**Chapter 4 – Final Glyphosate Effects Determinations**

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# Introduction

In this BE, either a “No Effect” (NE), “Not Likely to Adversely Affect” (NLAA) or a “Likely to Adversely Affect” (LAA) determination is made for 1795 listed species (including endangered, threatened, candidate, proposed species: and experimental populations) and 792 designated critical habitats. For each species and designated critical habitat, the effects determination is based on the methodology previously described in **Chapter 1** and the Revised Methods[[1]](#footnote-2). These determinations are described further below according to the Steps of the methodology in which a determination was made (*e.g.*, Step 1b, Step 2c, etc.) although some steps are combined as appropriate. Summary tables are provided within the chapter with more detailed tables and individual species determinations provided in appendices.

# Summary of Effects Determinations

Tables 4-1 and 4-2 below summarize the effects determinations for all species and designated critical habitats, including a count of the number of species determinations by taxon. In addition, Table 4-3 summarizes the step of the analysis in which each effects determination was made for the species and designated critical habitat while Table 4-4 includes a summary of the strength of evidence associated with each LAA determination (discussed in more detail in **Section 3**). Effects determinations are summarized for each individual species and critical habitat in **APPENDIX 4-1**. **APPENDIX 4-1 (“Summary Table All Calls” tab)** is organized into 8 major taxa: birds, mammals, amphibians, reptiles, terrestrial invertebrates, fish, aquatic invertebrates and plants. Species are listed by taxa, then alphabetically according to scientific name, then by species identification number. For each species, the table includes an effects determination for both the species and its critical habitat, if applicable, as the table also has an indication of how the effects determination was reached (*e.g.,* terrestrial weight-of-evidence analysis, qualitative).

**Table 4-1. Summary of Species Effects Determinations for Glyphosate (Counts by Taxon).**

|  |  |  |  |
| --- | --- | --- | --- |
| **Taxon** | **Step 1 Effects Determinations** | **Step 2 Effects Determinations** | **Totals** |
| **No Effect** | **May Affect** | **Not Likely to Adversely Affect** | **Likely to Adversely Affect** |
| Mammals | 0 | 99 | 24 | 75 | 99 |
| Birds | 0 | 108 | 20 | 88 | 108 |
| Amphibians | 0 | 36 | 0 | 36 | 36 |
| Reptiles | 0 | 47 | 14 | 33 | 47 |
| Fish | 0 | 190 | 11 | 179 | 190 |
| Plants | 0 | 948 | 8 | 940 | 948 |
| Aquatic Invertebrates | 0 | 207 | 22 | 185 | 207 |
| Terrestrial Invertebrates | 0 | 160 | 20 | 140 | 160 |
| Total | 0 | 1795 | 119 | 1676 | 1795 |
| Percent of total | 0% | 100% | 7% | 93% |   |

**Table 4-2. Summary of Critical Habitat Effects Determinations for Glyphosate (Counts by Taxon).**

|  |  |  |  |
| --- | --- | --- | --- |
| **Taxon** | **Step 1 Effects Determinations** | **Step 2 Effects Determinations** | **Totals** |
| **No Effect** | **May Affect** | **Not Likely to Adversely Affect** | **Likely to Adversely Affect** |
| Mammals | 0 | 33 | 6 | 27 | 33 |
| Birds | 0 | 31 | 1 | 30 | 31 |
| Amphibians | 0 | 25 | 0 | 25 | 25 |
| Reptiles | 0 | 16 | 6 | 10 | 16 |
| Fish | 0 | 107 | 2 | 105 | 107 |
| Plants | 0 | 460 | 4 | 456 | 460 |
| Aquatic Invertebrates | 0 | 71 | 3 | 68 | 71 |
| Terrestrial Invertebrates | 0 | 49 | 11 | 38 | 49 |
| Total | 0 | 792 | 33 | 759 | 792 |
| Percent of total | 0% | 100% | 4% | 96% |   |

