Appendix D

MagTool Manual

This is an Environmental Protection Agency document, edited by the U.S. Fish and Wildlife Service to reflect updates regarding methodology for mosquito control.

MAGtool - Conceptual Model Design

The Magnitude of Effect tool (MAGtool) is a provisional model[1] created by the USEPA to assist in the determination of the magnitude of the effect of potential pesticide use to a listed species on a population scale. The MAGtool uses the results generated in the Step 2 Biological Evaluation (BE) analysis to carry forward into the Step 3 population-level analysis for multiple lines of evidence, including mortality, growth, reproductive, behavioral and sensory effects. Using dose response relationships, the MAGtool predicts the magnitude of mortality for exposed individuals within a population. These individual mortality predictions are combined with information on the percent overlap of specific use sites with the species range and/or critical habitat to predict the percent mortality predicted in the population, using the percent overlap of specified pesticide use sites with the species range and/or critical habitat as a surrogate for the percent of population exposed. Adjustments can be made to the percent of population exposed depending on species and use characteristics, as well as limiting the specific use sites included in the analysis. Potential population impacts due to sublethal effects are made based on estimated exposure concentrations (EECs) exceeding sublethal toxicity input parameters and the percent of population exposed to these EECs.

These principles are further described below in the terrestrial and aquatic MAGtool sections. A brief description of the worksheets contained in the Excel workbook is provided at the end of the document (Attachment 1).

Geospatial Overlap Analysis

Methods for identifying potential pesticide use sites using USDA National Agriculture Statistic Service (NASS) Cropland data layer (CDL) for agricultural uses and other data sources for non-agricultural uses are outlined in the Problem Formulation and Attachment 1-3 (Method for Establishing the Use Site Footprints of the Biological Evaluations) of the BEs (https://www.epa.gov/endangered-species/biological-evaluation-chapters-malathion-esa-assessment). Using this methodology, the intersection of the species geospatial range and/or critical habitat with relevant use sites for the pesticide is used to determine a "percent overlap". Major differences between the spatial analysis in the BEs as compared to the analysis used in the provisional MAGtool model are discussed here.

One primary difference between the Step 2 and Step 3 overlap analysis is that the individual years of CDL data (2010-2015), summarized to the general agricultural classes, were used in Step 3 as opposed to the temporally aggregated general class layers which were utilized in Step 2 (non-agricultural layers stay the same from 2010 to 2015). This allows for the calculation of percent mortality and a distribution of anticipated effects by individual use footprint for each year. One exception for the MAGtool is the calculation of spray drift impacts based on Euclidean distance (described below), which was still based on the aggregated use layers utilized in Step 2. Yearly overlap can only be created for use layers derived from data sources updated on a yearly time step; at this time this only applies to those layers generated from the USDA NASS CDL. The CDL is limited to the contiguous United States (lower 48), so the MAGtool is only used for species with ranges in the lower 48. For this reason, results from the MAGtool only represent the area of the species files found within the contiguous United States. The area of the

[1] As a provisional model, the MAGtool is still undergoing internal QA/QC at the USEPA.

species files found partially or completely outside the lower 48 cannot be fully analyzed using the MAGtool. The results from the BE describing the overlap for the full range or critical habitat, based on the aggregated layers is available in the tool. Buffered and drift results are also based on the aggregated layers and the full range or critical habitat file.

Another addition in the MAGtool geospatial analysis is the use of Hydrologic Unit Code areas at the 12-digit scale (HUC 12s) to spatially define aquatic species. Using the species locations files provided by the Services, all intersecting HUC 12s are identified and used as the master species location file. When instructed by the Services, the master file was not replaced with the HUC 12 intersection; this occurred typically for species with both terrestrial and aquatic phases or primarily marine species. When the master species file is not based on HUC 12s, the reported overlap from the BE may not match the HUC 12 overlap from the MAGtool.

