Integration and Synthesis Summary for Amphibians

Introduction

This Integration and Synthesis Summary includes our jeopardy analysis for amphibian species that we or EPA determined would "likely be adversely affected" by the proposed action. Our jeopardy analysis of the proposed action's impacts to listed species is split into three major factors: vulnerability, exposure, and toxicity. The tables below contain summaries of vulnerability, exposure, and toxicity. Data and information used for each species include environmental baselines, cumulative effects, exposure information, and expected toxic effects for all species, and a template worksheet to show how species were assessed are in Appendix E. Status of the Species for each species can be found in Appendix B.

Most of these amphibian species have low exposure to simazine due to the factors described in the tables or individual rationales below, in combination with reductions in simazine spray drift and runoff resulting from implementation of conservation measures added to the product label (including those developed during this consultation through the Herbicide Strategy[1]; see Conservation Measures section below). We anticipate these measures will reduce exposures in the terrestrial and/or aquatic habitats where these species occur to a level where no more than low level direct and indirect adverse effects are anticipated for many listed amphibian species.

Vulnerability

For the amphibian species that we or EPA determined are "likely to be adversely affected" by the proposed action, we considered several factors for each listed amphibian to determine the current vulnerability of that species to additional stressors. This effort allows us to consider whether a species' current condition is stable, moving toward recovery, or moving toward further decline. In general, we expect the species' vulnerability to additional stressors to be higher if they are near extinction, far from recovery, or moving toward further decline than if their condition is stable or improving. We also identify which species are most (and least) susceptible to additional stressors in general based on information from species listing and recovery documents, or other sources as cited and considered in the Status of the Species and Critical Habitat section of this Opinion (Appendix B).

Our assessment of vulnerability focuses on six factors (as currently understood and available): (1) the species listing status and recent 5-year status review recommendation (if available), (2) distribution, (3) number of populations[2], (4) species population trends, (5) if pesticides have been

[1] https://www.regulations.gov/docket/EPA-HQ-OPP-2023-0365

[2] The number will vary in value and importance by species and in some cases is unknown. In general, species with a greater number of populations have greater representation, will be more resilient, and when distributed geographically, will have greater redundancy. Conversely, species with fewer populations, in general, have less representation, are less resilient, and have less redundancy.

noted as a threat, and (6) current and projected future impacts from activities associated with environmental baseline and cumulative effects. We obtained the information to create the vulnerability summary from the Status of the Species accounts (Appendix B), overarching Environmental Baseline section of the Opinion, five-year species status reviews, species recovery plans, species status assessments, range and critical habitat information from our ECOS[3] repository, and other sources containing the best available scientific information for the species.

We scored each of the six vulnerability components with high, medium, or low scores. We assigned a high vulnerability ranking to a species if all vulnerability components were scored as high, a mixture of medium and high, or if a threatened species was recommended for uplisting to endangered status in the most recent 5-year status review or proposed rule. We assigned a medium vulnerability ranking if a species' scores were all medium, a mix of high, medium, and low, or a mix of high and low (unless the species has been recommended for uplisting or delisting). We assigned a low vulnerability ranking to species with only low scores, a mixture of low and medium scores, or if the species was recommended for delisting. Considerations regarding specific aspects of the species' vulnerability or beyond what was included in the vulnerability ranking were applicable in our jeopardy analyses for some species depending on unique aspects of their vulnerability factors, recovery needs, or life history. This information is reflected in the rationales for conclusion below.

Exposure

We anticipate amphibians can be exposed to simazine through contact with contaminated water in their habitats or via dietary exposure, depending on if they are a terrestrial species with an aquatic phase, or a fully aquatic species. However, many amphibians may be exposed to simazine via multiple routes. We assume all simazine that is transported off-site, whether through spray drift or runoff, is likely to end up in local waterbodies, which may distribute simazine residues throughout the entire watershed. Simazine is moderately mobile in water and is persistent in the environment relative to other pesticides on the market, indicating that off-site transport, particularly through runoff, may result in exposure to listed amphibian species in areas far from both agricultural and non-agricultural use sites.

Exposure to Agricultural Uses

Simazine has several registered agricultural uses (see Appendix 1-4 of EPA's Biological Evaluation) in the conterminous United States. We characterize the expected level of exposure using overlaps between the species' ranges and agricultural land uses where simazine is registered for use (i.e., overlaps; including a 305-m off-site transport area adjacent to agricultural use sites), past simazine usage data (when available; the amount and location where simazine has been used in the past), any species-specific considerations such as life history information (e.g.,

[3] https://ecos.fws.gov/ecp/

habitat preferences, dietary needs, dispersal behavior), and existing protections or conservation actions (e.g., existing label measures, conservation measures from the action agency). Species with greater than 10% overlap between their range and simazine agricultural use sites are assigned a high overlap score, species with 5-10% overlap are assigned a medium overlap score, and species with less than 5% total overlap are assigned a low overlap score. In addition to range overlaps, we considered past usage data within a species' range to determine how much of a species' range we expect to be treated with simazine each year of the proposed action. Except where otherwise noted, usage data is provided by EPA applying data from their National and State Summary Use and Usage Matrix, as described in the Usage Analysis section of this Opinion. Species with usage data that indicate a large portion of their range (>10%) is treated with simazine each year are assigned a high usage score. Species that have a medium portion of their range (5-10%) treated with simazine each year are assigned a medium usage score, and species where data indicate a low portion of their range (<5%) is treated with simazine each year are assigned a low usage score.

We determine the agricultural exposure ranking by qualitatively considering both the total overlap and total usage, as well as any additional exposure considerations that might modify the level of exposure likely to occur. When overlap and usage scores are the same, we assign the agricultural exposure ranking the same score (e.g., if both overlap and usage is high, the agricultural exposure ranking is high). In cases where overlap is high and usage is medium or when overlap is medium and usage is low, we use the overlap score as the agricultural exposure ranking to maintain conservative exposure assumptions. As usage is a subset of overlap, the overlap score will always be greater than the usage score. In cases where overlap is high, but usage is low, we anticipate a moderate portion of the range may be treated over the duration of the proposed action even if only a small portion of the range is treated in any given year (particularly if the areas treated occur in different locations each year), leading to an agricultural exposure ranking of medium. For species where there are additional exposure considerations, we adjust the agricultural exposure ranking to reflect this additional information, as appropriate.

Agricultural uses of simazine include labeled uses for corn, vegetables and ground fruit, other crops, citrus, Christmas trees, grapes, and other orchards only within the conterminous United States.

Exposure to Non-Agricultural Uses

Simazine has several registered non-agricultural uses, including nurseries (only ornamental conifers, deciduous trees, and woody ornamental species), ornamental ponds (1,000 gallons or less), lawns, golf course and other turf. In many cases, data provided by EPA indicate low to high levels of overlap between species' ranges and non-agricultural UDLs. Overall, nurseries (including ornamental plant uses) represent a very small footprint across the action area; across all species in this consultation, the Nurseries UDL overlaps between 0%-0.2% of species' ranges and 0%-5.6% of species' ranges plus a 305-m buffer. For species known to occur near nurseries, we assess nurseries specifically in our assessment. UDLs for non-agricultural uses sites that represent turf tend to be less defined than those for agricultural UDLs and are less likely to accurately represent the actual footprint of these use sites on the landscape. As such, we assess exposure of species to all non-agricultural uses of simazine in a qualitative manner, considering the life history of species, methods of application, simazine usage, and any existing conservation measures to reduce drift and runoff or otherwise limit exposure to species. To facilitate this analysis, for every species in this Appendix, we reviewed species' documents (e.g., Status of the Species (Appendix B), 5-year reviews, Species Status Assessments, recovery plans, listing rules) to determine if the species could occur on or near non-agricultural simazine use sites (i.e., residential areas where lawns are likely present, golf courses, and nurseries) and the manner in which they may rely on these sites.

Depending on region, cool-season, warm-season, or a combination of turf grass species are managed on golf courses and lawns. Cool-season grasses grow best in cooler conditions, and warm-season grasses thrive in hot, dry weather (USDA, 2004); there is a transition zone across the U.S. where either category of turf grasses may be planted based on microclimate conditions. Exposure to triazines will kill cool-season grasses, but warm-season grasses can tolerate exposure to simazine. As such, EPA estimated where in the U.S. only cool-season grasses are exclusively used in turf based on the U.S. Department of Agriculture's plant hardiness zone map as simazine use is not expected in these areas (USDA, 2023). Because hardiness zones will change over time with environmental conditions, EPA created a static map based on the hardiness zones where they expect warm- and cool-season grasses are grown based on the most recent data mapped (i.e., 1991-2020). EPA determined zones 1a-6a represent cool-season grasses (i.e., white areas) and zones 6b-13b may include warm-season grasses (i.e., black areas) (.Figure 1). We expect the cool- and warm-season grass assessment to apply to all turf, including residential, commercial, and golf course turf. We refer to EPA's cool-season map in species assessments where relevant, particularly if a species occurs exclusively in the cool-season zone where we expect simazine will not be used on turf and no exposure will occur from this use.

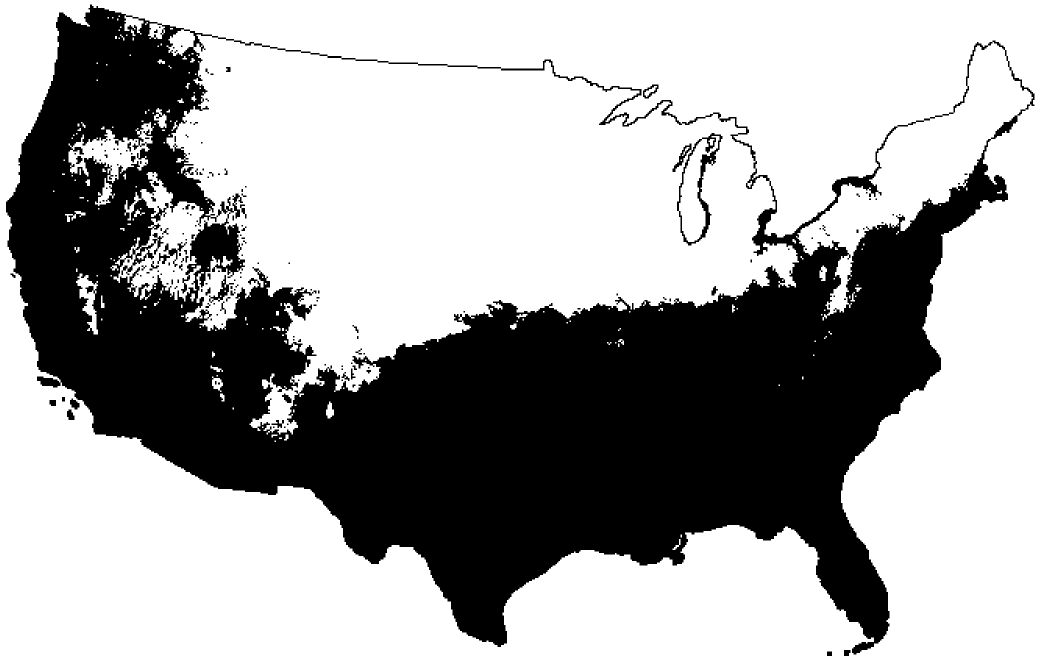

Figure 1. Map showing where cool-season grasses (white areas) and warm-season grasses (black areas) are used on turf across the continental U.S.

Particularly for residential and commercial turf uses, qualitative usage information obtained by EPA from the National Association of Landscape Professionals (NALP) indicate that simazine is no longer commonly used on residential or commercial turf as potential consequences to turf areas related to timing of application has led to preferential use of other herbicides that can be applied more broadly. If simazine were used on residential or commercial turf, it would be applied during the fall and spring as a pre-emergent. In addition, commercial and residential applicators typically apply herbicides with hand-held equipment that release course droplets, limiting the potential for spray drift.