**Table 4-3. Summary of Species Effects Determinations by Step (and part) in the Process.**

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | **Step 1A** | **Step 1B/C** | **Step 2A** | **Step 2B** | **Step 2C** | **Step 2D** | **Step 2E** | **Step 2F** | **Step 2G/H/I** |
| **Outside of the action area** | **No toxicity effects** | **Incomplete exposure pathway** | **Extinct** | **Unreliable overlap based on range** | **Exposure models unreliable** | **<1% overlap** | **<1 exposed and pop. >100** | **Weight of evidence** |
| **NE** | **NE** | **NLAA** | **NLAA** | **NLAA** | **LAA** | **NLAA** | **LAA** | **NLAA** | **NLAA** | **NLAA** | **LAA** |
| # of species in category | 0 | 0 | 45 | 15 | 9 | 4 | 45 | 2 | 0 | 0 | 5 | 1670 |
| # of critical habitats in category | 0 | 0 | 19 | 0 | 0 | 0 | 14 | 2 | 0 | 0 | 0 | 757 |

**Table 4-4. Classification of LAA Determinations by Strength of Evidence.**

|  |  |  |
| --- | --- | --- |
| **Strength of LAA Determination** | **Species range** | **Critical Habitat** |
| **Number** | **% of LAA determinations** | **Number** | **% of LAA determinations** |
| Strongest evidence of LAA | 1 | <1% | 6 | <1% |
| Moderate evidence of LAA | 1605 | 96% | 733 | 97% |
| Weakest evidence of LAA | 70 | 4% | 20 | 3% |

# Methodology for Making Effects Determinations

As discussed in **Chapter 1** and the Revised Method, effects determinations are made in a tiered manner, transitioning from more conservative, screening level assumptions to more refinement as the analysis progresses. As discussed in the Revised Method document, the MAGtool combines toxicological information, exposure analysis and results of the spatial analysis into one tool. The spatial footprint of the action area includes the pesticide footprint based on all labeled uses for the chemical and offsite transport due to spray drift, as described in the Revised Method. Due to the broad extent of the potential uses the action area has a minimal off-site transport zone, almost all area is captured as potential use. Additional information on how the action area was developed can also be found in **APPENDIX 1-6.**

For each species and critical habitat, the MAGtool provides output for each step of the method, proceeding from Step 1a to Step 2f. In Steps 2f-2ghi, output is provided as the number of individuals predicted to be impacted under the assumptions of the analysis. It is important to note that the output generated is the potential number of individuals that could be impacted (based on the assumptions of the simulation), not a prediction that they will be impacted. Throughout this analysis, the BE maintains conservative assumptions and may overstate the number of species exposed to and impacted by a pesticide. At Step 2g through 2i, EPA applies probabilistic methods utilizing the Excel Add-In, Oracle Crystal Ball. The output from these final steps is either a NLAA or LAA determination, with all LAA determinations receiving a strongest, moderate, or weakest evidence of LAA designation (further described in **Section 5.7**). Additional technical information on the MAGtool, can be found in the Revised Methods and the model documentation[[2]](#footnote-3).

The basis of the inputs used in the MAGtool to make effects determinations, including spatial analysis results, toxicity data and estimated environmental concentrations (EECs) are described in **Chapters 1-3.** Spreadsheets containing the inputs to the MAGtool are provided in **APPENDIX 4-2.** Additional details and output from the aquatic model parameter variation analyses (*i.e*., for curve number and application date) are provided in **APPENDICES 4-3 and 4-4.**

In addition to the MAGtool analysis, after an aquatic species or a terrestrial species that relies on aquatic dietary items has been given an NE or NLAA determination, EPA conducted an analysis to evaluate sources upstream of a species range or critical habitat that could affect the species. To do this, EPA evaluated monitoring data upstream and downstream of the species range/critical habitat to determine if any detections of the pesticide had occurred. Details of this analysis method are provided in **APPENDIX 4-6** and the analysis used to derive the results in **APPENDIX 4-7.**

# Step 1: No Effect/May Effect Determinations

In Step 1a, a “No Effect” determination is made if a listed species range or its designated critical habitat are outside of the action area. No species or critical habitats met these criteria for glyphosate.

