassland |
| | Kern primrose sphinx moth | *Euproserpinus euterpe* | 433 | 2 | Sandy washes |
| | Bay checkerspot butterfly | *Euphydryas editha bayensis* | 438 | 2 | Grassland |
| | Fender's blue butterfly | *Icaricia icarioides fenderi* | 450 | 2 | Prairies |
| | Saint Francis satyr butterfly | *Neonympha mitchellii francisci* | 455 | 2 | Meadows |
| | Carson wandering skipper | *Pseudocopaeodes eunus obscurus* | 462 | 2 | Grassland |
| | Dakota Skipper | *Hesperia dacotae* | 3412 | 2 | Prairies |
| | Karner blue butterfly | *Lycaeides melissa samuelis* | 420 | 2 | Grasslands, old fields, sand dunes, savannas |
| | Mitchell's satyr Butterfly | *Neonympha mitchellii mitchellii* | 424 | 2 | Fens, prairies, meadows, tamarack savannas, shrub-carr |
| | Bartram's hairstreak Butterfly | *Strymon acis bartrami* | 5067 | 2 | Pine rockland, rockland hammock, pine flatwoods |
| | Florida leafwing Butterfly | *Anaea troglodyta floridalis* | 8083 | 2 | Pine rockland |
| | Silverspot Butterfly | *Speyeria nokomis nokomis* | 1324 | 2 | Wet meadows, marshes |
| | Bog buck moth | *Hemileuca maia menyanthevora* | 6400 | 2 | Fens |

| Taxon | Common name | Scientific name | Entity ID^ | PULA # | Species habitat description (From FWS sources) |
|---|---|---|---|---|---|
| | Oregon silverspot butterfly | *Speyeria zerene hippolyta* | 431 | 2 | Grassland |
| | Island marble Butterfly | *Euchloe ausonides insulanus* | 5610 | 2 | Upland prairie |
| Beetles | Delta green ground beetle | *Elaphrus viridis* | 435 | 3 | Grassland-playa pool matrix |
| | Northeastern beach tiger beetle | *Cicindela dorsalis dorsalis* | 442 | 3 | Beach |
| | Salt Creek Tiger beetle | *Cicindela nevadica lincolniana* | 4910 | 3 | Wetlands, mud flats, banks of streams |
| | American burying beetle | *Nicrophorus americanus* | 440 | 3 | Grassland, meadows, partially forested canyons, shrubland |
| | Valley elderberry longhorn beetle | *Desmocerus californicus dimorphus* | 436 | 3 | Riparian forest |
| | Miami tiger beetle | *Cicindelidia floridana* | 10909 | 3 | Pine rockland |

^ Entity ID is a unique number assigned to a listed species used for tracking and information management
*Listed plant that is pollinated by the half black bumble bee (*Bombus vagans*). This plant is included because it is obligate to a specific insect species.
**Adult lifestage is terrestrial and may be exposed to spray drift.

### B.2 Spray Drift and Runoff/Erosion Mitigations

Depending on the pesticide, EPA may have sufficient toxicity data to differentiate impacts to listed aquatic insects, crustaceans, and mollusks. This depends on a chemical by chemical (or chemical class) basis where data are available. These taxa represent different types of listed species that use aquatic habitats. When considering the different types of habitats used by listed aquatic invertebrates or obligates and the three taxonomic categories that can be used to distinguish toxicity and impacts, EPA has identified 7 potential groups for aquatic invertebrates where potential spray drift and runoff/erosion mitigations have been identified. **Table B-3** identifies the specific aquatic species and which PULA group would apply.