Particularly for golf course turf uses, we obtained qualitative usage information directly from the Golf Course Superintendents Association of America (GCSAA) and an academic turf scientist that indicate that simazine is used to control winter annual broadleaf and annual bluegrass weeds on golf courses. They are applied as a pre-emergent in early fall and early winter to fairways and roughs, which make up approximately 30% of a golf course's acreage. Triazines are not applied to tee boxes or greens, which make up an additional 6% of golf course acreage. Most applications are made at rates lower than what is on the label (i.e., 1-1.5 lbs a.i./acre). These applications are made only once or twice a year, 45-60 days apart. In general, golf courses typically apply herbicides using dedicated ground equipment with a low boom height (as per the label), and golf course superintendents make use of several tools to monitor soil moisture before any applications are made to help ensure turf and soil conditions do not lead to off-target movement of herbicides. In addition, riparian buffer zones are often used on golf courses between all water features to reduce off target movement (Golf Course Superintendents

Association of America [GCSAA], pers. comm., 2025). The no-till methodology and continuous cover of a turf grass area inherent in managing golf course turf are equivalent to additional runoff mitigations (i.e., equivalent to 6 points on EPA's mitigation menu), and we considered them in our assessment.

For most species in this Appendix, we anticipate that non-agricultural uses will not meaningfully add to the overall level of anticipated exposure considered in our analysis of agricultural uses. Due to runoff and spray drift considerations described above, off-site exposure is not expected to result in effects to most species in this Appendix. In addition, we expect most listed species' habitat requirements precludes them from occupying non-agricultural use sites where simazine may be used. For species whose habitat is known or presumed to occur in non-agricultural use sites of simazine, we consider, individually and qualitatively, the extent and manner of non-agricultural simazine usage within the species' range to generally determine whether a small, moderate, or large number of individuals are likely to be exposed and the expected level of direct or indirect adverse effects from non-agricultural exposure of simazine.

References

GCSAA (Golf Course Superintendents Association of America). 2025. Personal communication with USFWS HQ staff.

USDA. 2004. Comparing warm-season and cool-season grasses for erosion control, water quality, and wildlife habitat. Natural Resources Conservation Service, U.S. Department of Agriculture. 5 pp.

USDA. 2023. Plant Hardiness Zone Map. Agricultural Research Service, U.S. Department of Agriculture. Accessed from https://planthardiness.ars.usda.gov/ on August 20, 2025.

Toxicity

We characterize the expected toxic effect to species based on the anticipated level of direct and indirect[4] adverse effects to individuals. Our analysis of toxicity assumes individuals are exposed to simazine at levels estimated by EPA's environmental exposure modeling and is focused on determining the level of adverse effect expected to occur once exposure has taken place. Direct effects are based on the anticipated level of mortality and sublethal effects (e.g., reduced growth, reproduction, impaired motor activity or behavior) likely to occur in exposed individuals.

[4] While our Opinion considers all consequences of the proposed action (per the definition of effects of the action at 50 CFR Part 402.02), the terms "direct" and "indirect" effects were used in EPA's BE, and are used in environmental risk assessment terminology in general, and do not have the same meaning as used in ESA regulations. As used in the effects analysis section, direct effects to species are those caused by the pesticide itself through dietary, dermal, or inhalation routes of exposure. Indirect effects occur when the pesticide acts on elements of the ecosystem that are required by the species, such as alterations to prey or shelter. Thus, in the effects analysis section, we may sometimes continue to use these terms to link back to the analysis in EPA's BE.

Indirect effects are based on the impact a listed species is likely to experience when the organisms they rely on, such as those that act as food or habitat resources (e.g., aquatic and terrestrial invertebrate prey for amphibians), are exposed to simazine and experience adverse effects.

We consider estimated concentrations of simazine on the landscape or within the environment, and effects reported in available toxicity studies to determine the level of direct and indirect adverse effects to listed species or critical habitat. Concentrations of simazine can vary greatly depending on where exposure takes place and/or what food item is consumed. For instance, exposures on or near agricultural and non-agricultural use sites are at higher levels than exposures that occur in areas far away from such sites. Based on available toxicity data, we anticipate wholly aquatic, or aquatic-phase amphibians are highly sensitive to simazine at some estimated environmental concentrations and are likely to experience sublethal effects even in habitats that only accumulate low levels. However, based on available toxicity data in birds (which we use as a surrogate for amphibians in the terrestrial phase as it applies to species that have a terrestrial phase), we expect that ingestion of vegetation or prey items contaminated with simazine will only result in direct adverse effects to growth in amphibians consuming food items exclusively on simazine use sites.

We anticipate species that rely on plant-based resources, such as algae and detritus for food or emergent aquatic vegetation as habitat, are likely to experience some indirect adverse effects, as available toxicity data in plants indicate reductions in plant survival or growth are likely to occur with simazine exposure. However, these plant resource reductions will not significantly impact these species unless they are obligate to a plant resource dietary item. Most amphibians are omnivores and thus can rely on other dietary resources or they consume arthropod prey which are not likely to be impacted by simazine exposure.

Concentrations of simazine can vary greatly among different regions and aquatic habitat types. Simazine is persistent in the environment and thus where simazine enters smaller streams or static waters (e.g., low flow/low volume waterbodies) from runoff or spray drift, we generally anticipate high levels of sublethal effects to individual amphibians where exposure occurs. In larger waterbodies (e.g., where concentrations may be lower due to dilution or other factors as described in the *Effects of the Action* section of the Biological Opinion), we expect lower levels of sublethal effects to amphibians.

We determine the overall toxicity ranking for amphibians by qualitatively assessing both the expected levels of direct adverse effects (i.e., reduced growth) and indirect effects (i.e., prey loss). As mentioned previously, available toxicity data indicate amphibians are sensitive to simazine and may be exposed during the terrestrial phase via dietary exposure or during the aquatic phase via water as applicable to the species and are thus likely to experience sublethal effects even in habitats that only accumulate low levels.

Conservation Measures

Herbicide Strategy Conservation Measures

As part of the simazine ESA consultation with the Service, EPA is implementing the final Herbicide Strategy to inform and identify any necessary conservation measures where EPA's analysis indicated there was a risk of population level effects to listed species. The measures identified by EPA, and committed to by the technical registrants, include a standard 15-foot spray drift buffer and a minimum of three runoff mitigation points[5] necessary in all areas where simazine is used, as well as additional runoff mitigation points for certain simazine uses limited to specific geographic areas.

The spray drift buffer will be placed on the general label and will apply to all uses of simazine. EPA's Herbicide Strategy provides applicators with options to reduce the distance of this buffer by using other spray drift reduction strategies that we anticipate will result in an equivalent reduction in spray drift entering non-target habitats as stated buffers. These measures and the degree to which applicators can reduce buffers by employing them are described in EPA's Herbicide Strategy and EPA's Ecological Mitigation Support Document to Support Endangered Species Strategies5. These documents are provided in Appendix A-1.

This buffer is in addition to spray drift mitigations that are already on the label, including:

- Restricting use to a maximum windspeed of 10 miles per hour,
- Prohibiting applications during temperature inversions,
- Applying with a release height of no more than 4 feet above the ground or crop canopy for ground applications,
- Selecting nozzles and pressures that deliver coarse or coarser droplets for all applications,
- and ground application only.

Based on EPA's analyses, the Service anticipates that the required spray drift conservation measures described above (from the current label and implemented through the Herbicide Strategy) will reduce spray drift from entering species' habitats by >95%. The Service anticipates that this reduction will minimize off-site transport of simazine from spray drift to a level where no more than low levels of effects are likely to occur to amphibians through this exposure route.

---

[5] Ecological Mitigation Support Document to Support Endangered Species Strategies.Ecological Mitigation Support Document to Support Endangered Species Strategies. Access at: https://www.epa.gov/system/files/documents/2025-04/ecological-mitigation-support-document-v.2-.pdf

Additionally, all agricultural labels will include a requirement for applicators to achieve 3 points of runoff mitigation, as described in the Herbicide Strategy, for all agricultural uses. EPA's Herbicide Strategy provides applicators with various options to reduce runoff and erosion and assigns points to each option based on its effectiveness. Applicators must implement sufficient mitigation points to meet the label requirement. Applicators can achieve the required points using the conservation measures identified on EPA's Mitigation Menu website[6]. The menu provides a suite of options, including relief points for certain field characteristics and likelihood for pesticide transport.

These runoff mitigation points are in addition to runoff mitigations that are already on the label, including:

- Product must not be mixed or loaded within 50 feet of intermittent streams and rivers, natural or impounded lakes and reservoirs.
- Product must not be applied within 66 feet of points where agricultural field (nurseries, Christmas tree plantings, and turf grasses for sod farms) surface water runoff enters perennial or intermittent streams and rivers or within 200 feet of natural or impounded lakes and reservoirs. If this product is applied to highly erodible land, the 66-foot buffer or setback from runoff entry points must be planted to crop or seeded with grass or other suitable crop.
- Do not apply within 66 feet of standpipes in tile-outletted terraced fields.
    - Apply this product to the entire tile-outletted terraced field under a no-till practice only when a high crop residue management practice is practiced. High crop residue management is described as a crop management practice where little, or no crop residue is removed from the field during and after crop harvest.

We expect implementation of the runoff and erosion reduction measures as required, to minimize off-site transport of simazine to habitats of listed species. EPA's analyses indicated that the general label requirement of three runoff mitigation points will reduce estimated environmental concentrations of simazine in runoff by up to an order of magnitude (i.e., up to 90% reduction, in other words reduce pesticide loading to one-tenth of pre-runoff mitigation levels).

In cases where EPA has identified additional runoff measures are needed, additional points (up to three, i.e., up to 99% reduction) will be required. EPA will communicate where additional runoff mitigation points are needed and for what specific simazine uses through their Bulletins Live! Two online platform[7], which all applicators are required to check before making pesticide applications. In areas requiring up to six runoff mitigation points total, EPA expects estimated

[6] Mitigation Menu website: https://www.epa.gov/pesticides/mitigation-menu

[7] Bulletins Live! Two website: https://www.epa.gov/endangered-species/bulletins-live-two-view-bulletins

environmental concentrations of simazine will decrease by up to two orders of magnitude (i.e., reduce pesticide loading to one-one hundredth of pre runoff mitigation levels).

We anticipate this level of mitigation will protect listed amphibian species by reducing the number of individuals exposed (by reducing the extent of off-site transport of simazine residues) and reducing the level of direct and indirect adverse effects that will occur to exposed individuals (by reducing estimated exposure concentrations).

Summary of Conclusions for Amphibian Species

After reviewing the current status of the species, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the registration of simazine, as proposed, is not likely to jeopardize the continued existence of at least 32 of the 33 amphibian entities in this Appendix. For the remaining amphibian in this appendix, we plan to continue coordination with EPA and the technical registrants to further assess the species.

In our analysis below, some species that had the same or very similar rationales for their conclusions were grouped together, to increase efficiency and avoid repetition. Relevant information and data unique to each individual species was considered when assigning species to groups and incorporated into the rationales as appropriate. Species-specific information (e.g., environmental baseline, cumulative effects, status of the species, exposure, and toxicity) was considered for all species, including those species in the grouped analyses, and are presented in full in Appendices B and E. Species with rationales that did not fit in a group, or warranted a separate rationale because of their life history, conservation status, or other information indicating that effects could be different, have an individual discussion to provide additional explanation. This approach allowed us to streamline our discussion in this Opinion by avoiding repeating our findings when species in the respective groupings would be expected to be affected similarly. The use of these groupings, therefore, does not mean that our evaluation failed to evaluate each individual species. On the contrary, our detailed process for each species-specific analysis remained the same, including for species for which we summarized our findings in tables below.