In Steps 1b and 1c, a “No Effect” determination is made for a species and its critical habitat if no effect to a listed species or its PPHD is anticipated based on screening conservative toxicity endpoints against the highest EEC predicted. No species met these criteria for glyphosate.

Overall, “May Affect” (MA) determinations were made for 1795 species and 792 critical habitats. Specific species determinations are provided in **APPENDIX 4-1.** All species given a May Affect determination at Step 1 progressed to the Step 2 analysis where a NLAA or LAA determination is made.

# Step 2: NLAA/LAA Determinations

## Step 2a: Is the species exposure pathway incomplete?

In Step 2a, the assessor considers whether the pathway to pesticide exposure is complete for an individual of a listed species or the taxa upon which it depends (*i.e.,* PPHD). In general, exposures to non-target animals and plants may occur through contact, consumption or inhalation. The pathways of exposure that are relevant to a given pesticide are dependent upon the application parameters and fate properties of a pesticide. An exposure pathway is considered incomplete when there is no reasonable expectation of continuity between the source of pesticide exposure and an individual organism of a listed species. In other words, the exposure pathway is considered incomplete if an individual of a listed species or organisms upon which it depends are not expected to be exposed through contact, consumption or inhalation. When the exposure pathway is incomplete, effects are not reasonably expected to occur. Therefore, a NLAA determination is made for species for which exposure pathways are incomplete.

For glyphosate, three types of species characteristics lead to a conclusion that the exposure pathway is incomplete: species or critical habitat that only occur on uninhabited islands, species that predominantly occur in the open ocean and terrestrial species that only occur in caves. Additional explanation of why the exposure pathway is incomplete for these three types of species habitats is provided in **APPENDIX 4-8**.

When considering the complete list of species, NLAA determinations were made for 45 species because they have incomplete exposure pathways for glyphosate. **APPENDIX 4-1** includes the species for which NLAA determinations are made because of incomplete exposure pathways. Of those species, 6 have ranges that are only on uninhabited islands; 21 species are located in the open ocean and only rely on the ocean for PPHD and 18 species are terrestrial invertebrates that are obligate to caves.

Of the 45 species with incomplete exposure pathways, 16 have designated critical habitats. NLAA determinations are made for the designated critical habitats of species with incomplete exposure pathways (see **APPENDIX 4-1**).

## Step 2b: Is the species most likely extinct?

Species recommended for delisting due to extinction by the Services are presumed extinct and receive a NLAA determination. NLAA determinations are made for these species as exposure from the action is not reasonably certain to occur, and, therefore, effects on the species are not anticipated. Species are only presumed extinct after a recommendation to delist is made by the Services in a review document (*e.g.*, Recovery plan, 5-year review).

The US Fish Wildlife Service has recommended 15 species for delisting due to extinction. NLAA determinations are made for these 8 species because they are presumed extinct (see **APPENDIX 4-1** for the list of species). None of these species have designated critical habitats.

## Step 2c: Is the range of species and resulting overlap considered unreliable?

As described in the Revised Method, in Step 2c, a review of the range data, provided by FWS, was completed for those that followed geopolitical boundaries (*e.g.,* counties or states), rather than natural ones. From that review, in cases where the ranges from ECOS and the field offices’ documentation differ substantially, a quantitative overlap analysis was not conducted and a LAA or a NLAA determination was based on a qualitative weight of evidence analysis.

Nine species were determined to have range data that differed substantially from the data provided in ECOS and as a result the overlap results would be unreliable. The weight of evidence included consideration of the size and unique traits of species range and life history (e.g., exists only in very remote location, etc.) as well as any information from FWS documents on stressors to species (i.e., pesticides) or proximity to potential use sites for glyphosate. Based on this analysis, a NLAA determination was made for 5 species and a LAA determination was made for 4 species, with moderate (3 species) and weak (1 species) evidence to support the LAA determination. The specific species are provided in **APPENDIX 4-1 (“Step 2c Qual - species range” tab)** as well as additional information on the review of the data for each species and the factors considered in making the determinations.