Finally, in order to predict species impacts due to off-site transport, the "Euclidean distance" is used to determine the proportion of the species range within each desired distance interval from a use site. The use site may be within the species range or outside the species range. Euclidean distance, or the shortest distance between two points, is defined in GIS modeling as the distance from center point of one pixel (e.g. location within the species range) center point of another pixel (e.g. the location of pesticide use in a raster map). These distances are projected off-site and are used to describe how overlap from spray drift intersects with a species range. At each incremental distance off site (set at 30 m), the % overlap with the species range is determined. The use of Euclidean distance in combination with predicted off-site EECs to predict off-site effects is discussed further in "Spray Drift Effects – Incorporating Euclidean distance overlap with EECs to predict mortality" section below. Examples of Euclidean distances are shown in Figure 1, below.

	108	94	90	94	108	
108	84	67	60	67	84	108
94	67	42	30	42	67	94
90	60	30	Use	30	60	90
94	67	42	30	42	67	94
108	84	67	60	67	84	108
	108	94	90	94	108	

Figure 1. Euclidean distance off-site transport "rings" as determined for use in the MAGtool.

Bulleted below are some additional points to consider in the interpretation of the overlap analysis in the MAGtool.

- When predicting overall mortality in an exposed population, the tool provides predicted mortality from individual use layers as well as the mortality output of all of the individual use layers for each year combined. When summing the individual results, total overlap may exceed 100% when individual uses overlap one another, even without considering uses such as Mosquito Control, which can occur in the same areas as other agricultural and non-agricultural use sites. , The extent to which individual use layers overlap one another nationally is provided in Attachment 2 and should be considered when interpreting results. Overall, the total percent overlap cannot exceed the percent overlap of the action area. Likewise, low overlap for an individual use may not indicate low overall spatial overlap of uses with the species range (*i.e.,* all uses should be considered).
- Given that all use layers are rasters comprised of square pixels, the overlap of the species and use site may include edge effects, potentially resulting in greater than 100% overlap. The boundaries of the species range files are irregular and do not follow the straight lines and right angles of square. If you were to place a circle on top of a square with the diameter of the circle equal to the edge of the square pixel, the square will cover more area in the four corners. When running a raster analysis that is based on square pixels, the total area may exceed the area of a range that does not have right angle edges, resulting in greater than 100% overlap.
- Euclidean distances, as utilized in ArcGIS, calculate the distance based on the distance from the center point of the use cell to center point of that cell, accounting for diagonal movement. Therefore, as shown in Figure 1 above, the distance for cells not on a straight line to the use cell, will actually be more than 30 m because it lies on a diagonal line. For the purposes of the MAGtool, the overlap "ring" is based on in which interval this distance value falls. For the figure above, the green squares fall in the >0– 30 m, the blue squares in the 31-60 m, the orange squares in the 61-90 m, etc. The use of a 30 m increment is arbitrary in this sense; it could be established at 20, 50, 100 or any other meter increment.
- Euclidean distance "rings" extend out from all use sites. If a ring from one use site encounters the ring from a different use site, the minimum distance to use is assigned as the distance value for that cell. The proportion of the species range found in each ring is represented by the % overlap at each distance interval, which for the purpose of the MAGtool is set to 30 meter increments. These distance intervals are mutually exclusive from each other. This % overlap is used in combination with the predicted EEC at that off-site distance to determine anticipated species impacts, as described further below.
- Buffered overlap (used predominantly in Step 2) is calculated using the Euclidean distance of the aggregated use layers and includes the use sites and spray drift, out to the limits of the drift models, for the specific use application method. The full species range is used in this calculation, the area within and outside the lower 48.
- Spray drift overlap is calculated using the Euclidean distance of the aggregated use layers with the interval set to 30 meters and represents the overlap unique to the interval. The full species range is used in this calculation, the area within and outside the lower 48.

Terrestrial MAGtool

The Terrestrial MAGtool is based on the output from the TED tool (https://www.epa.gov/endangered-species/provisional-models-endangered-species-pesticide-assessments#Terrestrial) which is embedded in the model and yearly use overlap data for the species range, as discussed above. Output from the TED tool used in Step 3 includes the dietary- and dose-based EECs for animals in order to make dose response predictions and comparisons to sublethal effects. In addition, output from the TED tool plant analysis is utilized. The Terrestrial MAGtool allows multiple user-defined effects endpoints (up to 5 for animals and up to 3 for plants) for use in making effects predictions. The methodology for calculating output for animals and plants is described below.