**Table B-3. Species Included in Spray Drift and Runoff/Erosion Mitigation PULA Groups**

| Taxon | Common name | Scientific name | Entity ID | PULA # | PULA habitat description | Species habitat description (From FWS sources) |
|---|---|---|---|---|---|---|
| Insects | Hines emerald dragonfly | *Somatochlora hineana* | 445 | 5 | Wetlands | Marshes, near streams |
| Crustaceans | Conservancy fairy shrimp | *Branchinecta conservatio* | 490 | 4 | Vernal pools | Vernal pools |
| | Longhorn fairy shrimp | *Branchinecta longiantenna* | 491 | 4 | Vernal pools | Vernal pools |
| | Vernal pool fairy shrimp | *Branchinecta lynchi* | 493 | 4 | Vernal pools | Vernal pools |
| | Vernal pool tadpole shrimp | *Lepidurus packardi* | 494 | 4 | Vernal pools | Vernal pools |
| | Noel's Amphipod | *Gammarus desperatus* | 1261 | 7 | Wetlands and ponds | Shallow waters of streams, ponds, ditches, sloughs and springs |
| | Brawleys Fork crayfish | *Cambarus williami* | 10771 | 7 | Wetlands and ponds | Shallow waters of streams |
| | California freshwater shrimp | *Syncaris pacifica* | 481 | 7 | Wetlands and ponds | Shallow waters of streams or intermittent streams with perennial pools |
| | Slenderclaw crayfish | *Cambarus cracens* | 10757 | 7 | Wetlands and ponds | Shallow waters of streams |
| | Alabama cave shrimp | *Palaemonias alabamae* | 480 | 10 | Karst systems | Subterranean aquatic pools |
| | Kentucky cave shrimp | *Palaemonias ganteri* | 482 | 10 | Karst systems | Cave river passage |
| | Illinois cave amphipod | *Gammarus acherondytes* | 484 | 10 | Karst systems | Cave streams |
| | Squirrel Chimney Cave shrimp | *Palaemonetes cummingi* | 487 | 10 | Karst systems | One cave sinkhole |
| Mussels/ snails (mollusks) | Roswell springsnail | *Pyrgulopsis roswellensis* | 1246 | 6 | Small water bodies, wetlands | Spring-fed seeps and high volume springs near head runs |
| | Kosters springsnail | *Juturnia kosteri* | 1247 | 6 | Small water bodies, wetlands | Spring-fed seeps and high volume springs near head runs |
| | Fat pocketbook | *Potamilus capax* | 342 | 6 & 8 | Small water bodies, wetlands, Low flow waters, ponds | Streams/rivers (slow moving, depositional areas) |

| Taxon | Common name | Scientific name | Entity ID | PULA # | PULA habitat description | Species habitat description (From FWS sources) |
|---|---|---|---|---|---|---|
| | Dwarf wedgemussel | *Alasmidonta heterodon* | 363 | 6 & 8 | Small water bodies, wetlands, Low flow waters, ponds | Creeks/rivers of varying sizes, slow to moderate current |
| | Gulf moccasinshell | *Medionidus penicillatus* | 384 | 6 & 8 | Small water bodies, wetlands, Low flow waters, ponds | Streams/rivers; wide variety of habitat with slight to moderate current |
| | Armored snail | *Pyrgulopsis (=Marstonia) pachyta* | 402 | 6 & 8 | Small water bodies, wetlands, Low flow waters, ponds | Streams; Slow to moderate current; associated with pool edges, tree roots, rocks |
| | Green floater | *Lasmigona subviridis* | 2643 | 6 & 8 | Small water bodies, wetlands, Low flow waters, ponds | Streams with low to medium flow; sand and gravel substrate |
| | Southern elktoe | *Alasmidonta triangulata* | 10829 | 6 & 8 | Small water bodies, wetlands, Low flow waters, ponds | Small creeks to large rivers; prefers slow current along stream margins. |
| | Alabama lampmussel | *Lampsilis virescens* | 326 | 8 | Low flow waters, ponds | Small creeks to large rivers, low to moderate current. |
| | Oval pigtoe | *Pleurobema pyriforme* | 371 | 8 | Low flow waters, ponds | Medium creeks/small rivers, slow to medium current |
| | Shinyrayed pocketbook | *Lampsilis subangulata* | 373 | 8 | Low flow waters, ponds | Medium creeks/rivers; permanently flowing areas, intolerant of impoundment |
| | Chipola slabshell | *Elliptio chipolaensis* | 386 | 8 | Low flow waters, ponds | Large creeks to large river; slow/moderate current |
| | Fuzzy pigtoe | *Pleurobema strodeanum* | 1369 | 8 | Low flow waters, ponds | Medium size creeks/rivers; slow to moderate current |
| | Tapered pigtoe | *Fusconaia burkei* | 6534 | 8 | Low flow waters, ponds | Medium size creeks/rivers; slow to moderate currents |
| | Southern sandshell | *Hamiota australis* | 7349 | 8 | Low flow waters, ponds | Small creeks to large rivers; slow to moderate currents; Hydrologic |