Four additional species were also included in this Step of the analysis as no spatial data were available and these species are considered extirpated based on communication with FWS. NLAA determinations are made for these 4 species (see **APPENDIX 4-1** for the list of species). None of these species have designated critical habitats.

## Step 2d: Are exposure models considered unreliable for assessed species?

At this time, the current exposure models used in this assessment cannot estimate exposures for all types of pesticide applications, all habitat types, or for all potential exposure routes relevant to listed species. Therefore, there may be uncertainty in the exposure values being used for a particular species based on what potential uses its range or critical habitat may overlap with, what type of habitat the species is found in, or what the main potential exposure route(s) might be. For species and critical habitats that have not been determined to be NE or NLAA based on the above analyses, consideration is given to how well the conceptual model of the relevant exposure model(s) matches up with the specific species being assessed. If the model estimates are not considered representative of the exposure of the species (due to an inconsistency in the exposure model and assessed species’ habitat), a qualitative analysis is conducted.

The qualitative analysis considered whether exposures to glyphosate are reasonably certain to occur given the habitat of the listed species (*e.g.,* ocean, beach, and/or freshwater habitats) and, if exposures are expected to occur, are impacts to an individual likely. The analysis also considered the potential for effects to the PPHD of the species and whether those effects would rise to the level of impacting an individual of a listed species. Circumstances that led to a LAA determination include species with an obligate relationship to a prey item that has a LAA determination with high confidence (*e.g.*, the Orca is a listed species that is obligate to listed salmon species) and species that utilize both saltwater and freshwater habitats and may be exposed to glyphosate (*e.g.*, the Western manatee may be exposed in freshwater environments). Circumstances that led to a NLAA determination include:

* marine species that do not have an obligate relationship and whose exposures to glyphosate are reasonably expected to be *de minimus* (e.g., whales that utilize open ocean);
* marine species that also utilize terrestrial environments (on a limited basis), because exposure to glyphosate is not reasonably expected to occur at levels that will impact an individual (*e.g.,* sea turtles and pinnipeds);
* marine species that rely on multiple dietary items because exposure to glyphosate is not reasonably expected to decrease prey populations; and
* terrestrial species that are predominantly located outside of the jurisdiction of the United States because use of glyphosate in the US is unlikely to result in exposure.

When considering the species information and potential for exposures, LAA determinations were made for 2 species and 2 critical habitats and NLAA determinations were made for 45 species and 14 critical habitats. Additional discussion on these determinations is provided in **APPENDIX 4-8**.

## Step 2e: Is the percent of species range/critical habitat that overlaps with the action area less than 1%?

As described in the Revised Method, the effects determination for any listed species or designated critical habitat whose range overlaps <1% with the area of effects, after considering the quantitative analyses, will be a NLAA determination. The cutoff of 1% is based on the precision of the available data. No species or critical habitats met these criteria for glyphosate.

## Step 2f: Based on conservative assumptions, is it likely that less than 1 individual exposed?

Step 2f applies a more refined approach and considers available usage data when identifying the likely portion of a species range where pesticide exposure may occur; different approaches were employed for crop and non-crop uses due to differences in the nature of the available usage data. At this step in the method, the percent overlap analysis becomes a surrogate for the percentage of the population exposed; further description of the methodology is available in the Revised Method. In Step 2, the number of individuals exposed and impacted is considered using the likely exposure area. Additionally, the designation of a species likely being on or off a use site, based on the species life history, is applied at this step. In Step 2f, the maximum PCT and upper distribution of acres in the species range is used to represent the % overlap with the range and the number of individuals likely exposed. This approach is also applied to the critical habitat.

Based on this analysis, no species or critical habitats met these criteria for glyphosate.

## Step 2g/h/i: Weight of Evidence Analysis for final effects determinations

As described in the Revised Method, a weight of evidence analysis was used for any species reaching Step 2 parts g, h and i of the analysis. This included 1675 species and 757 critical habitats. The purpose of the weight of evidence was to consider multiple factors and scenarios in making the effects determination, including various percent crop treated (PCT)/acres distribution scenarios, alternative assumptions for species populations, potential alternative toxicity endpoints as well as typical application rates. Additionally, probabilistic components were introduced into the analysis at this step to allow for the use of distributions of potential EECs and toxicological responses.