Animals

1. Using all the uses with direct overlap from the species range or critical habitat based on the Step 2 analysis, EECs for each dietary item relevant to the species for each specified use layer and labeled use rate are calculated for the species. The user defines if mean or upper bound EECs are to be used in the calculation.
2. Based on user-defined toxicity endpoints specified on input tab, the magnitude of mortality is predicted for each dietary item and each specified use and application rate.
3. The percent overlap of the species range or critical habitat for six individual CDL years (2010 - 2015) is multiplied by the predicted percent mortality for each year/use/dietary item.
4. Predicted percent mortality for each use for each year is aggregated to determine the percent mortality associated with species exposure to the pesticide.
5. A distribution is developed using the 6 years of CDL data and static non-ag use layers. These are reported at each 5th percentile level based on the calculated aggregated mortality for each year and the 50th and 95th percentile values for mortality for each dietary item and each endpoint and are reported on the Step 3 output page.
6. Calculations are done based on dose-based and dietary-based toxicity endpoints. Dose-based endpoints are adjusted for the weight of the species of interest prior to mortality calculations.
7. For indirect effects to animals, the same methodology is used, applying the user-defined endpoints specified for taxa associated with the species for indirect effects (*e.g.,* prey items).
8. For sublethal effects, EECs are compared to user-defined endpoints to determine exceedances of endpoints for each use and is defined in the key on the Step 3 sheet under outputs.
9. In addition, the user is able to enter the number of days of exposure in the inputs, and a distribution of results is created based on the number of days the sublethal endpoint is exceeded and the population exposed.
10. The same analysis is completed for the critical habitat. Detailed results of the analysis are found in the TerrResults and TerrResultsCH sheets.
11. Direct effects due to spray drift are also calculated based on predicted morality and percent overlap of species range with the use site at 30-meter increments (described above in "Spray Drift effects based on predicted mortality due to drift and % overlap").

Plants

The Step 3 analysis for plants utilizes information from the plants analysis in the TED tool and overlap data similar to the Step 2 analysis. The differences between Step 2 and 3 for plants is the MAGtool applies the specific labeled application rate for each use that is relevant to the species, rather than the general minimum/maximum use rates applied in Step 2. In addition, percent overlap for each individual year is reported and additional predictions on percent mortality to biotic pollinators and diaspore dispersal vectors on site and at 30-m distances off site are provided.

Exceedance at the site of application is determined by a comparison of the toxicity endpoint to the single application rate, both in units of lb a.i./A. Runoff to dry and semi-aquatic areas and spray drift calculations are reported based on the results of the TED tool (which uses principles for runoff calculations from TerrPlant[2]). These analyses are conducted for all uses that have direct overlap with the species range or critical habitat. For indirect biotic effects, the same analysis as described above under "animals" is used to predict effects to pollinators and diaspore dispersal vectors (birds, mammals and terrestrial invertebrates) on site. In addition, indirect biotic effects due to spray drift are also calculated based on predicted morality and percent overlap of species range with the use site at 30-meter increments (described below in "Spray Drift effects based on predicted mortality due to drift and % overlap").

Aquatic Magtool

Aquatic Fish and Invertebrates

The Aquatic MAGtool uses many of the same concepts as the Terrestrial MAGtool, with adjustments made for exposure in the aquatic environment. Species ranges for aquatic fish, invertebrates, and plants were determined based on HUC 12s which contain the waterbodies associated with the species. The percent overlap is determined for each HUC 12 in the species range with each of the non-ag and yearly ag use sites and is used to adjust the percent of a species population that may be exposed to EECs from that use, or as a means to adjust the EECs for medium and large flowing waterbodies. The 30 annual maximum daily or period (*e.g.*, 4-day, 21-day, or 60-day) average EECs for each Pesticide in Water Calculator (PWC) run for a use are used to simulate the range of exposure concentrations to which the species could be exposed. While the PWC runs are conducted at the larger 2-digit HUC level (HUC 2), HUC 12s are subsets of the HUC 2s and the HUC 2 EECs are intended to represent exposure within the HUC 12 species ranges . All of this information, coupled with the effects endpoints of interest, is used to estimate a distribution of exposure and effects to the species population.

Different methods are used for species depending on if they are in flowing or static waterbodies and if they are in single or multiple HUC 12s.