Species with low exposure informed by low overlap with agricultural lands in the action area and low likelihood of non-agricultural exposure

The species in Table 1 are grouped together as they all have low concern of direct and indirect adverse effects due to low exposure as informed by low overlap between the species' range and areas where simazine is registered for use. While we present some specific information about the species in Table 1 below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

Table 1. Species with low exposure informed by low overlap with agricultural areas and low likelihood of non-agricultural exposure.

Common Name	Scientific Name	Vulnerability Ranking	Agricultural Exposure Ranking	Toxicity Ranking	Total Agricultural Action Area Overlap (% Range)	Determination
Desert slender salamander	*Batrachoseps aridus*	High	Low	Medium	<0.1	No Jeopardy
Austin blind Salamander	*Eurycea waterlooensis*	High	Low	High	0.4	No Jeopardy
Barton Springs salamander	*Eurycea sosorum*	High	Low	High	0.3	No Jeopardy
Black warrior (=Sipsey Fork) Waterdog	*Necturus alabamensis*	High	Low	High	2.2	No Jeopardy
Eastern Hellbender	*Cryptobranchus alleganiensis alleganiensis*	Medium	Low	Low	2.1	No Jeopardy
Georgetown Salamander	*Eurycea naufragia*	High	Low	High	1.5	No Jeopardy
Jollyville Plateau Salamander	*Eurycea tonkawae*	High	Low	High	4.4	No Jeopardy
San Marcos salamander	*Eurycea nana*	High	Low	High	1.0	No Jeopardy
Texas blind salamander	*Eurycea rathbuni*	High	Low	High	1.7	No Jeopardy

The species in Table 1 have high or medium vulnerability rankings, indicating that these species may be less robust in response to direct and indirect adverse effects from simazine than species with low vulnerability. These species have a high, medium or low toxicity ranking as sublethal effects and some loss of prey abundance may occur if exposed to simazine. Some species, like the Eastern hellbender and Black warrior waterdog, may occur in aquatic habitats adjacent to agricultural use sites where simazine could be used, but we do not expect individuals will be exposed to levels of simazine that will cause measurable effects to growth because the limitations on use (spray drift reduction measures cited above) and buffers already on the label reduce those exposures to levels below which we would observe these effects. Similarly, other species in this grouping (e.g., central Texas *Eurycea* spp.) may also experience offsite exposure from runoff from agricultural use sites, but we do not expect predicted concentrations of simazine in runoff will cause any measurable direct toxic effects to individuals that would adversely affect their growth given both the low estimates of overlap with the species ranges and the volume and flow rates encountered by these species in their respective habitats.

Thus, we anticipate, at most, a very small number of individuals are likely to be exposed to simazine. All the species in this group have low extent of overlap between agricultural use sites and their ranges (including associated off-site transport areas). Furthermore, the total agricultural overlap metric we use is a conservative estimate of exposure as it does not fully account for redundancy between use site layers, assumes exposure is occurring in all possible overlapping areas, and does not consider information on past simazine usage. As such, we expect that exposure of these species to simazine will occur in an even smaller portion of the species' ranges. Where available, habitat preferences and data describing past simazine usage confirms this expectation. Thus, while these species' vulnerability and toxicity rankings may vary, we have high confidence that exposure will be limited to small portions of the species ranges from agricultural simazine use.

For non-agricultural uses of simazine, we qualitatively evaluated the potential for simazine exposure from non-agricultural use sites to individual species based on their preferred habitat and current known locations within the context of our expectation that overall, species will experience minimal exposure from non-agricultural simazine use sites (described in the Exposure section, above). Based on individual reviews of available life history information for each of the 9 species in Table 1, we expect non-agricultural use sites do not provide the species' necessary habitat (e.g., subterranean, aquatic karst, medium to large streams and rivers), therefore, these species are unlikely to be exposed to non-agricultural uses of this herbicide. None of the species in Table 1 are likely to occur on non-agricultural use sites for which simazine is registered as all but the desert slender salamander (DSS) are fully aquatic and the DSS is primarily known from two subterranean locations within the Santa Rosa and San Jacinto Mountains National Monument area where we would also anticipate a very low likelihood of exposure. However, for each of these species, we evaluated habitat use, occurrence information, and existing protections from recent Service documents and determined that exposure to non-agricultural simazine use is expected to be minimal based on the species' life histories, stressors, threats, and conservation measures in place as described above. For example, the central Texas *Eurycea*, as neotenic (retaining juvenile characteristics at maturity) and fully aquatic salamanders are susceptible to groundwater contamination from runoff from residential or golf course uses proximate to their spring habitats, but exposure is expected to be low as individuals spend a significant portion of their life underground within springs and caves of the Edwards Aquifer. In addition, there are a host of measures taken within the ranges of the central Texas Eurycea to mitigate stormwater runoff[8], particularly from urban and suburban areas (e.g., roads, gold courses and other developed spaces) such that we are afforded additional assurances that the likelihood of exposure to simazine remains low for these species. In addition, EECs for non-agricultural uses within the range of all of these amphibians are well below levels at which we would observe any adverse effects (direct or indirect) to these species. Given the usage data available, as well as existing conservation measures for non-agricultural uses of simazine, we anticipate no more than a small number of individuals of each of the species in Table 1 will be exposed and experience adverse effects, either direct or indirect, from non-agricultural uses of simazine.

The Austin blind salamander, Barton Springs salamander, Georgetown salamander, Jollyville Plateau salamander, San Marcos salamander, and Texas blind salamander are found in spring flows of the Edwards Aquifer. While recharge of these aquifer systems makes them susceptible to contaminants due to the porous nature of karst systems and simazine is persistent in water, the flow rates in the high flow waters where these salamanders are found are believed to be sufficient to dilute simazine, both concentration and residence time, resulting in minimal anticipated exposure, if any. We do not expect simazine to concentrate in the low flow/low volume waterbodies associated with these springs. In addition, there are several conservation activities that take place for the Edwards Aquifer including the Texas Commission on Environmental Quality's (TCEQ) Edwards Aquifer Rules (30 Texas Administrative Code § 213), land acquisitions and conservation easements (see USFWS 2024), water quality protection recommendations, regional water planning, the City of Georgetown's Edwards Aquifer Recharge Zone Water Quality Ordinance, the City of Austin's habitat conservation plan covering operation and maintenance of Barton Springs Pool and adjacent springs, as well as captive assurance colonies (for the Austin blind salamander, Barton Springs salamander, San Marcos salamander, and Texas blind salamander) and water quality monitoring (USFWS 2016, USFWS San Marcos Aquatic Resources Center pers comm, 2025). In addition, all three salamanders' ranges have very little overlap with agriculture (0.0-4.4%).

The species' range for the desert slender salamander is primarily on protected or federal lands[9] (i.e., National Parks, National Forests), and specifically for this species, in the Santa Rosa and San Jacinto Mountains National Monument area where we expect pesticide usage to be low, in addition to its range overlapping small areas of agricultural lands.

In summary, the species in Table 1 have low exposure as evidence by the low overlap of their ranges with agricultural land uses. We do not anticipate any mortality for these species due to low overlap with agricultural areas and the low level of EECs within the range of these amphibians. We anticipate only a small number of individuals are likely to experience direct adverse effects to growth from simazine exposure or indirect adverse effects through reductions

[8] See Edwards Aquifer HCP amendments: https://edwardsaquifer.org/wp-content/uploads/2024/07/Edwards-Aquifer-Recovery-Implementation-Program-Nov-2021.pdf

[9] Simazine use on federal lands is anticipated to be low given the limited and regulated uses. For example, simazine use is primarily on agricultural lands, Christmas tree farms and golf courses (see Appendix 1-4 of the BE), which are generally limited or nonexistent on federal lands.

in prey abundance over the project duration. Therefore, we determine the overall risk of adverse effects to these species is low. After reviewing the current status of the species, environmental baseline for the action area, cumulative effects, and effects of the action (including the conservation measures that are incorporated into the proposed action), we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in Table 1 in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of these amphibian species.

References:

U.S. Fish and Wildlife Service. 2025. San Marcos Aquatic Resources Center personal communication with HQ staff.

U.S. Fish and Wildlife Service. 2025. Desert Slender Salamander (*Batrachoseps Major Aridusmajor aridus*), 5 Year Review: Summary and Evaluation. Carlsbad, California. 25 pp.

U.S. Fish and Wildlife Service. 2024. Recovery Outline for the Georgetown Salamander, Jollyville Plateau Salamander, and Salado Salamander. Austin, Texas. 15 pp.

U.S. Fish and Wildlife Service. 2016. Barton Springs Salamander (*Eurycea sosorum*) Recovery Plan Amended to include Austin Blind Salamander (*Eurycea waterlooensis*). Albuquerque, New Mexico. 148 pp.

Species with low exposure informed by low past usage from the California Department of Pesticide Regulation's Pesticide Use Reporting data

The species in Table 2 are grouped together because they all occur completely within California and they all have low exposure determined by low levels of past simazine usage within their ranges (% Range Treated), as informed by the California Department of Pesticide Regulation Pesticide Use Reporting (CalPUR) data. While we present some specific information about the species in Table 2 below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

Table 2. Species with low exposure informed by low past usage from the California Department of Pesticide Regulation's Pesticide Use Reporting data and low likelihood of non-agricultural exposure.

Common Name	Scientific Name	Vulnerability Ranking	Exposure Ranking	Toxicity Ranking	% Range Treated (CalPUR)	Determination
Arroyo (=arroyo southwestern) toad	*Anaxyrus californicus*	Medium	Low	Medium	0.2	No Jeopardy
California red-legged frog	*Rana draytonii*	Medium	Low	Medium	0.1	No Jeopardy
California tiger salamander (Sonoma County DPS)	*Ambystoma californiense*	High	Low	Medium	0.5	No Jeopardy
California tiger salamander (Central California DPS)	*Ambystoma californiense*	High	Low	Medium	0.8	No Jeopardy
California tiger salamander (Santa Barbara County DPS)	*Ambystoma californiense*	High	Low	Medium	0.1	No Jeopardy
Foothill yellow-legged frog (Central Coast Range south of San Francisco Bay to San Benito and Fresno Counties)	*Rana boylii*	High	Low	Medium	<0.1	No Jeopardy
Foothill yellow-legged frog (Coast Range from Monterey County south to Los Angeles County)	*Rana boylii*	High	Low	Medium	0.1	No Jeopardy
Foothill yellow-legged frog (Sierra Nevada Mountains south of American River sub-basin south to Transverse Range, Kern County)	*Rana boylii*	High	Low	Medium	0.1	No Jeopardy
Foothill yellow-legged frog (North Feather River watershed largely in	*Rana boylii*	High	Low	Medium	<0.1	No Jeopardy

Common Name	Scientific Name	Vulnerability Ranking	Exposure Ranking	Toxicity Ranking	% Range Treated (CalPUR)	Determination
Plumas and Butte Counties)						
Mountain yellow-legged frog (southern DPS)	*Rana muscosa*	High	Low	Medium	0.2	No Jeopardy
Santa Cruz long-toed salamander	*Ambystoma macrodactylum croceum*	High	Low	Medium	<0.1	No Jeopardy

All the species in Table 2 are endemic to California in the U.S. and have medium or high vulnerabilities, indicating that they may not be able to withstand additional stressors in their environment, including mortality of individuals from simazine exposure. There is a low to high extent of overlap with agricultural uses of simazine in the range of these amphibians and from 2013-2022, 0.0% - 0.8% of the range of these amphibians has been treated with simazine, indicating that only a small number of individuals are likely to experience any exposure for these species as well (Table 2). While CalPUR data include all agricultural usage, it is also inclusive of certain non-agricultural uses, such as those performed by professional commercial applicators. Given that this usage data is mandated by the state of California and that these data are provided regularly at a relatively high spatial resolution, we have high confidence that only a small percent of the species' ranges is likely to be exposed to simazine.