In addition to making a NLAA or LAA determination for a species and critical habitat from the analyses, as part of the effects determination a degree of confidence was assigned to each LAA determination. This was denoted as “evidence in the LAA” determination and each species or critical habitat was assigned a weak, moderate or strong evidence in the LAA determination based on multiple factors, including: the impact of using less conservative assumptions in the analysis, the quality of the species range or usage data, impacts to both the species and PPHD as opposed to only one, the presence of reported incidents involving the species taxa or PPHD taxa, the presence of monitoring data that exceeds endpoints, exposure only due to spray drift and the likelihood of drift into a species habitat (*e.g.*, if the species inhabits forests). This is described in more detail in the Revised Method document and in **ATTACHMENT 4-1**. The three strength of evidence categories applied to LAA determinations are not used for NE or NLAA determinations. Given the conservative nature of the Step 1 and Step 2 analysis, EPA is confident that when a NE or NLAA determination is made, there will be no effects to an individual of the assessed species or an individual of a species is not likely to be adversely affected.

One uncertainty noted for some species is that the best available species range data does not accurately reflect where the species is expected to be located. As a proof of concept, an overlap scenario is considered in the weight of evidence for a subset of species based on a more refined analysis of the likely habitat of the species. This included a subset of 126 species, including plants, mammals, birds and terrestrial invertebrates. Under this scenario, the exposure area within the species range for each species is defined as the likely habitat, based on the GAP/Landfire layer[[3]](#footnote-4). NLAA determinations are made for species if the overlap of the action area and the preferred habitat layer is less than 1%, or a NLAA determination is made based on the complete WoE analysis with the habitat layer applied.

The MAGtool technical documentation describes the algorithm used to assign an automated NLAA or LAA determination and the strength of evidence in the LAA and it is also provided for reference in **ATTACHMENT 4-1**. Lines of evidence were considered for each LAA determination in the weight of evidence. These lines of evidence were also reviewed by an assessor when appropriate to allow for individual refinement of the determination, if needed. Additionally, in the output, the contribution of each specific use site to the total number of individuals potentially impacted is provided, as well as other characterization of the effects determinations.

Based on the WoE analysis, a NLAA determination was made for 5 species and no species’ critical habitat and a LAA determination was made for 1670 species and 760 critical habitats (Table 4-3 and Table 4-4). Of these, 126 were evaluated based on the application of the habitat layer as described above. NLAA determinations were made for 1 of the species based on an overlap of the action area (to the fullest buffer extent) of <1% after the application of the habitat layer and 2 species after the weight of evidence analysis. Of the remaining 123 species, all 123 were still found to be LAA, predominantly with moderate evidence of risk. The overall determination or strength of evidence did not change for most of these species when compared to the analysis without the habitat layer, but the number of individuals predicted to be impacted tended to decrease. With the application of the refined habitat layer, although the number of individuals that could be impacted may be reduced, there is greater confidence in the effects determination due to the restriction of the range to the habitat layer. The application of habitat layers and evaluating their impact on the confidence in LAA determinations will be further developed in the future. Specific species results are provided in **APPENDIX 4-1.**

For the strength of evidence of each LAA determination, the majority of species were found to be in the moderate evidence of LAA. LAA determinations were distributed across all taxa. Additional details on the distribution of the strength of determinations as well as additional characterization of the effects determinations is provided in Tables 4-5 thru 4-8 below.