For static waterbodies and low-flow flowing waterbodies (Bins 2 and 5-7; described in Attachment 3-1 of BEs, https://www.epa.gov/endangered-species/biological-evaluation-chapters-malathion-esa-assessment), pesticide loading is assumed to be from local uses (e.g. adjacent fields) and exposure, therefore, will be associated with specific uses within the HUC 12. For the medium and large-flow flowing waterbodies (Bins 3 and 4), pesticide exposure is associated with transport from all uses within an entire watershed (represented in this case the HUC 12). For the static and low-flow flowing waterbodies, the percent overlap was used, as it was in the terrestrial version of the tool, as a surrogate for percent of the species exposed to a use's EECs. For medium and high-flow flowing waterbodies, the EECs were adjusted using the percent overlap, much as a percent crop area adjustment factor would be used, and summed to develop an EEC to which the entire population in the HUC 12 would be exposed.

For a species range which is limited to a single HUC 12, the entire species population is exposed to EECs associated with that HUC 12. For a species range that spans multiple HUC 12s, it is uncertain how much of the species population is associated with each of the HUC 12s. The user can assume a uniform

[2] https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/terrplant-version-122-users-guide-pesticide-exposure

distribution of the species throughout the species range. In this case, the fraction of the area of a HUC 12 in the species range is used as a surrogate for the fraction of the population in the HUC 12. The user can alternatively assume a non-uniform distribution across the HUC 12s. The user may have information on the species' distribution within the range that can inform a species' distribution within their range, including: meta-populations, age cohorts, and other life history characteristics. In these cases, the user will need to specify the percent of the population associated with each HUC 12 in the species range.

Below is a more detailed description of the methodology used to estimate the probability distributions for mortality and sublethal effects for species assumed to have a uniform distribution across the HUC 12s.

For species in static waterbodies and low-flow flowing waterbodies (Bins 2 and 5-7) with a range limited to a single HUC 12:

1. An estimate of the pesticide use footprint within the single HUC 12 watershed corresponding to the species range is developed using the 6 annual summaries of general CDL use site classes and non-ag use sites.
2. The percent mortality is estimated using 30-year annual maximum daily or 4-day average EECs for the uses in the HUC 12. For sublethal endpoints, the 30-year annual maximum daily, 4-day, 21-day, or 60-day average EECs are used for the uses in the HUC 12 to estimate the percent of the population exposed to an EEC that may meet or exceed the sublethal endpoint (exposure periods should be selected that most accurately reflect the duration of study from which toxicity endpoint are derived). If an EEC meets or exceeds the sublethal endpoint, the entire population exposed to that EEC is exposed to an EEC that meets or exceeds the sublethal endpoint. Otherwise, none of the population is exposed.
3. The percent mortalities and sublethal exceedances are adjusted using the 6 CDL percent use footprints. This results in 180 values (30-year annual maximum values x 6 different CDL percent use layers) for each use.
4. For each year/percent use combination, the percent mortalities and percent meeting or exceeding the sublethal effects are summed across the uses to estimate the effects to the entire population. This results in 180 values for the HUC 12, which is used to develop a probability distribution for the entire population.

For species in static waterbodies and low-flow flowing waterbodies (Bins 2 and 5-7) with a range larger than a single HUC 12, the same process, as discussed above, is used, except each HUC 12 is assigned a weight based on the acreage of the HUC 12 in relation to the entire range. The same steps as discussed above are applied along with:

1. The percent mortalities and percent meeting or exceeding the sublethal effects across uses for each HUC 12 is multiplied by the fraction of the population in the HUC 12 to estimate the effects to the subpopulation in the HUC 12. This results in 180 values for the HUC 12, which is used to develop a probability distribution for the subpopulation in the HUC 12.
2. To determine the population effects distribution across the entire range (all HUC 12s combined), for each year/percent use combination, the weighted percent mortalities and percent meeting or exceeding the sublethal effects are summed across uses for each of the HUC 12s above to

estimate the effects to the entire population. This results in 180 values for the species range, which is used to develop a probability distribution for the species population.