| Taxon | Common name | Scientific name | Entity ID | PULA # | PULA habitat description | Species habitat description (From FWS sources) |
|---|---|---|---|---|---|---|
| | | | | | | regime necessary to maintain well oxygenated waters. |
| | Suwannee moccasinshell | *Medionidus walkeri* | 7372 | 8 | Low flow waters, ponds | Large streams; slow/moderate currents |
| | Southern kidneyshell | *Ptychobranchus jonesi* | 7949 | 8 | Low flow waters, ponds | Medium size creeks/rivers; slow current |
| | Salamander mussel | *Simpsonaias ambigua* | 8134 | 8 | Low flow waters, ponds | Small creeks to rivers; seasonal low flow; shelter habitat with space under slab rock/bedrock crevice |
| | Mexican fawnsfoot | *Truncilla cognata* | 8229 | 8 | Low flow waters, ponds | Medium to large rivers; riffle and run or stream bank habitats with clay, silt, or sand substrate |
| | Texas fawnsfoot | *Truncilla macrodon* | 9967 | 8 | Low flow waters, ponds | Low flow backwaters of medium- to large-sized streams; mud, sand, and gravel substrates |
| | Texas pimpleback | *Cyclonaias petrina* | 9968 | 8 | Low flow waters, ponds | Riffle and run habitats of medium to large creeks and rivers |
| | Purple Cats paw (Purple Cats paw pearlymussel) | *Epioblasma obliquata obliquata* | 323 | 9 | Medium/large flowing waters, lakes, reservoirs | Large river species, shallow/Moderate depths, swift-moderate current |
| | White catspaw (pearlymussel) | *Epioblasma obliquata perobliqua* | 324 | 9 | Medium/large flowing waters, lakes, reservoirs | Small to moderate size rivers, riffle/run |
| | Pink mucket (pearlymussel) | *Lampsilis abrupta* | 331 | 9 | Medium/large flowing waters, lakes, reservoirs | Most often associated with large rivers, fast flowing; 0.5m to 8m depth |
| | Curtis pearlymussel | *Epioblasma florentina curtisii* | 333 | 9 | Medium/large flowing waters, lakes, reservoirs | Shallow stable riffles and runs; btw headwater lowland streams |