**Table 4-5. Distribution of LAA Determinations Across Evidence Classes for Species Range and Critical Habitat.**

|  |  |  |
| --- | --- | --- |
| **Strength of determination of LAA** | **Species range** | **Critical Habitat** |
| **Number** | **% of LAA determinations** | **Number** | **% of LAA determinations** |
| Strongest evidence of LAA | 1 | <1% | 6 | <1% |
| Moderate evidence of LAA | 1605 | 96% | 733 | 97% |
| Weakest evidence of LAA | 70 | 4% | 20 | 3% |

**Table 4-6. Distribution of LAA Determinations Across Taxonomic Groups for Species Range.**

|  |  |  |
| --- | --- | --- |
| **Taxa** | **Strength of evidence of LAA (counts)** | **Strength of evidence of LAA (%)** |
| **Strong** | **Moderate** | **Weak** | **Total** | **Strong** | **Moderate** | **Weak** |
| Mammals | 0 | 67 | 8 | 75 | 0% | 89% | 11% |
| Birds | 1 | 71 | 16 | 88 | 1% | 81% | 18% |
| Amphibians | 0 | 34 | 2 | 36 | 0% | 94% | 6% |
| Reptiles | 0 | 29 | 4 | 33 | 0% | 88% | 12% |
| Fish | 0 | 176 | 3 | 179 | 0% | 98% | 2% |
| Plants | 0 | 940 | 0 | 940 | 0% | 100% | 0% |
| Aquatic Invertebrates | 0 | 171 | 14 | 185 | 0% | 92% | 8% |
| Terrestrial Invertebrates | 0 | 117 | 23 | 140 | 0% | 84% | 16% |

**Table 4-7. Additional characterization of LAA and NLAA determinations.**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **LAA based on Max Upper only?** | **LAA with no impacts by alternative analysis?** | **LAA based on drift only?** | **LAA based on indirect effects only?** | **LAA based on one use only?** | **NLAA with low population (<100)?** |
|
| 0 | 472 | 0 | 52 | 14 | 2 |

**Table 4-8. Impact of all UDLs on LAA effects determinations.**

|  |  |  |
| --- | --- | --- |
| **UDL1** | **Number of times UDL predicted to impact a species2** | **Rank** |
|
| **CONUS** |
| CONUS\_Noncultivated | 1085 | 1 |
| CONUS\_Open Space Developed | 987 | 2 |
| CONUS\_Right of Way | 899 | 3 |
| CONUS\_Forest Trees | 851 | 4 |
| CONUS\_Developed | 840 | 5 |
| CONUS\_Pasture | 803 | 6 |
| CONUS\_CRP | 772 | 7 |
| CONUS\_Fallow | 574 | 8 |
| CONUS\_Bermuda Grass | 451 | 9 |
| CONUS\_Corn | 402 | 10 |
| CONUS\_Wheat | 331 | 11 |
| CONUS\_Other Grains | 308 | 12 |
| CONUS\_Soybeans | 238 | 13 |
| CONUS\_Other Crops | 230 | 14 |
| CONUS\_Cotton | 206 | 15 |
| CONUS\_Other Orchards | 195 | 16 |
| CONUS\_Vegetables and Ground Fruit | 192 | 17 |
| CONUS\_Other Row Crops | 107 | 18 |
| CONUS\_Nurseries | 99 | 19 |
| CONUS\_Grapes | 87 | 20 |
| CONUS\_Citrus | 55 | 21 |
| CONUS\_Xmas Tree | 31 | 22 |
| CONUS\_Rice | 14 | 23 |
| **NL48 Layers** |
| NL48\_Noncultivated | 613 | 1 |
| NL48\_Forest Trees | 565 | 2 |
| NL48\_Right of Way | 474 | 3 |
| NL48\_Developed | 436 | 4 |
| NL48\_Open Space Developed | 295 | 5 |
| NL48\_CRP | 195 | 6 |
| NL48\_Pasture | 169 | 7 |
| NL48\_Ag | 30 | 8 |
| NL48\_Nurseries | 11 | 9 |
| 1 List does not include Aquatic Herbicide layer. This layer has overlap with all aquatic species and impacts to these species based on this use are anticipated.2 Counts terrestrial and aquatic impacts separately, one species could be impacted twice by same use in both terrestrial and aquatic environment3 NL48\_Ag layer also represents the NL48 Fallow layer |

The number of and strength of LAA determinations found for glyphosate is expected given the action area of the chemical and the toxicity profile. Glyphosate is an herbicide with a large number of uses and roughly 280 million pounds are applied to crops, and 21 million pounds are applied to non-agricultural sites each year. Non-agricultural UDLs, including Non-cultivated, Open Space Developed, Right of Way, Forest Trees and Developed were the most frequent UDLs predicted to impact a species, although numerous other non-agricultural and agricultural UDLS may also impact species as shown in Table 4-8.UDLs listed in Table 4-8 do not include the Aquatic Herbicide layer, which has overlap with all species and represents direct applications to water. All species that utilize water bodies where aquatic applications are made may also have potential impacts from this use, in addition to the use layers listed in Table 4-8 above.