For species in medium and high-flow flowing waterbodies (Bins 3 and 4) that have a range limited to a single HUC 12:

1. The individual use footprints within the single HUC 12 watershed corresponding to the species range is estimated using the 6 annual summaries of generalized CDL classes and the non-ag use site.
2. The 30-year annual maximum daily or 4-day average EECs are adjusted for the medium and high-flowing waterbodies (Bins 3 and 4) for each use in HUC 12 based on percent use area. For sublethal effects, the 30-year annual maximum daily, 4-day, 21-day, or 60-day average EECs for each use in the HUC 12 are adjusted based on the percent use area.
3. The adjusted EECs are aggregated.
4. Assuming the entire population in HUC 12 is exposed to the aggregated EEC, the distribution of percent mortality for the population using dose response curve and probability of meeting or exceeding a sublethal endpoint is determined using aggregated EECs in the HUC 12 for each year.

For species in medium and high-flow flowing waterbodies (Bins 3 and 4) that have a range larger than a single HUC 12, the same process, as discussed above, is used, except each HUC 12 is assigned a weight based on the acreage of the HUC 12 in relation to the entire range. The same steps as discussed above are applied along with:

1. The percent mortality is multiplied by the percent of the population in HUC 12. This is repeated for the probability of exceeding a sublethal endpoint.
2. The results from Step 2 are summed to determine the percent mortality/probability of exceeding sublethal effect for total population.

Results for exposures resulting from Mosquito Control were calculated by separate runs of the MAGtool. This use can occur in the same areas as other use sites on the landscape, resulting in substantial overlap. As a result the MAGtool could readily produce difficult to interpret results (e.g. >100% mortalities).

Spray Drift Effects – Incorporating Euclidan distance overlap with EECs to predict mortality

Aquatic

The Aquatic MAGtool employs the same algorithm used in AgDRIFT to estimate aquatic EECs resulting from spray drift only. The tool estimates the drift across the waterbody width at 30-meter distances away from a treated field. The product of this average drift and the application rate, divided by the depth of the waterbody, results in a short-term average concentration in the waterbody due to spray drift. This concentration is then used to estimate the percent mortality that could potentially occur in a waterbody exposed to spray drift. Unlike the terrestrial tool, no application of percent overlap from the Euclidean distance is applied to the aquatic EECs.

Attachment 1. MAGtool tab descriptions

Terrestrial MAGtool tab descriptions

README – Provides general instructions and list of updates made to tool.

Step 2 File Generator – Used to load the Chemical input parameters for Step 3 (cell D1). All other parts of page used in file generation for Step 2.

Step 3 multi species – Provides summary information for whatever animal species that has just been run in table format in one line. Allows information to be copied and create a running list of summary output with one line per species.

Step 3 summary – Provides summary information for whatever animal species that has just been run in sentence format on mortality, sublethal, indirect and spray drift impacts.

Terr MAGTool Output – Input and Output summary table including 5, 50 and 95% percentile results.

Step 3 Animal – Output page for Step 3 animal analysis

Step 3 Animal_CH – Output page for Step 3 critical habitat analysis

Animal Step 2 WoE – Step 2 matrix and WoE results for animal species

Step 3 Plant multi species, Step 3 Plant and Plant Step 2 WoE – Same as above, except for plants instead of animals

TerrRESULTS – Detailed calculations used to produce output including magnitude of mortality, yearly percent overlap for individual uses and adjustments for species range

TerrRESULTS_CH – Detailed calculations used to produce output including magnitude of mortality, yearly percent overlap for individual uses and adjustments for critical habitat

Inputs (TEDtool) – Inputs used for TEDtool calculations; includes the “minimum” and “upper bound” rates used in Step 2 to generate “minimum” and “maximum” results, respectively

6 year mean – Mean overlap of each species range with each use site for 6 years of CDL data

CDL_L48_2010 thu 2016 – Percent overlap of use site with each species range for each CDL year

CDL_CH_L48_2010 thu 2016 – Percent overlap of critical habitat with each species range for each CDL year

Plants (TEDtool) – Plant output for TEDtool analysis

Aquatic dependent sp thresholds (TEDtool) - Thresholds for aquatic-dependent vertebrate species; dietary based thresholds/endpoints for each line of evidence converted to concentration in ug/L based on BCF or BAF as specified in inputs

aquatic organism tissue concs (TEDtool) – Predicted tissue concentrations of aquatic organisms based on BCF and range of aquatic concentrations