| Taxon | Common name | Scientific name | Entity ID | PULA # | PULA habitat description | Species habitat description (From FWS sources) |
|---|---|---|---|---|---|---|
| | Tar River spinymussel | *Elliptio steinstansana* | 351 | 9 | Medium/large flowing waters, lakes, reservoirs | Swift creek, fast flowing areas |
| | Clubshell | *Pleurobema clava* | 352 | 9 | Medium/large flowing waters, lakes, reservoirs | Small creeks to large rivers; intolerant of slackwater |
| | Fanshell | *Cyprogenia stegaria* | 368 | 9 | Medium/large flowing waters, lakes, reservoirs | Medium/large rivers, moderate current |
| | Northern riffleshell | *Epioblasma torulosa rangiana* | 374 | 9 | Medium/large flowing waters, lakes, reservoirs | Shallow streams to large rivers; preferred habitat appears to be swift flowing areas |
| | Ochlockonee moccasinshell | *Medionidus simpsonianus* | 385 | 9 | Medium/large flowing waters, lakes, reservoirs | Large creeks & River; moderate currents |
| | Bliss Rapids snail | *Taylorconcha serpenticola* | 398 | 9 | Medium/large flowing waters, lakes, reservoirs | Springs and riverine habitats; spring/rapids areas |
| | Snake River physa snail | *Physa natricina* | 399 | 9 | Medium/large flowing waters, lakes, reservoirs | Snake River, faster flowing areas; 0.5-3m depth |
| | Banbury Springs limpet | *Lanx sp.* | 409 | 9 | Medium/large flowing waters, lakes, reservoirs | Cold spring regions, 2-20 in depth with swift current |
| | Slender campeloma | *Campeloma decampi* | 417 | 9 | Medium/large flowing waters, lakes, reservoirs | Found in a variety of streams and rivers, sometimes in shallow depths |
| | Rabbitsfoot | *Quadrula cylindrica cylindrica* | 3645 | 9 | Medium/large flowing waters, lakes, reservoirs | Small/medium rivers, swift currents |

| Taxon | Common name | Scientific name | Entity ID | PULA # | PULA habitat description | Species habitat description (From FWS sources) |
|---|---|---|---|---|---|---|
| | Choctaw bean | *Villosa choctawensis* | 4042 | 9 | Medium/large flowing waters, lakes, reservoirs | Large creeks/rivers, moderate currents |
| | Yellow lance | *Elliptio lanceolata* | 4074 | 9 | Medium/large flowing waters, lakes, reservoirs | Large creeks/rivers, moderate currents |
| | Altamaha Spinymussel | *Elliptio spinosa* | 4210 | 9 | Medium/large flowing waters, lakes, reservoirs | Large rivers, fast flowing areas |
| | Snuffbox mussel | *Epioblasma triquetra* | 5281 | 9 | Medium/large flowing waters, lakes, reservoirs | Small creeks to large rivers; lakes; swift currents |
| | Slabside Pearlymussel | *Pleuronaia dolabelloides* | 6841 | 9 | Medium/large flowing waters, lakes, reservoirs | Creeks/rivers; riffle fast flowing regions; shallow areas |
| | Higgins eye (pearlymussel) | *Lampsilis higginsii* | 325 | 9 | Medium/large flowing waters, lakes, reservoirs | Large rivers species, low velocity |
| | White wartyback (pearlymussel) | *Plethobasus cicatricosus* | 336 | 9 | Medium/large flowing waters, lakes, reservoirs | Shoals/riffles in large rivers |
| | Rough pigtoe | *Pleurobema plenum* | 338 | 9 | Medium/large flowing waters, lakes, reservoirs | Medium/large rivers (20m wide or greater) |
| | Orangefoot pimpleback (pearlymussel) | *Plethobasus cooperianus* | 340 | 9 | Medium/large flowing waters, lakes, reservoirs | Medium/large rivers |
| | Ring pink (mussel) | *Obovaria retusa* | 341 | 9 | Medium/large flowing waters, lakes, reservoirs | Prefers large rivers |