Due to the lack of availability and uncertainty in usage data associated with non-agricultural use sites, strength of evidence was moderate at best when these uses were the main contributors to risk, reflected in the 96% and 97% of LAA effects determinations associated with moderate evidence. Glyphosate also has toxicity across multiple taxa, in particular to plants, which may contribute to it having toxic effects to a listed species as well as its PPHD. Although each species analysis is unique, these factors may help to explain the general trend seen in the data of many species with a LAA determination. Four percent or fewer of species and critical habitats were associated with strongest or weakest evidence of risk.

Summary results for the species determinations are contained in **APPENDIX 4-1 (‘Summary’ tab)** and are denoted as either “TerrWoE”, “AquaWoE” or “TerrWoE and AquaWoE” as the source of the effects determination. Additional worksheets in **APPENDIX 4-1** include total determination counts for species and a key to file locations for each species. Detailed weight of evidence output for all species are located in **APPENDIX 4-9**, organized according to the file key in **APPENDIX 4-1**.

# Upstream Monitoring Data Analysis

As previously discussed, as part of the analysis any species that was classified as a NE or NLAA, was reviewed to ensure that no sources upstream of a species range or critical habitat would affect the species. To do this, EPA evaluated the monitoring data with regards to the location to the species range/critical habitat (*e.g.,* upstream or downstream) to determine if any detections of the pesticide had occurred. Only monitoring sites upstream of or in the species range/critical habitat were considered relevant for the downstream transport analysis, as there is uncertainty in the downstream monitoring sites as to where the pesticide originated (*i.e.*, was pesticide used in the species range/critical habitat, or outside where the species would not be exposed).

Results of the analysis are described in **APPENDIX 4-6.** As no aquatic species or critical habitat determinations were NLAA or NE based on quantitative analysis, no effects determinations were revised based on the monitoring data analysis.

# Additional Characterization of Effects Determinations, Uncertainties and Refinements

These effects determinations were developed based on refinements to the methods for evaluating risks to listed species, such as inclusion of usage data and probabilistic modeling. There are several areas of the analysis that could be further refined to increase confidence in the effects determinations. See **Attachment 4-1** for details on how these uncertainties influence the confidence of the effects determinations. Any refinements in the following areas would potentially increase the EPA’s confidence in the LAA determinations:

* Resolution of spatial data. There are uncertainties in the spatial footprint associated with the non-agricultural uses of glyphosate and there are limited data available to inform the extent of usage in any given area for these types of uses. Specific layers that would particularly benefit from refinement include the Noncultivated and Aquatic Herbicide layers, which are wide ranging and impact a large number of species. Another important uncertainty is that the available range data for some listed species are at the sub-county level, with boundaries that are biological in nature, while others follow geopolitical boundaries, such as county or state lines. Species with overly broad ranges that include habitats the species would not utilize lead to uncertainties in effects determinations.
* Resolution of usage data. Usage data are available at the state, region, or national level while species’ range or critical habitat information or at the sub-state level. To address the difference in scale, we made several assumptions with respect to where pesticide-treated acres could occur relative to a species’ habitat (*e.g.,* all treated acres occur within the habitat, evenly dispersed throughout the state, or primarily outside of a species habitat).
* Threshold for assessing impacts on prey, pollination, habitat, dispersal (PPHD) of a species. There are uncertainties associated with the magnitude of impact to a particular species’ prey base or habitat for a given pesticide that could result in a discernible effect to that listed species.
* Non-agricultural use rates. For some non-agricultural uses, the single application rates were calculated at rates up to 40 lbs a.e./A. These higher rates of 40 lbs a.e./A are calculated by extrapolating up from a smaller area as is expressed on the label. These rates were interpreted to be relevant for a wide variety of non-crop areas where total vegetation control is desired. These calculated rates were selected for modeling and may be a potential area for label refinement in the future.
* Formulation toxicity. Surfactants, including the polyethoxylated tallow amines (POEA), are often included in formulations and some have been shown to be more toxic to aquatic animals than glyphosate alone. The potential increased toxicity of formulations is considered through the selection of toxicity endpoints. Clarification of formulation labels could present an opportunity to refine some aspects of toxicity endpoint selection.