Min/Max rate concentrations (TEDtool) – upperbound and mean EECs in various dietary items based on minimum and maximum application rates specified in inputs page

Min/Max rate - dietary conc results (TEDtool) - number of exceedances of thresholds and endpoints for upperbound and mean EECs based on minimum and maximum application rates specified in inputs page

Min/Max rate doses (TEDtool) - For all vertebrate species, dose based dietary EECs for each dietary item as well as dose based drinking water, dermal and inhalation exposure. Also includes spray drift distance to thresholds, thresholds expressed as individual dose based values and factor difference between max dose and thresholds

All sheets with "(2)" denotation in sheet name [*e.g.,* inputs (2), Plants (2)] – replicates of TED tool sheets above, but for additional applications rates ("alt" rates) used in Step 2 analysis (maximum single and maximum multiple application rate used in Step 2 to generate "minimum" and "maximum" results, respectively)

All aq thresholds – Aquatic thresholds used in the Step 2/3 Aquatic tool, this sheet is updated for chemical specific data when inputs are loaded

CDL Use Rates – Application rates, number of applications, retreatment interval and application method for CDL layers, this sheet is updated for chemical specific data when inputs are loaded

Species Summary – Peak maximum and minimum daily values for each species, each bin and each use modeled, this sheet is updated for chemical specific data when inputs are loaded; all HUC 2s with overlap with species range were modeled, colored cells represent EECs filtered only for those uses that have direct overlap with species range

listed species info MASTER – Contains animal species information including species IDs, dietary items, terrestrial or aquatic habitats and obligate relationships

Spray Drift – Used in Step 2, contains spray drift distances based on the minimum and upperbound application rates for each threshold for each line of evidence for aquatic bins

Spray Drift_Alt - Used in Step 2, contains spray drift distances based on the maximum single and maximum multiple application rate for each threshold for each line of evidence for aquatic bins

PercentOverlap_CDL – Used in Step 2, contains the aggregated data layers for 6 years direct overlap with species range; columns with orange headers have been filtered to only show layers relevant to the chemical in question (based on data in input tab for relevant use layers)

PercentOverlap_CDL_CH – Used in Step 2, contains the aggregated data layers for 6 years direct overlap with critical habitat; columns with orange headers have been filtered to only show layers relevant to the chemical in question (based on data in input tab for relevant use layers)

PercentOverlap_CDL_Buff – Used in Step 2, contains the aggregated data layers for 6 years direct overlap with species range buffered out for aerial spray drift (2600 ft; yellow columns); columns with orange headers have been filtered to only show layers relevant to the chemical in question (based on data in input tab for relevant use layers)

PercentOverlap_CDL_CH_Buff – Used in Step 2, contains the aggregated data layers for 6 years direct overlap with critical habitat buffered out for aerial spray drift (2600 ft; yellow columns); columns with orange headers have been filtered to only show layers relevant to the chemical in question (based on data in input tab for relevant use layers)

Species Information – Plant species information including taxonomic grouping, FWS regions, obligate relationships and habitat descriptions

Pollination Mechanisms – Plant pollination mechanisms

Diaspore Dispersal Mechanisms – Plant diaspore dispersal mechanisms

Habitat – Indicators if plant habitat is terrestrial or aquatic or wetland

Obligate Relationships –Plant obligate relationships

Elevation restriction – Plant elevation restriction data, if available

Draft – Habitat Groups – FWS plant habitat groups

Eucl Dist Overlap – Raw data on percent overlap of use sites with species range at 30 m Euclidean distance intervals

MAX/MIN Spray Drift EEC and Mort – Predicted mortality for each use site at 30 m Euclidean distance intervals based on % overlap at each increment and individual dietary items

MAX/MIN Spray Drift EEC and Mort Plants – Same as above but pertains to indirect effects to biotic pollinators for plants (insects, birds and mammal)

Spray Drift by Distance – Upperbound and Mean EECs in various dietary items based on minimum and upperbound application rates (as specified in inputs tab) at 30 m increments

SD Dose by Distance Min/Max - – Upperbound and Mean EECs in various dietary items on a dose basis for all vertebrate terrestrial animals; based on minimum and upperbound application rates (as specified in inputs tab) at 30 m increments

Aquatic MAGtool tab descriptions

Tabs listed below are only those that are found within the AquaMAGtool that were not described above in the Terrestrial MAGtool.