While species in Table 2 have medium to high vulnerability and individuals may experience reductions in prey, we anticipate only a small number of individuals are likely to be exposed to simazine from agricultural use given that CalPUR data indicate low past usage within their ranges. For example, while the Arroyo toad utilizes low flow aquatic habitats (intermittent to perennial streams with low or no flow) for the eggs and tadpole life stages, the CalPUR data indicate a low overlap of its habitat with simazine usage (0.2 % annually). While these species have relatively higher percent overlap between agricultural uses and their ranges than species in other tables, CalPUR simazine usage data indicates that very little simazine has been used from 2013-2022 within the sections where these species' ranges occur. Where available, habitat preferences confirm this expectation. For example, the mountain yellow-legged frog (northern DPS), Santa Cruz long-toed salamander, and California red-legged frog occur in areas where we do not expect simazine use to occur (e.g., National Forests, subterranean habitats, protected lands). These species are unlikely to frequent non-agricultural use sites or agricultural use areas.

For non-agricultural uses of simazine, we anticipate that most non-agricultural usage, such as that performed by professional commercial applicators, will be captured in the CalPUR data. In addition, we qualitatively evaluated the potential for simazine exposure from non-agricultural use sites to individual species based on their preferred habitat and current known locations within the context of our expectation that overall, species will experience minimal exposure from non-agricultural simazine use sites (described in the Exposure section, above). Based on individual reviews of available life history information for each of the 11 listed entities (6 species, including multiple DPS for the California tiger salamander and the foothill yellow-legged frog) in Table 2, we expect non-agricultural use sites do not provide the species' necessary habitat (e.g., sandy-bottomed low-gradient streams, vernal pools, aquatic sites adjacent to dense woodlands), therefore, these species are unlikely to be exposed to non-agricultural uses of this herbicide. There are four species that we determined could occur on developed and open space developed (non-agricultural) use sites. However, for each of these species, we evaluated habitat use, occurrence information, and existing protections from recent Service documents and determined that exposure to non-agricultural simazine use is expected to be minimal based on the species' life histories, stressors, threats, and conservation measures in place as described above. For example, developed and open space developed use sites have a significant overlap with the range of the Arroyo toad. However, Arroyo toads are breeding habitat specialists and need slow moving streams that are composed of sandy soils with sandy streamside terraces. Reproduction is dependent upon the availability of very shallow, still, or low-flow pools in which breeding, egg laying, and tadpole development occur, which is less likely to be found in developed or open space developed areas. Given available usage data, we anticipate no more than small numbers of individuals of each species listed in Table 2 will be exposed to simazine through non-agricultural uses and experience direct adverse effects (including sublethal impacts to growth).

In summary, we expect no more than low levels of direct exposure to simazine or indirect reductions in prey abundance for these species based on the low level of simazine usage within the species' ranges. We also expect non-agricultural exposure is low. While pesticides are noted as a threat to some of the species in this group and some species may experience sublethal effects (e.g., reduced growth) and indirect effects (e.g., loss of prey items), we expect these adverse effects will be limited to only a small number of individuals. Therefore, we determine, at most, a small number of individuals will experience direct effects to growth or reductions in dietary items from the proposed action, and the overall risk of adverse effects these species is low. After reviewing the current status of the species, environmental baseline for the action area, cumulative effects, and effects of the action (including the conservation measures that are incorporated into the proposed action), we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in Table 2 in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of these amphibian species.

References:

U.S. Fish and Wildlife Service. 2025. Santa Cruz Long-Toad Salamander (*Ambystoma macrodactylum croceum*) 5-Year Review: Evaluation and Summary. Ventura, California.

U.S. Fish and Wildlife Service. 2024. Mountain Yellow-legged Frog [Southern California Distinct Population Segment (*Rana muscosa*)] 5-Year Review: Summary and Evaluation. Carlsbad, California.

U.S. Fish and Wildlife Service. 2023. Arroyo Toad (*Bufo californicus*) 5-Year Review: Summary and Evaluation. Ventura, California.

U.S. Fish and Wildlife Service. 2022. California Red-Legged Frog (*Rana draytonii*) 5-Year Review: Summary and Evaluation. Sacramento, California.

U.S. Fish and Wildlife Service. 2021. Species status assessment report for the foothill yellow-legged frog (*Rana boylii*), Version 2.0. October 2021. U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Sacramento, California.

U.S. Fish and Wildlife Service. 2017. Recovery Plan for the Central California Distinct Population Segment of the California Tiger Salamander (*Ambystoma californiense*). U.S. Fish and Wildlife Service, Pacific Southwest Region, Sacramento, California. v + 69pp.

Species with low exposure informed by low past usage of all herbicides from the USDA's Census of Agriculture

The species in Table 3 are grouped together because very little of their ranges have been treated with simazine in the past according to data from USDA's Census of Agriculture. Our concern for adverse effects (direct or indirect) is low. While we present some specific information about the species below, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

Table 3. Species with low agricultural exposure informed by low past usage of all herbicides from the USDA's Census of Agriculture (CoA) and low likelihood of non-agricultural exposure.

Common Name	Scientific Name	Vulnerability Ranking	Agricultural Exposure Ranking	Toxicity Ranking	% Range Treated (CoA)	Determination
Cheat Mountain salamander	*Plethodon nettingi*	Medium	Low	Medium	2.3	No Jeopardy
Chiricahua leopard frog	*Rana chiricahuensis*	Medium	Low	Medium	3.1	No Jeopardy
Oregon spotted frog	*Rana pretiosa*	Medium	Low	Medium	4.9	No Jeopardy
Sierra Nevada Yellow-legged Frog	*Rana sierrae*	High	Low	Medium	1.8	No Jeopardy
Sonoran tiger salamander	*Ambystoma mavortium stebbinsi*	Medium	Low	Medium	1.8	No Jeopardy

All the species in Table 3 have either medium or high vulnerabilities. The Sierra Nevada yellow-legged frog has high vulnerability as they have a restricted distribution and have pesticides noted as a threat. We anticipate these species may be more susceptible to impacts to individuals resulting from exposure to simazine. Species like the Cheat Mountain salamander, Chiricahua leopard frog and Oregon spotted frog have medium vulnerability. While these species may be more robust in general to direct and indirect adverse effects than high vulnerability species, we anticipate these species may still be susceptible to such effects from simazine exposure.

Despite the medium to high vulnerability of these species, we anticipate only a small number of individuals are likely to experience any exposure to agricultural uses of simazine as the USDA Census of Agriculture (CoA) indicates very little herbicide usage (of any active ingredient) occurred within the agricultural crops in the past in the counties where these species' ranges occur. Given that this reporting broadly includes all herbicide usage, we consider CoA data to be conservative estimates of simazine usage that indicates very little of the species' ranges are likely to be treated. In addition, some of these species exist largely on federal lands (e.g., Cheat Mountain salamander in the Monongahela National Forest, Sierra Nevada yellow-legged frog in the El Dorado, Inyo, Lassen, Plumas, Sierra, Stanislaus, Tahoe, and Toiyabe National Forests) and are anticipated to have a very low likelihood of exposure given that these National Forests are not likely to contain significant areas, if any, for which simazine is registered for use (e.g., agriculture, turf, golf courses). As detailed in the main body of the BO, simazine is not registered for forestry use (except for Christmas tree plantings, which would not be anticipated in a National Forest). As such, we anticipate no more than a small number of individuals are likely to be exposed to simazine through agricultural uses.

While we expect that some of these species may occur near non-agricultural use sites, we anticipate no more than a small number of individuals of each species will be exposed to simazine from non-agricultural uses. Of the species listed in Table 3, we expect all of them may co-occur within watersheds with Developed, and Open-Spaced Developed use sites and may be exposed to simazine runoff or spray drift through these non-agricultural uses. However, for all non-agricultural turf uses, triazines are not used on cool season grasses because they will die after exposure, but triazines are used on warm season grasses (i.e., the deep south and southeastern parts of CONUS) from the warm season hardiness zone north into the warm-cool transition zone. The Oregon spotted frog and Sierra Nevada yellow-legged frog, for example, are not located in areas of CONUS where warm season grasses grow and thus would not likely be exposed to simazine from this use. In addition, for golf course turf uses, simazine is applied as a pre-emergent in early fall and early winter to fairways and roughs, which make up approximately 30% of a golf course's acreage. Applications are made only once or twice a year, 45-60 days apart. In general, golf courses typically apply herbicides using dedicated ground equipment with a low boom height (as per the label), and golf course superintendents make use of several tools to monitor soil moisture before any applications are made to help ensure turf and soil conditions do not lead to off-target movement of herbicides. In addition, riparian buffer zones are often used on golf courses between all water features to reduce off target movement (Golf Course Superintendents Association of America [GCSAA], pers. comm., 2025). The no-till methodology and continuous cover of a turf grass area inherent in managing golf course turf are equivalent to additional runoff mitigations (i.e., equivalent to six points on EPA's mitigation menu), and we considered them in our assessment as limits to the amount of runoff that may enter nearby aquatic habitats where these amphibians may be found. Finally, for all species in this grouping have we expect that simazine concentrations from non-agricultural uses within their range will be well below the sublethal threshold where we would observe any direct adverse effects to these species. Further, all species in this grouping have < 0.01 % overlap with nurseries indicating very low exposure to simazine from this non-agricultural use.

While maximum estimated environmental concentrations of simazine may cause sublethal adverse effects (e.g., reduced growth) to all species in Table 3, we anticipate these high level exposures will only occur on occasion and that typical exposure concentrations are likely to be lower than levels where toxicity studies have observed sublethal effects in fish (i.e., the amphibians surrogate). Therefore, we expect low levels of direct sublethal adverse effects (i.e., reduced growth) to a small number of individuals of these species. Similarly, we anticipate species that rely on plant-based resources, such as algae and detritus for food or emergent aquatic vegetation as habitat, are likely to experience some indirect adverse effects, as available toxicity data in plants indicate reductions in plant survival or growth are likely to occur with simazine exposure. However, these plant resource reductions will not significantly impact these species unless they are obligate to a plant resource dietary item. The salamanders in this group (Cheat Mountain and Sonoran tiger) are not anticipated to consume plant material at any life stage. The three frog species (Chiricahua, Oregon spotted, and Sierra Nevada yellow-legged) may consume plants in the tadpole stage, but are not anticipated to be on-field in their aquatic stages. We also do not anticipate concentrations for aquatic stage amphibians to reach levels that would eliminate or severely limit plant materials available to these life stages for these species. Later life stage and terrestrial frogs and salamanders are insectivorous, omnivorous or carnivorous and are not likely to experience indirect adverse effects to prey items.

In summary, while direct sublethal adverse effects to growth may occur to all species in Table 3 and indirect sublethal adverse effects may occur to the several frog species Table 3, we expect these adverse effects will be limited to only a small portion of individuals as available CoA usage data indicate only low levels of simazine usage are likely to occur within these species' ranges. After reviewing the current status of the species, environmental baseline for the action area, cumulative effects, and effects of the action (including the conservation measures that are incorporated into the proposed action), we have determined the proposed action is not likely to appreciably reduce the survival and recovery of these species in Table 3. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of these species in the wild.

Species with low agricultural exposure informed by spray drift and runoff conservation measures and low likelihood of non-agricultural exposure

The species in Table 4 are grouped together as we anticipate all these species are at low risk of direct and indirect adverse effects from the proposed action as a result of conservation measures included in the description of the action, including general label changes and Pesticide Use Limitation Areas (PULAs).

Table 4. Species with low agricultural exposure due to spray drift and runoff conservation measures and low likelihood of non-agricultural exposure.