| Taxon | Common name | Scientific name | Entity ID | PULA # | PULA habitat description | Species habitat description (From FWS sources) |
|---|---|---|---|---|---|---|
| | Purple bankclimber (mussel) | *Elliptoideus sloatianus* | 366 | 9 | Medium/large flowing waters, lakes, reservoirs | Small to large river channels |
| | Fat threeridge (mussel) | *Amblema neislerii* | 375 | 9 | Medium/large flowing waters, lakes, reservoirs | Small to large rivers; slow to moderate current |
| | Spectaclecase (mussel) | *Cumberlandia monodonta* | 4490 | 9 | Medium/large flowing waters, lakes, reservoirs | Large rivers; slow to swift current |
| | Sheepnose Mussel | *Plethobasus cyphyus* | 7816 | 9 | Medium/large flowing waters, lakes, reservoirs | Medium-size rivers; deep water (> 2m) |
| | Western fanshell | *Cyprogenia aberti* | 5391 | 9 | Medium/large flowing waters, lakes, reservoirs | Large creeks and rivers with moderate to swift current; gravel-sand substrates |
| | Tennessee pigtoe | *Pleuronaia barnesiana* | 10844 | 9 | Medium/large flowing waters, lakes, reservoirs | Medium to large rivers with moderate current; rare in pools and slackwaters |
| | Rayed Bean | *Villosa fabalis* | 6062 | 9 | Medium/large flowing waters, lakes, reservoirs | Rivers, streams, creeks, or lakes, in areas of moderate flow, in sand and gravel substrate. |
| | Atlantic pigtoe | *Fusconaia masoni* | 7048 | 9 | Medium/large flowing waters, lakes, reservoirs | Creeks and rivers with moderate flow. |
| | Longsolid | *Fusconaia subrotunda* | 10838 | 9 | Medium/large flowing waters, lakes, reservoirs | Small to large rivers; slow to moderate current |
| | Round hickorynut | *Obovaria subrotunda* | 10837 | 9 | Medium/large flowing waters, lakes, reservoirs | Small to large rivers; slow to moderate current; riffle, run, and pool habitats. |

| Taxon | Common name | Scientific name | Entity ID | PULA # | PULA habitat description | Species habitat description (From FWS sources) |
|---|---|---|---|---|---|---|
| | Neosho Mucket | *Lampsilis rafinesqueana* | 4086 | 9 | Medium/large flowing waters, lakes, reservoirs | Small to large rivers; swift current; shallow riffle and runs with gravel. |
| | Everglade snail kite* | *Rostrhamus sociabilis plumbeus* | 1221 | 6 & 9 | Small water bodies, wetlands, Medium/large flowing waters, lakes, reservoirs | Wetlands, including lowland freshwater marshes, shallow vegetated edges of lakes, and natural and man-made waterbodies. |
| Plants | Hoover's spurge | *Chamaesyce hooveri* | 527 | 11 | Non-flowing wetlands | Shallow, seasonal wetlands; Sinkhole ponds. |
| | Contra Costa goldfields | *Lasthenia conjugens* | 566 | 11 | Non-flowing wetlands | Vernal pools, swales, and low depressions in open valley and foothill grasslands |
| | Few-flowered navarretia | *Navarretia leucocephala ssp. pauciflora* | 578 | 11 | Non-flowing wetlands | Vernal pools |
| | Many-flowered navarretia | *Navarretia leucocephala ssp. plieantha* | 579 | 11 | Non-flowing wetlands | Vernal pools, vernal lakes, and swales for survival |
| | Lake County stonecrop | *Parvisedum leiocarpum* | 585 | 11 | Non-flowing wetlands | Vernal pools |
| | Kenwood Marsh checker-mallow | *Sidalcea oregana ssp. valida* | 612 | 11 | Non-flowing wetlands | Freshwater marsh |
| | Sonoma sunshine | *Blennosperma bakeri* | 647 | 11 | Non-flowing wetlands | Vernal pools |
| | Brooksville bellflower | *Campanula robinsiae* | 653 | 11 | Non-flowing wetlands | Margins of ponds and marshes with fluctuating water levels and moist seepage areas |
| | Chorro Creek bog thistle | *Cirsium fontinale var. obispoense* | 667 | 11 | Non-flowing wetlands | Open seep areas in serpentine soil outcrops |
| | Bunched arrowhead | *Sagittaria fasciculata* | 818 | 11 | Non-flowing wetlands | Bogs and seepages |
| | Cooley's meadowrue | *Thalictrum cooleyi* | 852 | 11 | Non-flowing wetlands | Wet pine savannas and grass-sedge bogs |