Step 3 - Output page for Step 3 aquatic animal analysis

Every HUC12 input – Sheet designated to allow user to list specific HUC12s to run in species analysis

Output distributions – % mortality and EEC distributions as well as sublethal exceedances for each bin and CDL relevant to species analysis

New MagTool Template - Input and Output summary table including 5, 50 and 95% percentile results

Rate and use inputs – Relevant data from TEDtool inputs, including application rates for spray drift calculations, relevant use layers and physical, chemical and fate properties

HUC12_ACRES – List of all HUC12s, associated HUC2 and number of acres in HUC12

SpeciesHUC12 – List of HUC12s associated with each species

CriticalHabitatHUC12 – List of HUC12s associated with each critical habitat

Spray Drift all - Used in Step 2, contains spray drift distances based on the minimum and upperbound application rates for each threshold for each line of evidence for aquatic bins

listed species info- AqWoE – Contains aquatic plant and animal species information including species IDs, dietary items, terrestrial or aquatic habitats and obligate relationships

Spray Drift Distance – Used in Step 2, contains spray drift distances based on the minimum and upperbound application rates for each threshold for each line of evidence for aquatic bins

Relevant hidden sheets: CDL_L48_2010 thu 2016 – Percent overlap of use site with each HUC12 for each CDL year

Attachment 2. Redundancy in spatial overlap between CDL use layers

Column crop makes up x% of 1st row crop	Cattle Eartag	Christmas Tree	Corn	Cotton	Cull Piles	Developed	Golf Courses	Managed Forest	Nurseries	Open Space Developed	Orchards and Vineyards	Other Crops	Other Grains	Other RowCrops	Pasture	Pineseed Orchards	Rice	Right of Way	Soybeans	Vegetables and Ground Fruit	Wheat
Cattle Eartag		63	15	9	24	2	16	35	17	2	24	23	15	12	74	4	5	18	14	12	15
Christmas Tree	0		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corn	4	14		28	8	1	1	1	8	3	8	17	28	47	8	0	16	4	80	36	36
Cotton	0	0	4		3	0	0	0	1	1	3	5	10	22	1	1	4	1	4	5	7
Cull Piles	0	5	0	1		0	1	0	2	0	95	2	1	1	1	1	1	0	0	3	1
Developed	0	1	0	0	1		11	0	43	0	1	1	0	0	0	0	0	42	0	1	0
Golf Courses	0	0	0	0	0	0		0	0	2	0	0	0	0	0	0	0	0	0	0	0
Managed Forest	10	13	1	1	9	1	3		3	2	9	2	1	1	4	100	0	6	1	1	1
Nurseries	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	0	0
Open Space Developed	0	2	1	3	3	0	65	1	18		3	1	1	1	1	1	1	21	1	1	1
Orchards and Vineyards	0	5	0	1	98	0	1	0	2	0		2	1	1	1	1	1	0	0	4	1
Other Crops	3	13	7	16	19	1	3	1	5	2	20		34	14	6	2	32	2	6	21	32
Other Grains	1	3	8	21	5	0	1	0	1	1	6	23		18	3	0	7	1	6	21	27
Other RowCrops	0	0	4	14	1	0	0	0	0	0	1	3	5		1	1	1	0	3	13	7
Pasture	63	88	25	18	48	6	30	11	24	11	49	41	35	24		22	8	19	21	29	30
Pineseed Orchards	0	0	0	0	1	0	0	4	0	0	1	0	0	0	0		0	0	0	0	0
Rice	0	0	1	1	0	0	0	0	0	0	0	3	1	0	0	0		0	3	0	0
Right of Way	3	8	2	3	5	100	15	3	53	37	5	3	2	2	4	3	2		2	2	2
Soybeans	4	4	73	26	3	1	1	1	7	3	3	12	21	35	6	0	69	4		25	35
Vegetables and Ground Fruit	0	4	4	4	8	0	0	0	2	0	8	5	8	16	1	0	1	0	3		9
Wheat	3	4	24	36	8	1	1	0	3	3	9	52	65	60	7	0	8	3	26	59	