Common Name	Scientific Name	Vulnerability Ranking	Agricultural Exposure Ranking	Toxicity Ranking	Conservation Measures	Determination
Frosted flatwoods salamander	*Ambystoma cingulatum*	High	Low	Medium	General label measures + 6 points for all uses (with 1 exception)	No Jeopardy
Houston toad	*Bufo houstonensis*	High	Low	Medium	General label measures + 6 points for all uses (with 1 exception)	No Jeopardy
Reticulated flatwoods salamander	*Ambystoma bishopi*	High	Low	Medium	General label measures + 6 points for all uses (with 1 exception)	No Jeopardy
Dusky gopher frog	*Rana sevosa*	High	Low	Medium	General label measures + 6 points for all uses (with 1 exception)	No Jeopardy

The species in Table 4 are grouped together because the conservation measures included in the proposed action—including those required under EPA's Herbicide Strategy—are expected to sufficiently reduce simazine transport to terrestrial and aquatic habitats such that no more than low levels of adverse effects (direct or indirect) are anticipated. All species in this group have high vulnerabilities, reflecting their limited distributions, small or declining populations, and known sensitivity to environmental stressors. These species have medium toxicity rankings. The conservation measures will both reduce the number of individuals exposed (by reducing the extent of off-site transport of simazine residues) and reduce the level of adverse effects that will occur to exposed individuals (by reducing estimated exposure concentrations).

For all species in this group, EPA's Herbicide Strategy requires a minimum of three runoff mitigation points and implementation of a 15-foot spray drift buffer on all agricultural simazine applications. Applicators must select runoff and erosion control practices from EPA's mitigation menu, which is designed to be flexible while ensuring site-level risk is reduced. These measures are anticipated to reduce pesticide loading into aquatic habitats by up to 90% (one order of magnitude) compared to unmitigated runoff.

Although modeled overlap between species' ranges and simazine agricultural use sites is high for the species in this group, the conservation measures are expected to reduce the likelihood, magnitude, and frequency of exposure to a level where we expect no more than low levels of direct and indirect adverse effects to individuals will occur.

All four species in this grouping require an additional three points for runoff mitigation, for a total of six points for all uses. There is one simazine use (strawberries within the Vegetables and Ground Fruit UDL) where these additional points are not needed and that is based on concentrations of simazine within the aquatic habitats where they are found do not exceed the sublethal threshold. The conservation measures already present on the label which includes three points for runoff mitigation as well as a 15-foot buffer to reduce spray drift are sufficient to mitigate the effects from simazine exposure within their range for this use.

Given the implementation of the conservation measures, the low toxicity of all species in this group, and the expectation that any exposure will occur at low and environmentally inconsequential levels, we anticipate that direct or indirect adverse effects, where they occur, will be limited to a small number of individuals. After reviewing the current status of the species, environmental baseline for the action area, cumulative effects, and effects of the action (including the conservation measures that are incorporated into the proposed action), we have determined the proposed action is not expected to appreciably reduce the likelihood of survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the species listed in Table 4.

Species with Individual Integration and Synthesis Summaries

The species in Table 5 have individual Integration and Synthesis summaries. We expect Herbicide Strategy conservation measures to reduce pesticide loading into aquatic habitats by 90-99% (i.e., one to two orders of magnitude) compared to unmitigated runoff and reduce spray drift from entering species' terrestrial habitats by >95%. We anticipate that this reduction will minimize off-site transport of simazine to a level where no more than low levels of adverse effects are likely to occur to plants through this exposure route. While the conservation measures are expected to reduce the extent of off-field exposure and reduce exposure concentrations, we anticipate simazine residues on use sites could remain at levels high enough to cause greater than low levels of adverse direct and/or indirect effects to these species. They may occur on simazine use sites, either agricultural or non-agricultural. For each species, we provide additional information on vulnerability (including environmental baseline and cumulative effects), exposure, and toxicity in Appendix E. The status of the species accounts can be found in Appendix B.

Table 5. Species with Individual Integration and Synthesis summaries

Common Name	Scientific Name	Determination
Neuse River waterdog	*Necturus lewisi*	No Jeopardy
Western spadefoot	*Spea hammondii*	No Jeopardy

Integration and Synthesis Summary: Neuse River waterdog

Scientific Name:	Common Name:	Entity ID:
Necturus lewisi	Neuse River waterdog	2932

Conclusion: No Jeopardy

Species Range

Based on range map dated: 10/10/2018; Wherever found; *States within the range:* NC

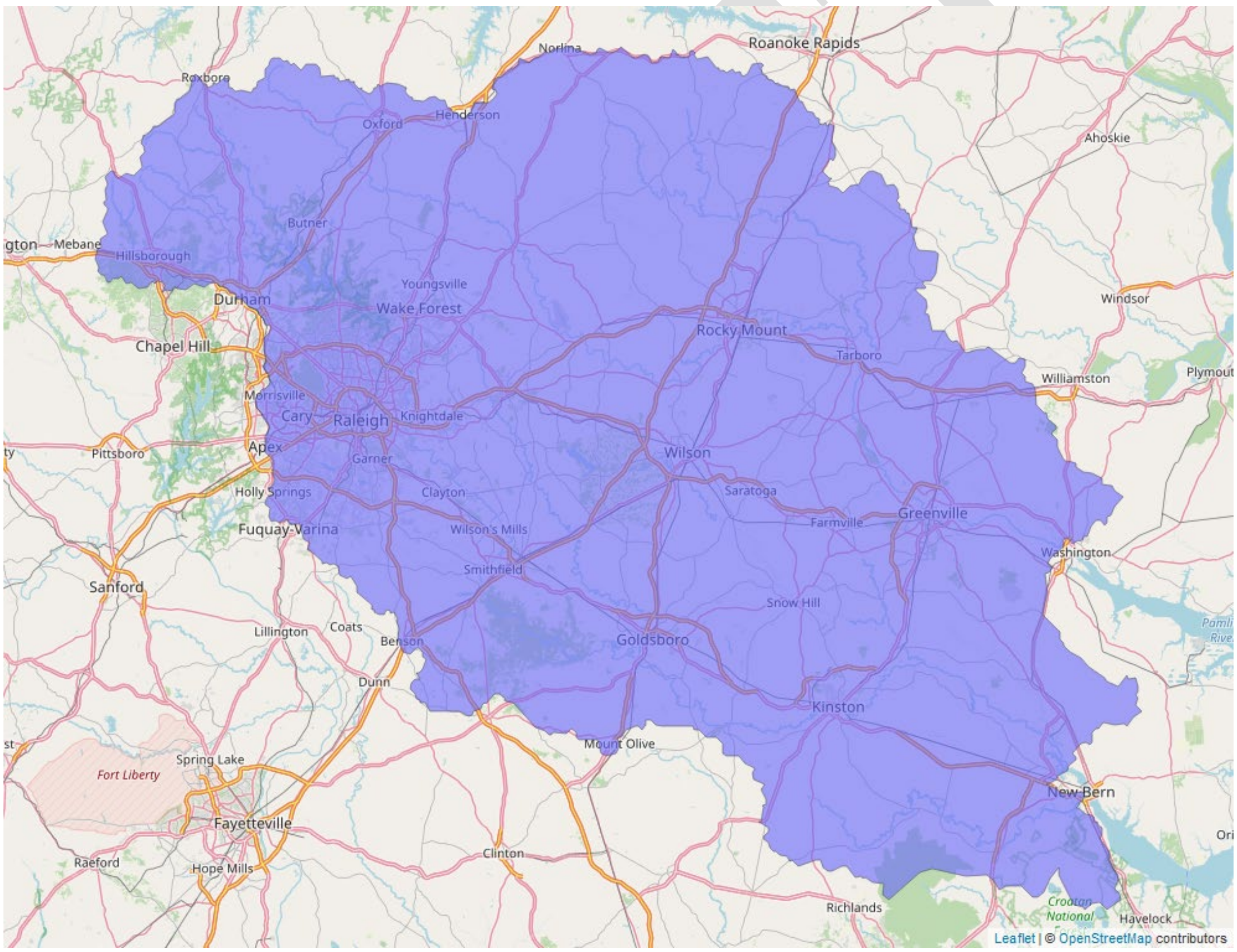

Figure 2. Range map of Neuse River waterdog (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/6772.

Vulnerability

As mentioned in the Introduction, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function not only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

Summary of Status

Listing status: Threatened

Most recent 5-year review recommendation: N/A

Most recently completed 5-year review: None available for this species

Distribution: Small, endemic, constrained, and/or isolated population(s)

Number of populations: Multiple populations (few)

Species trends: Declining population(s) - one or more populations declining

Pesticides noted in Service documents as a threat to the species: Yes

Environmental Baseline/Cumulative Effects (EB/CE) Summary

The Neuse River waterdog is a permanently aquatic salamander species endemic to the Tar-Pamlico and Neuse River drainages in North Carolina. The species occurs in riffles, runs, and pools in medium to large streams and rivers with moderate gradient in both the Piedmont and Coastal Plain physiographic regions. Waterdogs prefer clean water with permanent flow and are not tolerant of siltation and turbidity. Benthic critters such as the waterdog have disproportionate rates of imperilment and extirpation because stream bottoms are often the first habitats affected by pollution. The Neuse River waterdog has declined in abundance and distribution and many remaining populations are fragmented (USFWS 2021a). Since the 2018 SSA analyses (USFWS 2021a), survey and research efforts have led to documentation of Neuse River waterdogs in places they were believed to be extirpated. The species was found in 37 HUC-10s between 2011-2022; 338 of 430 were added since 2018. As of 2023, the Neuse River waterdog has 3 populations: Trent, Neuse (8 subpopulations), and Tar-Pamlico (5 subpopulations) (USFWS 2023). The one population predicted to remain extant (Tar) is expected to be characterized by low occupancy and abundance in the future (USFWS 2021a).

The Neuse River waterdog faces a variety of risks from declines in water quality, loss of stream flow, riparian and instream fragmentation, deterioration of instream habitats, invasive species (i.e., red swamp crayfish (*Procambarus clarkii*), flathead catfish (*Pylodictis olivaris*), and hydrilla (*Hydrilla verticillata*)). These risks, which are expected to be exacerbated by urbanization and climate change, were important factors in our assessment of the future viability of the Neuse River waterdog. Streams with urbanized or agriculturally dominated riparian corridors are subject to increased sediment-loading from unstable banks and/or impervious surface runoff, resulting in less suitable in-stream habitat for waterdogs as compared to habitat with forested corridors. Agricultural pesticide use can have detrimental effects, and studies have shown the species to have low to moderate levels of pesticide contamination from a variety of sources, including insect control. The human population in the southern portion of the U.S. has increased by nearly 1% annually since 2020 (twice the average nationally) and we expect additional growth in the future. (U.S. Census, 2025). With human population growth, we also expect additional urban development that could result in mortality or habitat loss for the Neuse River waterdog. Climate change has already begun to affect the watersheds where Neuse River Waterdog occurs, resulting in higher air temperatures, increased evaporation, and altered precipitation patterns such that water levels range-wide have reached historic lows, which put the populations at elevated risk for habitat loss, especially in the headwater areas. We expect other threats to the waterdog, including water quality issues, loss of stream flow, fragmentation, and general habitat loss to be exacerbates by increased development and climate change (USFWS 2021a).

Overall Vulnerability: High

Effects of the Action: Exposure

Overlap with Agricultural Use Sites

We do not expect the Neuse River waterdog will occur on-field as the species is entirely aquatic, and thus expect exposure will only result from off-field transport via spray drift or runoff to the species aquatic habitat. Given that the species' range is delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave agricultural use sites will be collected in the waterbodies within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. Data indicate that 18.6% of the species' watershed overlaps with agricultural use sites (Table 6).

Table 6. Overlap of simazine use by crop for the Neuse River waterdog.

Use Layer	Total Overlap (% Watershed)	% Watershed Treated
Citrus	0	0
Corn	11	2.2
Grapes	<0.1	<0.1

Use Layer	Total Overlap (% Watershed)	% Watershed Treated
Other Crops	4.1	<0.1
Other Orchards	<0.1	<0.1
Vegetables and Ground Fruit	3.5	<0.1
Christmas Trees	<0.1	<0.1
Total	**18.6**	**2.2**

Usage

Past usage data indicate that up to 2.2% of the species' range has been treated with simazine annually from agricultural uses. The use layer with the highest anticipated usage is corn at an annual rate of 2.2% annually.