| Taxon | Common name | Scientific name | Entity ID | PULA # | PULA habitat description | Species habitat description (From FWS sources) |
|---|---|---|---|---|---|---|
| | Marsh Sandwort | *Arenaria paludicola* | 881 | 11 | Non-flowing wetlands | Freshwater marshes and swamps, and other mesic wetland or boggy habitats |
| | Pondberry | *Lindera melissifolia* | 960 | 11 | Non-flowing wetlands | Seasonally flooded wetlands; riverine bottomland hardwood forests and geographically isolated wetlands |
| | Rough-leaved loosestrife | *Lysimachia asperulaefolia* | 967 | 11 | Non-flowing wetlands | Wet shrubby plant communities growing on moist sand or peat in longleaf pine forests |
| | Spreading navarretia | *Navarretia fossalis* | 972 | 11 | Non-flowing wetlands | Vernal pools |
| | Godfrey's butterwort | *Pinguicula ionantha* | 982 | 11 | Non-flowing wetlands | Seepage bogs, deep swampy bogs, ditches, and depressions |
| | Alabama canebrake pitcher-plant | *Sarracenia rubra ssp. alabamensis* | 994 | 11 | Non-flowing wetlands | Seepage bogs |
| | Howell's spectacular thelypody | *Thelypodium howellii ssp. spectabilis* | 1008 | 11 | Non-flowing wetlands | Wet meadows |
| | Huachuca water-umbel | *Lilaeopsis schaffneriana var. recurva* | 1030 | 11 | Non-flowing wetlands | Marshy wetlands (cienegas) in Sonoran Desert |
| | Butte County meadowfoam | *Limnanthes floccosa ssp. californica* | 1081 | 11 | Non-flowing wetlands | Vernal swales and vernal pool edges |
| | Large-flowered woolly meadowfoam | *Limnanthes pumila ssp. grandiflora* | 1262 | 11 | Non-flowing wetlands | Vernal pools |
| | Wright's marsh thistle | *Cirsium wrightii* | 9965 | 11 | Non-flowing wetlands | Marshy habitats associated with springs and seeps |
| | Arizona eryngo | *Eryngium sparganophyllum* | 11513 | 11 | Non-flowing wetlands | Marshy wetlands (cienegas) |
| | Burke's goldfields | *Lasthenia burkei* | 748 | 11 | Non-flowing wetlands | hallow vernal pools and wet swales |

| Taxon | Common name | Scientific name | Entity ID | PULA # | PULA habitat description | Species habitat description (From FWS sources) |
|---|---|---|---|---|---|---|
| Amphibians | Santa Cruz long-toed salamander | *Ambystoma macrodactylum croceum* | 188 | 11 | Non-flowing wetlands | Breeding habitat is freshwater ephemeral ponds and wetlands |
| | California tiger Salamander** | *Ambystoma californiense* | 203 | 11 | Non-flowing wetlands | Breeding habitat includes ephemeral pools, permanent livestock ponds and other artificial wetlands |
| | California tiger Salamander** | *Ambystoma californiense* | 4773 | 11 | Non-flowing wetlands | Breeding habitat includes ephemeral pools, permanent livestock ponds and other artificial wetlands |
| | California tiger Salamander** | *Ambystoma californiense* | 8395 | 11 | Non-flowing wetlands | Breeding habitat includes ephemeral pools, permanent livestock ponds and other artificial wetlands |
| | Reticulated flatwoods salamander | *Ambystoma bishopi* | 9943 | 11 | Non-flowing wetlands | ephemeral wetlands (swamps or marshes) |
| Reptiles | Bog turtle | *Glyptemys muhlenbergii* | 182 | 11 | Non-flowing wetlands | Sphagnum bogs, calcareous fens, marshy/sedge-tussock meadows, spring seeps, wet cow pastures, and shrub swamps |

*Listed bird that feeds on apple snails (*Pomacea paludosa*; a mollusk species). This bird is included because it is obligate to a specific aquatic invertebrate species.

**Distinct population segment