This assessment considers available toxicity and monitoring data to characterize the risk of glyphosate to listed species. Additional characterization associated with glyphosate specifically include:

* Toxicity endpoint selection. Some data sets had a large amount of toxicity data, while for other taxon, data was sparse. When data was sparse, conservative assumptions were made based on the available data for the taxon. Toxicity can also vary widely between formulations, and conservative assumptions were made in choosing toxicity endpoints. As a consideration of other toxicity data, an alternative less conservative assumption was made and included as part of the alternative analysis scenario. The results of the alternative analysis should be considered when evaluating the uncertainty and potential outcomes of the analysis due to the variability in the available toxicity data, as well as the influence of other input parameter assumptions (*i.e.,* application rate, population size, etc.).
* Formulation vs. technical grade toxicity data. The use of toxicity data based on glyphosate formulations can have a considerable impact on predicted effects due to the difference between toxicity values for formulated and technical glyphosate. For many taxa, this impact is captured in the alternative analysis using endpoints for technical glyphosate.
* Monitoring data. There is a significant body of monitoring data available for glyphosate. Effects determination were made based largely on the results of modeling. Monitoring data was considered as part of the weight of evidence and in the determination of an NE or NLAA (any NE or NLAA determinations are screened for the presence of monitoring data before that effects determination was made; however, no species matched this criteria for glyphosate). Monitoring data results are included in the weight of evidence output for each aquatic species.

# Conclusions

For 1795 listed species, including endangered, threatened, candidate, proposed species, and experimental populations; and 792 designated critical habitats, a NE, NLAA or a LAA determination was made for glyphosate. The weight of evidence for each LAA determination was also characterized as either strongest, moderate, or weakest. All of Steps 1 (parts a-c) and 2 (parts a-i) were applied for the majority of listed species and critical habitats.

No NE determinations were made for any species or designated critical habitats. NLAA determinations were made for 119 species and 33 species’ critical habitat and LAA determinations were made for 1676 species and 759 critical habitats. Approximately 93% of all species and 96% of all critical habitats were given a LAA determination and these species were distributed across all taxa. Of those LAA determinations, <1% were considered to have strongest evidence, 96% were considered to have moderate evidence, and 4% were considered to have weakest evidence for species and <1% were considered to have strongest evidence, 97% were considered to have moderate evidence, and 3% were considered to have weakest evidence for critical habitat. Non-cultivated, Open Space Developed, Right of Way, Forest Trees and Developed UDLs were the use sites most frequently associated with impacts to species or critical habitats with LAA determinations. The Aquatic Herbicide UDL has overlap with all species ranges and critical habitats and species that utilize water bodies where aquatic applications are made may also have potential impacts from this use.

1. Available online at: <https://www.epa.gov/endangered-species/revised-method-national-level-listed-species-biological-evaluations-conventional> [↑](#footnote-ref-2)
2. Available online at: <https://www.epa.gov/endangered-species/models-and-tools-endangered-species-pesticide-assessments> [↑](#footnote-ref-3)
3. U.S. Geological Survey Gap Analysis Program, 20160513, GAP/LANDFIRE National Terrestrial Ecosystems 2011: U.S. Geological Survey: Boise, ID, <https://www.sciencebase.gov/catalog/item/573cc51be4b0dae0d5e4b0c5>. [↑](#footnote-ref-4)