Additional Exposure Considerations

Neuse River waterdogs breed once per year, with mating in the fall/winter and spawning in the spring. During the spring (May-June), females will lay a clutch of ~25-90 eggs in a rudimentary nest, under large rocks in moderate currents. Ashton (1985) noted that nest sites are guarded by females and are often found under large bedrock outcrops or large boulders with sand and gravel beneath them, often placed there by the waterdogs (USFWS 2018).

Exposure from Non-Agricultural Uses

The Neuse River waterdog may be exposed to simazine runoff or spray drift through the non-agricultural uses for applications within developed areas such as residential lawns or open space developed areas such as golf courses and nurseries. While the nurseries footprint is small within the range of the Neuse River waterdog, there are ~ 80 golf courses within the range of the Neuse River waterdog. North Carolina is within the transition zone where warm season grasses for golf course turf may be treated with simazine within the range of the Neuse River waterdog.

Conservation Measures

As part of the simazine ESA consultation with the Service, EPA is implementing the final Herbicide Strategy to inform and identify any necessary conservation measures where EPA's analysis indicated there was a risk of population level effects to listed species. The measures identified by EPA, and committed to by the technical registrants, include a standard 15-foot spray drift buffer and a minimum of three runoff mitigation points necessary in all areas where simazine is used, as well as additional runoff mitigation points for certain simazine uses limited to specific geographic areas.

The spray drift buffer will be placed on the general label and will apply to all uses of simazine. EPA's Herbicide Strategy provides applicators with options to reduce the distance of this buffer by using other spray drift reduction strategies that we anticipate will result in an equivalent reduction in spray drift entering non-target habitats as the stated buffers. These measures and the degree to which applicators can reduce buffers by employing them are described in EPA's Herbicide Strategy and EPA's Ecological Mitigation Support Document to Support Endangered Species Strategies. These documents are provided in Appendix A-1.

This buffer is in addition to spray drift mitigations that are already on the label, including:

- Restricting use to a maximum windspeed of 10 miles per hour,
- Prohibiting applications during temperature inversions,
- Applying with a release height of no more than 4 feet above the ground or crop canopy for ground applications,
- Selecting nozzles and pressures that deliver coarse or coarser droplets for all applications and ground application only.

Effects of the Action: Toxicity

Direct Effects

Estimated environmental concentrations of simazine in the Neuse River waterdog's habitat will vary depending on the application rate corresponding to different registered uses, the habitat features (e.g., flow rate and size of waterbody), and the region. EPA's fate modeling indicate that maximum estimated environmental concentrations will range between 0.6 µg/L to 167.4 µg/L (Table 7).

Table 7. Estimated environmental concentrations (EECs; µg/L) for Use Data Layers for the Neuse River waterdog.

HUC2[10]	Habitat	Citrus	Corn	Developed	Grapes	OSD[11]	Other Crops	Other Orchards	VGF[12]	Christmas Trees
3	Low flow or low volume	89.0	38.6	1.1	61.1	3.1	60.0	167.4	67.3	83.8
3	High flow	36.3	13.8	0.6	18.4	0.8	18.9	35.0	32.9	10.0

[10] HUC = hydrologic unit code. In this case a HUC2, which is the broadest designation in a hierarchical nationwide system to delineate watersheds created by the U.S. Geological Survey. See https://nas.er.usgs.gov/hucs.aspx.

[11] OSD = open space developed. Generally, refers to lawns, turf areas, golf courses and similar land uses.

[12] VGF = vegetables and ground fruit. Generally, refers to vegetables, sweet corn, and fruit grown on the ground.

These EECs encompass exposure expected from all uses, including both agricultural and non-agricultural. Mortality is not expected in any of the aquatic habitats where the Neuse River waterdog is found. The Neuse River waterdog prefers riffles, runs, and pools in medium to large streams and rivers with moderate gradient such as streams wider than 15m, although some have been observed in smaller creeks deeper than 100 cm, and with a main channel flow rate greater than 10cm/sec (USFWS 2021b), so it may be found in both high flow waterbodies and low flow /low volume waterbodies. We anticipate a reduction in growth for the Neuse River waterdog in some low flow/low volume waterbodies within its range. However, breeding and nesting most likely occur in water bodies with moderate current protected under large boulders or bedrock outcrops below the water surface where EECs are likely to be lower than what would impact reproduction.

For residential uses of simazine, we do not anticipate much exposure from applications of this type as simazine is no longer commonly used on residential or commercial turf as potential consequences to turf areas related to timing of application has led to preferential use of other herbicides that can be applied more broadly.

While there are a large number of golf courses within the range of the Neuse River waterdog, and simazine is used on warm season grasses, golf courses typically apply herbicides using dedicated ground equipment with a low boom height (as per the label), and the no-till methodology and continuous cover of a turf grass area inherent in managing golf course turf are equivalent to additional runoff mitigations (i.e., equivalent to six points on EPA's mitigation menu). These general practices help ensure turf and soil conditions do not lead to off-target movement of simazine. In addition, riparian buffer zones are often used on golf courses between all water features to reduce off target movement as well. We also anticipate non-agricultural uses will not meaningfully add to the overall level of anticipated exposure considered within the range of the Neuse River waterdog due to runoff and spray drift considerations described above and off-site exposure is not expected to result in effects to listed species as the EECs are well below concentrations where we would anticipate any direct adverse effects to the Neuse River waterdog. In addition, the Neuse River waterdog habitat requirements preclude them from occupying non-agricultural use sites where simazine may be used.

Indirect Effects

Simazine is likely to impact any aquatic vegetation the Neuse River waterdog relies on for breeding and sheltering however, simazine is not likely to eliminate all aquatic vegetation within a water body and aquatic plant-based sources will replenish over time in any dynamic aquatic system (flowing or non-flowing) based on several mesocosm and microcosm studies discussed in the main body of the Opinion. The Neuse River waterdog can consume invertebrate species as a food resource. Available toxicity data indicate that invertebrate species, particularly aquatic arthropods, are sensitive to simazine and are likely to exhibit reduced fecundity and reduced growth in adults with exposure to simazine at the predicted environmental concentrations. However, we do not expect all invertebrate species will be equally sensitive to simazine exposure. Abundance of some invertebrate species may be reduced while other species may not exhibit as large of a reduction in abundance. As such, we anticipate a temporary loss of certain invertebrate prey species will result in no more than low levels of indirect adverse effects to the Neuse River waterdog.

Effects of the Action Summary

The Neuse River waterdog has medium exposure. There is a large presence of agricultural simazine use sites within the species' range (18.6% total overlap) and a low level of anticipated agricultural usage rate within the range (up to 2.2% of the range treated annually). As such, we expect a medium number of individuals are likely to experience exposure.

Individuals may occur near non-agricultural use sites, including developed and open space developed areas. However, as described above, there are a number of general practices for golf course turf use and residential turf grass applications that minimize the likelihood of off-site movement into non-target areas and the low likelihood of simazine use for residential areas also minimizes the exposure we anticipate for the Neuse River waterdog.

The Neuse River waterdog has medium toxicity. Based on predicted environmental concentrations of simazine from agricultural uses within the species' habitat of low flow/low volume habitats, we expect there will be a low likelihood of direct effects (e.g., reduced growth) and a low level of indirect effects through the loss of prey resources and vegetation for sheltering and breeding. We anticipate this level of direct and indirect effects will result in a low level of adverse effects to a medium number of individuals. Therefore, we determine the overall risk of adverse effects to the species is medium from agricultural uses of simazine.

Species Conclusion

The Neuse River waterdog is a fully aquatic salamander that sometimes utilizes low to moderate-gradient streams with low current velocities but prefers riffles, runs, and pools in medium to large streams and rivers with moderate gradient. The species requires uncontaminated sites and is intolerant of degraded water quality as from siltation or turbidity so that, in general, stream channels with forested and stable banks where erosion is limited are more likely to support the species than sites where vegetation and stream banks have been altered (i.e., where agriculture or development activities exist). The Neuse River waterdog has a high vulnerability based on its status, distribution, and trends. Because the species is aquatic, we expect exposure to occur through spray drift and runoff.

In general, the Neuse River waterdog is under a variety of threats, including habitat loss/degradation related to water quality impairment and in-stream and riparian deterioration from development. Invasive species also represent a risk to the species. While these threats appear to represent the most significant risks to the species, the Neuse River waterdog also occurs in aquatic habitats adjacent to agricultural and non-agricultural use sites where simazine could be used, including medium to large streams and rivers with moderate gradients. While simazine exposure is anticipated at low levels due to low levels of residual runoff in streams and rivers adjacent to non-agricultural sources (e.g., golf courses) we expect a low number of individuals will be exposed to low levels of simazine that will cause measurable sub-lethal effects to growth. For agricultural uses, the anticipated levels of exposure from runoff are anticipated to result in low levels of sublethal adverse effects from indirect effects to aquatic invertebrates (i.e., loss of dietary resources).

Thus, we anticipate a low number of individuals of this species and their food resources will experience exposure over the duration of the action. We do not expect mortality of individual Neuse River waterdogs, but we do anticipate low levels of direct adverse effects to growth from agricultural exposure and indirect adverse effects from some reduction of food resources (i.e., aquatic invertebrates). We anticipate the reduction of growth and loss of dietary items in a small number of individuals will not result in species-level effects. After reviewing the current status of the species, environmental baseline for the action area, cumulative effects, and effects of the action (including the conservation measures that are incorporated into the proposed action), we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the Neuse River waterdog.

References

U.S. Census. 2025. United States Population Growth by Region. https://www.census.gov/popclock/data_tables.php?component=growth (accessed: 9/25/2025).

U.S. Fish and Wildlife Service. 2023. Draft Recovery Plan for the Neuse River Waterdog (*Necturus lewisi*). Raleigh, North Carolina. 17 pp.

U.S. Fish and Wildlife Service. 2021a. Species Status Assessment Report for the Neuse River Waterdog (*Necturus lewisi*). Version 1.2. February 2021. Atlanta, Georgia.

U.S. Fish and Wildlife Service. 2021b. Endangered and Threatened Wildlife and Plants; Threatened Species Status With Section 4(d) Rule for Neuse River Waterdog, Endangered Species Status for Carolina Madtom, and Designations of Critical Habitat. Final Rule. Federal Register 86(109): 30688-30751.

Integration and Synthesis Summary: Western spadefoot[13]

Scientific Name:	Common Name:	Entity ID:
Spea hammondii	Western spadefoot	12393, 12394

Conclusion: No Jeopardy

Species Range

Based on range map dated: 08/19/2025; Northern (12393) and Southern (12394) Distinct Population Segments; *States within the range:* CA

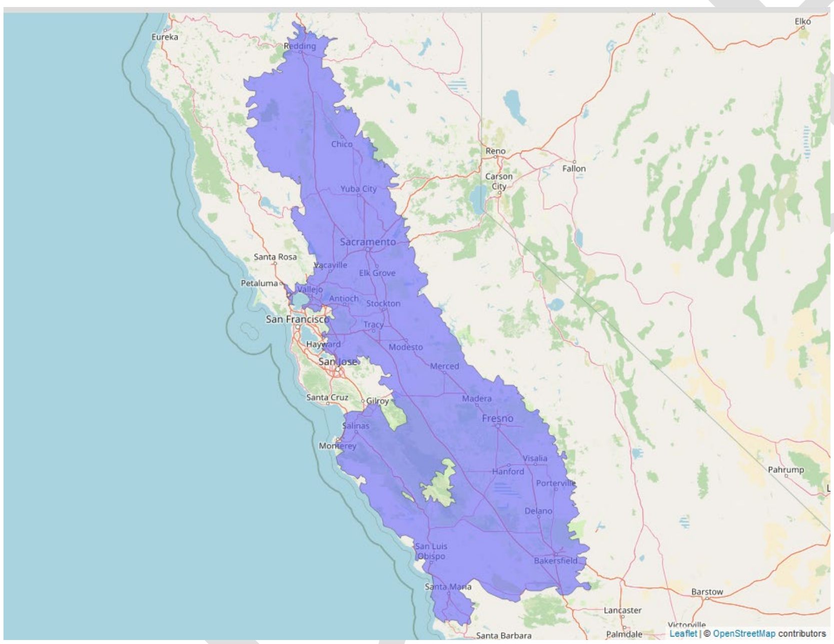

Figure 3. Northern DPS map of western spadefoot (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/5425.

---

[13] EPA provided a determination for western spadefoot entity ID 6096, which is an unlisted entity. The species was proposed as two Distinct Population Segments (DPS) with entity IDs 12393 (northern DPS) and 12394 (southern DPS). We addressed the two proposed DPSs in our Opinion.

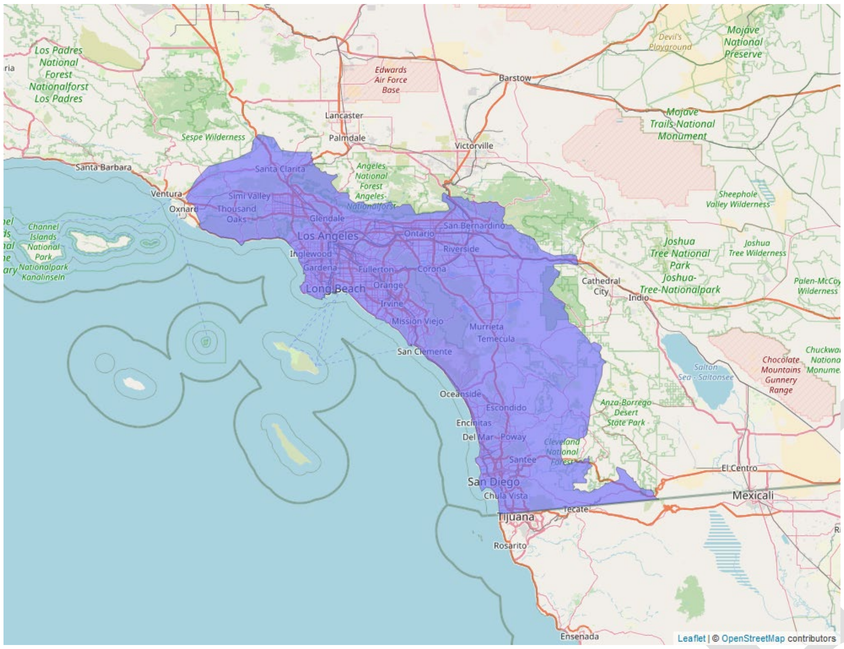

Figure 4. Southern DPS map of western spadefoot (blue polygons). Range map accessed at https://ecos.fws.gov/ecp/species/5425.

Vulnerability

As mentioned in the Introduction, vulnerability considers the present and likely future condition of the species to determine its vulnerability to additional stressors. In making our jeopardy determination, vulnerability of the species is a function not only of its status, but also the environmental baseline and cumulative effects. These are summarized below for this species.

Summary of Status

Listing status: Proposed Threatened

Most recent 5-year review recommendation: N/A

Most recently completed 5-year review: None available for this species

Distribution: Species/Populations neither constrained nor widespread

Number of populations: Multiple populations (numerous)

Species trends: Declining population(s) - one or more populations declining

Pesticides noted in Service documents as a threat to the species: Yes

Environmental Baseline/Cumulative Effects (EB/CE) Summary

Western spadefoots are primarily terrestrial and inhabit underground burrows. Radio-tagged individuals in southern California were found in underground burrows from 1 cm to 18 cm (0.4–7 in.) depth below the surface during the breeding season. It is estimated that western spadefoot individuals can burrow approximately 1 m (3 ft) below ground during the dry season to avoid temperature extremes and desiccation. During a majority of their life cycle, western spadefoot remains in a torpor state in underground burrows in upland areas surrounding their aquatic (breeding) habitat. Spadefoots emerge from their burrows to forage and breed in ephemeral pools following seasonal rains in winter and spring. Emergence is likely related to a sound or vibration cue from the rain. Most surface activity is nocturnal, presumably to reduce water loss. Depending on temperature and annual rains, western spadefoot breeding and oviposition generally occurs from October to May, most often in temporary pools and non-flowing drainage areas from winter or spring rains.

The historical range of western spadefoot is from the vicinity of Redding in Shasta County, California, southward to northwestern Baja California, Mexico. They have been found at sites from sea level up to 1,385 meters (m) (4,500 feet (ft)) in the Sierra Nevada foothills. In California, western spadefoot ranges throughout the Central Valley, and in the Coast Ranges and the coastal lowlands from San Francisco Bay southward to Mexico. Currently, the species is patchily distributed throughout its historical range. However, the western spadefoot is thought to be extirpated throughout most of the lowlands of southern California and from many historical locations within the Central Valley. In the northern western spadefoot range, the largest declines have been observed in the Sacramento Valley and San Joaquin Valley, while declines have been more modest in the Coast Ranges.

Western spadefoot habitat is primarily open treeless grasslands, scrub, or mixed woodland and grassland where aquatic breeding habitat is available. Western spadefoots require both aquatic and terrestrial habitat components in close proximity, within the dispersal distance of the species, to meet all life history requirements. Spadefoots are primarily terrestrial, and require upland habitats for feeding and for constructing burrows for long dry-season dormancy. Western spadefoots have been found to favor areas with grassland cover for burrow sites in both the northern and southern clade, and also shrub/scrub habitat in the southern clade. Aquatic habitat is used for breeding and developing larvae and typically includes temporary vernal pools, sand or gravel washes, and small streams that are often seasonal. However, eggs and larvae of western spadefoot have been observed in a variety of permanent and temporary wetlands, both natural and altered, including rivers, creeks, artificial ponds, livestock ponds, sedimentation and flood control ponds, irrigation and roadside ditches, roadside puddles, tire ruts, and borrow pits, indicating a degree of ecological plasticity.

Overall Vulnerability: High

Effects of the Action: Exposure

Overlap with Agricultural Use Sites

We do not expect western spadefoots will occur on-field, and thus expect exposure will only result from off-field transport via spray drift or runoff. However, this species while not on-field, is known to breed and not disperse very far from their breeding pools that could functionally be agricultural ditches. Given that the ranges for listed aquatic species are generally delineated using the relevant HUC 12 watersheds, we anticipate that all residues that leave agricultural use sites will be collected in the waterbodies (including ephemeral agricultural ditches used as breeding pools) within the species range where individuals occur regardless of how residues leave treated sites or where in the range they are deposited. As such, we do not extend overlap metrics off-field as this will not functionally change the expected exposures that listed aquatic species are likely to experience. Data indicate that 25.1% of the species' watershed overlaps with agricultural use sites (Table 8).

Table 8. Overlap of simazine use by crop for the western spadefoot toad.

Use Layer	Total Overlap (% Watershed)
Citrus	0.8
Corn	2.5
Grapes	2.7
Other Crops	6.8
Other Orchards	9.4
Vegetables and Ground Fruit	2.9
Christmas Trees	0
Total	**25.1**

Usage

Mandatory reporting data from the state of California indicates that, between 2013-2022, and agricultural areas reporting any pesticide usage was 4% and 29.3% for the 12394 and 12393 Entity IDs, respectively. Of those areas reporting pesticide usage, up to 2.8 % and 23.0% for the 12394 and 12393 Entity IDs, respectively reported use of any herbicide. Based on this reporting data, we expect 0.2% and 0.7% of the 12394 and 12393 Entity IDs, respectively of the species' range is likely to be treated with simazine annually, specifically ().Based on this reporting data, we expect 0.2% and 0.7% of the 12394 and 12393 Entity IDs, respectively of the species' range is likely to be treated with simazine annually, specifically (Table 9).

Table 9. Past usage of all pesticides, herbicides, and simazine specifically near the western spadefoot's range according to the California Department of Pesticide Regulation's Pesticide Use Reporting.

Entity ID and DPS	% overlap with all pesticide usage areas	% overlap with all herbicide usage areas	% overlap with simazine usage
12394 – southern DPS	4.0	2.8	0.2
12393 – northern DPS	29.3	23.0	0.7

The western spadefoot toad is currently proposed for listing in two Distinct Population Segments (DPSs), one DPS for the northern extent of the range, and a southern DPS for the populations of southern California. EPA initially provided overlap data for a single range for the species with its final BE, but subsequently updated the CalPUR overlap information for usage with the Service's proposal to list the species as threatened within a northern DPS and southern DPS. Due to the changing listing proposal, the EPA's overlap information, at present, represents the slightly broader geographic area of the initial single range (Ent ID 6096). However, as the combined proposed northern DPS (Entity ID 12393) and southern DPS (Entity ID 12394) are estimated to overlap the single range extent by more than 90%, we believe the agricultural overlap information is still generally valid as an estimate. If we can obtain updated information before a final biological opinion, we will update our analysis for this data.

Additional Exposure Considerations

Western spadefoots are primarily terrestrial and inhabit underground burrows from 1 cm to 18 cm (0.4–7 inches) depth below the surface during the breeding season. It is estimated that western spadefoot individuals can burrow approximately 1 meter (3 feet) below ground during the dry season to avoid temperature extremes and desiccation. During a majority of their life cycle, western spadefoots remain in a torpor state in underground burrows in upland areas surrounding their aquatic (breeding) habitat. Spadefoots emerge from their burrows to forage and breed in ephemeral pools following seasonal rains in winter and spring. Most surface activity is nocturnal, presumably to reduce water loss. Depending on temperature and annual rains, western spadefoot breeding and oviposition generally occurs from October to May, most often in temporary pools and non-flowing drainage areas from winter or spring rains. Eggs and larvae of the western spadefoot have been observed in a variety of permanent and temporary wetlands, both natural and altered, including rivers, creeks, artificial ponds, livestock ponds, sedimentation and flood control ponds, irrigation and roadside ditches, roadside puddles, tire ruts, and borrow pits, indicating a degree of ecological plasticity (USFWS 2023a).Western spadefoots occur in ephemeral ponds, some of which occur on agricultural lands and ditches (USFWS 2023b).

Exposure from Non-Agricultural Uses

The western spadefoot occurs in ephemeral ponds, some of which may occur on non-agricultural use sites (USFWS 2023b).

Conservation Measures

As part of the simazine ESA consultation with the Service, EPA is implementing the final Herbicide Strategy to inform and identify any necessary conservation measures where EPA's analysis indicated there was a risk of population level effects to listed species. The measures identified by EPA, and committed to by the technical registrants, include a standard 15-foot spray drift buffer and a minimum of three runoff mitigation points necessary in all areas where simazine is used, as well as additional runoff mitigation points for certain simazine uses limited to specific geographic areas.

The spray drift buffer will be placed on the general label and will apply to all uses of simazine. EPA's Herbicide Strategy provides applicators with options to reduce the distance of this buffer by using other spray drift reduction strategies that we anticipate will result in an equivalent reduction in spray drift entering non-target habitats as stated buffers. These measures and the degree to which applicators can reduce buffers by employing them are described in EPA's Herbicide Strategy and EPA's Ecological Mitigation Support Document to Support Endangered Species Strategies. These documents are provided in Appendix A-1.

This buffer is in addition to spray drift mitigations that are already on the label, including:

- Restricting use to a maximum windspeed of 10 miles per hour,
- Prohibiting applications during temperature inversions,
- Applying with a release height of no more than 4 feet above the ground or crop canopy for ground applications,
- Selecting nozzles and pressures that deliver coarse or coarser droplets for all applications and ground application only.

In addition to label measures, the western spadefoot is in a Pesticide Use Limitation Area (PULA) that requires an additional three runoff mitigation points (i.e., six points total) for all uses except mixed greens in Washington, peaches and nectarines in California, and all strawberries. We anticipate these additional runoff points will further reduce simazine residues in runoff by another order of magnitude (i.e., up to 99% reduction in simazine runoff residues in total).

Effects of the Action: Toxicity

Direct Effects

The western spadefoot is primarily terrestrial. They have not been observed to disperse very far from their breeding pools (USFWS 2023a). If they are near agricultural areas when breeding in agricultural area ditches, terrestrial estimated environmental concentrations of simazine from dietary exposure consumption of terrestrial arthropods will lead to reduced reproductive output (reduction in number of eggs laid, reduction in viable embryos, and reductions in hatchling survival). Mortality is not expected from simazine exposure in any of the terrestrial habitats where the western spadefoot is found.

Aquatic habitat is used for breeding and developing larvae and typically includes temporary vernal pools, sand or gravel washes, and small streams that are often seasonal. In the aquatic habitat of the western spadefoot, estimated environmental concentrations of simazine will vary depending on the application rate corresponding to different registered uses, the aquatic habitat features (e.g., flow rate and size of waterbody), and the region. EPA's fate modeling indicate that maximum estimated environmental concentrations will range between 0.2 µg/L to 68 µg/L (Table 10).

Table 10. Aquatic estimated environmental concentrations (EECs) for aquatic phase of the western spadefoot.

HUC2[14]	Habitat	Citrus	Corn	Developed	Grapes	OSD[15]	Other Crops	Other Orchards	VGF[16]	Christmas Trees
18a	Low flow or low volume	17.8	10.8	1.1	13.3	0.5	7.3	68	36.4	12.9
18a	High flow	1.2	0.6	0.3	1.5	0.3	1.0	8.3	5.8	1.1
18a	High volume	0.6	0.3	0.4	0.8	1.6	0.6	4.1	4.0	0.6
18b	Low flow or low volume	17.8	8.1	1.1	13.9	0.3	6.8	65	33.4	8.7
18b	High flow	0.4	0.6	0.2	0.6	0.2	0.6	1.8	3.9	0.5
18b	High volume	0.2	0.3	0.2	0.3	1.4	0.3	1.6	2.1	0.2

These EECs encompass exposure expected from all uses, including both agricultural and non-agricultural. Mortality is not expected in any of the aquatic habitats where the western spadefoot is found. The western spadefoot occurs in primarily open treeless grasslands, scrub, or mixed woodland and grassland where aquatic breeding habitat is available. When not burrowed underground, during the breeding season and during tadpole development, we anticipate a reduction in growth for the western spadefoot in some low flow/low volume waterbodies within its range from applications made to peaches or nectarines if they are in a low flow/low volume breeding pond/vernal pool.

[14] HUC = hydrologic unit code. In this case a HUC2, which is the broadest designation in a hierarchical nationwide system to delineate watersheds created by the U.S. Geological Survey. See https://nas.er.usgs.gov/hucs.aspx.

[15] OSD = open space developed. Generally, refers to lawns, turf areas, golf courses and similar land uses.

[16] VGF = vegetables and ground fruit. Generally, refers to vegetables, sweet corn, and fruit grown on the ground.

For residential uses of simazine, we do not anticipate much exposure from applications of this type as simazine is no longer commonly used on residential or commercial turf as potential consequences to turf areas related to timing of application has led to preferential use of other herbicides that can be applied more broadly.

While there are a many golf courses within the range of the western spadefoot, golf courses typically apply herbicides using dedicated ground equipment with a low boom height (as per the label), and the no-till methodology and continuous cover of a turf grass area inherent in managing golf course turf are equivalent to additional runoff mitigations (i.e., equivalent to 6 points on EPA's mitigation menu. These general practices help ensure turf and soil conditions do not lead to off-target movement of simazine. In addition, riparian buffer zones are often used on golf courses between all water features to reduce off target movement as well. We also anticipate non-agricultural uses will not meaningfully add to the overall level of anticipated exposure considered within the range of the western spadefoot due to runoff and spray drift considerations described above and off-site exposure is not expected to result in effects to listed species.

Indirect Effects

Simazine is likely to impact any aquatic vegetation the western spadefoot relies on for breeding and sheltering however, simazine is not likely to eliminate all aquatic vegetation within a water body and aquatic plant based sources will replenish over time in any dynamic aquatic system (flowing or non-flowing) based on several mesocosm and microcosm studies discussed in the main body of the Opinion. Simazine is also likely to impact any vegetation used during the terrestrial phase in dispersal habitats. Adult western spadefoot forage on a variety of small invertebrate prey including grasshoppers, true bugs, moths, ground beetles, predaceous diving beetles, ladybird beetles, click beetles, flies, ants, and earthworms (USFWS 2023a). Adult western spadefoot can consume 11 percent of their body mass during a single feeding and adults must be able to acquire sufficient energy for their long dormancy period of 8 to 10 months in only a few weeks so it is likely they will consume large quantities at or near breeding pools and dispersal areas (USFWS 2023a). The specific food items consumed by western spadefoot larvae are unknown, but they likely need some food to persist such as planktonic organisms, algae, and fairy shrimp (USFWS 2023a). Available toxicity data indicate that invertebrate species, particularly aquatic arthropods, are sensitive to simazine and are likely to exhibit reduced fecundity and reduced growth in adults with exposure to simazine at the predicted environmental concentrations. However, we do not expect all invertebrate species will be equally sensitive to simazine exposure. Abundance of some invertebrate species may be reduced while other species may not exhibit as large of a reduction in abundance. As such, we anticipate a temporary loss of certain aquatic invertebrate prey species, but this will result in no more than low levels of adverse indirect effect to the western spadefoot.

Effects of the Action Summary

Exposure for the western spadefoot is medium. There is a large presence of agricultural simazine use sites within the species' range (25.1% total overlap) and a low level of anticipated agricultural usage within the range (up to 0.9% of the range treated annually). As such, we expect a moderate number of individuals are likely to experience exposure.

Individuals may occur near non-agricultural use sites, including developed and open space developed areas. However, as described above, there are a number of general practices for golf course turf use and residential turf grass applications that minimize the likelihood of off-site movement into non-target areas and the low likelihood of simazine use for residential areas also minimizes the exposure we anticipate for the western spadefoot.

The western spadefoot burrows for most of the year (8-10 months) however it is known to occur in agricultural ditches that can function as breeding pools. They are also known to disperse short distances from breeding pools, which makes them more susceptible to simazine from agricultural uses. They are also known to consume a significant portion of their body weight during singular feedings and in doing so, if near agricultural areas, makes exposure to simazine from agricultural uses through the dietary route in the terrestrial phase more likely to occur. Based on predicted terrestrial environmental concentrations of simazine from agricultural uses within the species' range, the western spadefoot is likely to experience reduced reproductive output such as a reduction in number of eggs laid, reductions in viable embryos, and reductions in hatchling survival.

During the aquatic phase we expect there will be some direct effects (e.g., reduced growth) based on estimated environmental concentrations of simazine in habitats of low flow/low volume habitats, and a low level of indirect effects through the loss of some prey resources and vegetation for sheltering and breeding. We anticipate this level of direct and indirect effects during both the terrestrial and aquatic phases for this species will result in a medium level of adverse effects to a moderate number of individuals. Therefore, we determine the overall risk of adverse effects to the species is medium from agricultural uses of simazine in the terrestrial and aquatic phases for this species.

Species Conclusion

The Western spadefoot toad is a small, largely fossorial toad inhabiting dry grasslands and woodlands proximate to vernal pools, sand or gravel washes, and small streams, often only seasonally wetted. The species was once broadly distributed through California's Central Valley into northern Mexico but is currently patchily distributed in the foothills of the Sierra Nevada and Coast Ranges having been extirpated from many of the lowlands of southern California and from many former sites in lower elevations of the Central Valley. The Western spadefoot toad has a high vulnerability based on its status, distribution, and trends. Because the species is largely terrestrial, but reproduces in aquatic sites, we expect exposure to primarily occur through spray drift and runoff in aquatic breeding sites.

The Western spadefoot toad is under a variety of threats, including habitat loss/degradation related to urban development and agricultural conversion degrading or destroying natural habitats in the Central Valley and in southern California. While these threats appear to represent the most significant risks to the species, the Western spadefoot toad also occurs in aquatic habitats proximate to agricultural and non-agricultural use sites where simazine is anticipated to be used, including drainage and agricultural ditches adjacent to agricultural use sites where runoff from agricultural sites is a risk. While we do not anticipate adverse effects from simazine exposure through runoff in seasonal aquatic sites (e.g., vernal pools) in or adjacent to non-agricultural sources (e.g., golf courses, open space developed sites), given the low usage (0.9%) of simazine across the distribution of the species, we do expect a small number of individuals will be exposed to biologically meaningful levels of simazine from residual agricultural runoff that will cause measurable direct effects to growth in affected individuals. While limitations on use (spray drift reduction measures cited above) and buffers already on the label reduce those exposures for many use types to levels below which we would observe such effects, for a limited number of use types we still anticipate exceedances of EECs such that effects to growth from exposure and effects to prey availability are anticipated to a small number of individuals.

Thus, we anticipate a small number of individuals of this species and their food resources will experience exposure over the duration of the action. While we do not expect mortality of individual Western spadefoot toads, we do anticipate low levels of direct adverse effects to growth from agricultural exposure and indirect adverse effects from some reduction of food resources (i.e., aquatic vegetation). We anticipate the reduction of growth and loss of dietary items in a small number of individuals will not result in species-level effects. After reviewing the current status of the species, environmental baseline for the action area, cumulative effects, and effects of the action (including the conservation measures that are incorporated into the proposed action), we have determined the proposed action is not expected to appreciably reduce the survival and recovery of the species in the wild. Thus, it is our biological opinion that the proposed action is not likely to jeopardize the continued existence of the western spadefoot toad.

References

U.S. Fish and Wildlife Service. 2023a. Species Status Assessment Report for the Western Spadefoot (*Spea hammondii*), Version 1.1. Sacramento, California. 129 pp.

U.S. Fish and Wildlife Service. 2023b. Endangered and Threatened Wildlife and Plants: Threatened Status With Section 4(d) Rule for the Northern and Southern Distinct Population Segments of the Western Spadefoot. Proposed Rule. Federal Register 88(232):84252-84278.

Species requiring further analysis

In our draft Biological Opinion, we focused our analyses on 1) species with low expected exposure to simazine (due to low overlap, usage, or conservation measures adopted prior to consultation), and 2) species with more than low levels of exposure that benefited from conservation measures identified through the Herbicide Strategy that aimed to reduce off-site transport of simazine (i.e., listed plants and listed animals that depend on plant resources). For the species in Table 11, we identified the need for further coordination. We expect Herbicide Strategy conservation measures to reduce pesticide loading into aquatic habitats by up to 90% (i.e., one order of magnitude) compared to unmitigated runoff, and reduce spray drift from entering species' terrestrial habitats by >95%. We anticipate that this reduction will minimize off-site transport of simazine to a level where no more than low levels of adverse effects are likely to occur to mammals through this exposure route. However, these species are highly vulnerable, and while the required mitigations are expected to reduce the extent of off-field exposure and reduce exposure concentrations, we anticipate simazine residues on use sites could remain at levels high enough to cause greater than low levels of adverse direct and/or indirect effects to these amphibian species. They may occur on simazine use sites, either agricultural or non-agricultural. We intend to continue coordinating with EPA and simazine registrants between the release of this draft Opinion and the transmission of the final Opinion to gain information regarding the exposure and effects of this species to simazine. As such, we have not yet made a determination for this species.

Table 11. Species requiring further analysis

Common Name	Scientific Name	Vulnerability Ranking	Exposure Ranking	Toxicity Ranking
Salado salamander	*Eurycea chisholmensis*	High	High	High